

**SPECIAL AWARDS:**

- Jonathan Levitt receives Outstanding Graduate Researcher Award from SoE
- Natalie Wolchover (A08) receives Astronaut Foundation Award
- Joanna Xylas wins the Benjamin G. Brown Scholarship
- Derrick Hwu wins the de-Florez Prize for Human Engineering

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## From the Department Chair...

This was an exciting year for us. Department programs continued to grow in depth, breadth, and support. We added a new tenure-track faculty member, Catherine K. Kuo, to expand our program in regenerative medicine. We continued to benefit from terrific technical and administrative support by our talented and dedicated staff. Our research programs grew with traditional PI directed efforts, as well as many new cross-disciplinary initiatives. Our post-doctoral associates, graduate students, and undergraduate students continue to push the research forward with outstanding journal contributions, new technological dis-

coveries and participation at national and international meetings. Our new group of BME first majors was selected and our first class is nearing the end of their third year. We continued to build strong ties to surrounding biomedical industries, hospitals and collaborating universities to expand opportunities for our program. We also continue to ex-

tend our international efforts, as we will embark this year on our next foray in international outreach with a new BME summer program in France. In total, we continued on an exciting path of education and discovery in the fields of regenerative medicine and medical imaging, buoyed by a vibrant educational and collaborative spirit among the faculty and students. We welcome you to read about some of these recent activities and to become actively involved in our plans for the future. There are many ways that you can participate, so please let us hear from you.

- David Kaplan, Department Chair



**Professor David Kaplan**

## BME Welcomes New Faculty

Professor Catherine K. Kuo joins the Biomedical Engineering Department after a post-doctoral fellowship in the Cartilage Biology and Orthopaedics Branch in the National Institute of Arthritis and Musculoskeletal and Skin Diseases, at the National Institutes of Health (NIH). At the NIH, she investigated the effects of gene transfer, signaling biofactors, three-dimensional scaffolds, and mechanical forces on adult mesenchymal stem cells, with the primary aim of regenerating musculoskeletal tissues from stem cells. She also conducted research in the areas of tendon

developmental biology, embryonic wound healing of tendon, and bioreactor development and fabrication. Prior to her NIH fellowship, she earned a joint doctoral degree in Biomaterials and Macromolecular Science and Engineering from the University of Michigan, Ann Arbor. Her thesis work focused on developing novel hydrogel scaffolds for tissue engineering, and characterizing structure-property relationships of these materials.

Kuo's current research interests are in three major areas: [1] potential for adult mesenchymal

stem cells to recapitulate mechanisms of embryonic development; [2] novel bioinspired scaffold fabrication and implementation; and [3] methods to measure mechanical stresses and strains experienced by developing soft tissues during embryogenesis.



**Professor Catherine K. Kuo**

## BME goes to France



Talloires, France

This year will present the unique opportunity for students to visit Europe while learning about Biomedical Engineering and taking part in active research. The Department, in collaboration with the Summer Studies Institute in Talloires, will offer BME 50—Introduction to Biomedical Engineering in Talloires, France. The course will be taught by all of the BME faculty between July 12—26, 2008, and will be followed by four-week internships in Europe.

The course gives a broad overview of Biomedical Engineering, covering key topics of general interest while paying special attention to research applications. Particular attention is devoted to making ties to the ongoing research activities of the BME department.

The BME faculty are very active in international collaborations and having the course in Talloires will enable many of our European colleagues to join in the fabric of the course

and add to its topics. Giving an international perspective on engineering approaches to biomedical problems will benefit the students. Discussions on bioethics will also expose the students to different standards and approaches and offer an invaluable international perspective of the field.

The two-week course will serve as preparation for the students to intern in the laboratories of the BME faculty's

*Continued, page 4, BME 50*

## Research Courses for Undergrads

Our inaugural class of first majors in BME are currently going through their junior year. It has been great to see these students engaging in their rigorous curriculum and getting involved in hands-on research projects. One of the unique aspects of our first major curriculum is the inclusion of four half-credit research based courses during the sophomore and junior years of the program. The courses are in-

tended to provide some basic skills at the beginning of the semester that the students can use to actually address a research need or problem in the laboratory of a BME faculty member. The courses introduce the students to design and machining, cell culture and characterization, signal and data analysis methods, and technical writing and presentations. More importantly, they provide the students the op-

portunity to engage in a real research project, become familiar with the work that the faculty are conducting and get to know some of the undergraduate, graduate students and postdoctoral fellows that work in the labs. It will be exciting to see our first class of BME first majors completing their Senior Theses next year, and, hopefully, seeing the application of all the research skills the students have acquired.

## President's Marathon Challenge

Professor Cronin-Golomb training for the Marathon, March 2008.



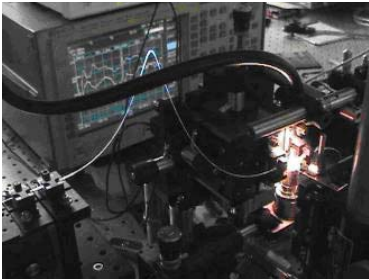
BME faculty Chris Cannizzaro and Mark Cronin-Golomb are raising money to support

nutrition, medical, and fitness research at Tufts by participat-

ing in the President's Marathon Challenge, a team of 200 students, staff, faculty, and friends training as a group to run in the 112th Boston Marathon on April 21st. We consider this the ultimate way to test principles of biomedical engineering in physiology. And we antici-

pate that in the future, the tissue engineering research in the BME department will be able to help people maintain active lifestyles and so that more will be able to participate in challenges such as the Boston Marathon.

# All Optical Control of Microfluidic Devices



It is often necessary in biomedical research to be able to perform chemical and physical manipulations of microscopic samples of proteins, cells, or bacteria and the field of microfluidics is playing an ever increasing role in enabling these sorts of processes. Microfluidic devices involve micrometer scale channels, pumps and mixers that comprise what essentially amounts to a lab on a chip. Professors Omenetto and Cronin-Golomb have made

**Supercontinuum traveling through a hollow core photonic crystal fiber to the optical trapping microscope on the right.**

significant progress in using optics to assist in both the manipulation and sorting of samples in microfluidic devices.

For example, their group has recently demonstrated the incorporation of a diffraction grating in a microfluidic channel to realize a microfluidic spectrometer using supercontinuum light for application to chemical sensing applications. The fluid under test flows through a channel in the device, and can simultaneously be spectrally probed.

(IEEE Photonics Technology Letters vol. 19 p. 1976 (2007)).

On the manipulation side, undergraduates Eric Takasugi and Natalie Wolchover have made valuable contributions to the team showing that optical traps can be used to load and control multiple silica microspheres in a fluid filled hollow core photonic crystal fiber. This opens the possibility for the study of interactions between the beads and supercontinuum guided within the core of the fiber, with numerous possibilities for sensing and optical processing. The optical traps are formed by computer controlled tightly focused infrared laser beams via a graphical user interface developed in Labview.

*Optofluidics is an emerging field that uses fluids to tune optical properties for sensing applications*

## New Research Faculty

The Department has welcomed four new research faculty this past year:

**Chris Cannizzaro**, PhD, is a Research Assistant Professor. His major research areas are in bioprocess engineering, tissue engineering, microfluidics, laboratory automation and high-throughput screening. Chris received a BS in ChemE at UMass Amherst and after a short stint in Colorado, (receiving a MS in ChemE from CSU), he went off to the University of Milan to study biochemistry on a Fulbright Grant. He later attend EPFL in Lausanne, Switzerland, ultimately receiving his PhD in ChemE in 2002. He spent one year at the Hawaii Natural Energy Institute before making his way back to Massachusetts for a postdoctoral position at MIT to work on developing bioreactor systems for the International Space Station.

**Bruce Panilaitis**, PhD, Research Assistant Professor, focuses his research on the interface between the mammalian immune system and biomaterials. This has led to work in vaccine and drug delivery, as well as characterizing the innate and acquired immune response initiated by various biomaterials. In addition, the group utilizes molecular biology, microbiology, and chemical engineering to modify and tailor biomaterials to better understand their relationship with the immune response. Bruce received his BA in biochemistry from Colby College, and his PhD from Tufts University in biology.

**Rob Peattie**, PhD, Research Associate Professor, was trained in physiology and mechanical and biomedical engineering. He earned his PhD from Johns Hopkins University, and he did a postdoctoral fellowship there as well. Rob's research focuses on

the responses of cells and tissues to mechanical challenges. At present, his lab has two main thrusts, one a study of large vessel hemodynamic pathologies and the other investigating control of angiogenic responses to growth factor-containing implants.

**Angelo Sassaroli**, PhD, Research Assistant Professor, researches near infrared spectroscopy. It is a technique that has shown good potential for monitoring non-invasively the concentration of oxy and deoxy-hemoglobin in real time from various tissues and organs. In his time spent at Tufts, Angelo has been more and more involved in collaborations where the central focus is the human brain. Specifically, his interests range from devising better ways of data collection to studying and implementing effective algorithms of data analysis. Angelo earned his PhD in physics from The University of Electro-Communications, Tokyo, Japan.

## 2007 BME Retreat



Pictures from the Third Annual BME Retreat; September 2007; Boothbay Harbor, ME (taken by Taylor Williams).

During the Labor Day weekend, almost fifty graduate students, faculty and family members gathered in Boothbay Harbor, ME for the third annual BME retreat. The event was graciously hosted by Professor Kaplan and his family who opened up their summer home by the water for the occasion. The weather was fantastic, the view stunning and the opportunity to get to know each other

even better. After lunch, students and faculty took walks, played soccer, volleyball and tennis. Some brave souls actually took a swim. Scientific talks and posters in the evening were followed by a traditional Maine lobster dinner and scrumptious pies. A big breakfast the next morning got us started on a day that was open for further traveling and exploring of the beautiful Maine coastline. Thanks to all who participated and helped with cooking and cleaning.



*“An international perspective on engineering approaches to biomedical problems will certainly benefit the students.”*

## BME 50, en France

*BME 50, Continued from pg 2*

European collaborators. We see these internships, which will last between 3-4 weeks, as a direct complement to the course. The internships will be a required complement to the course and will offer students the opportunity to spend time doing research in France, Switzerland, Italy, the Netherlands, the UK or Germany.

The course will be quantitative and convey the role of mathematical, physical, computational, and engineering concepts that are necessary to address the wide array of biomedical problems. Specific topics to be covered include: Modeling the human body, mechanical, electrical, and other approaches; developing real-life tools, such as a virtual

heart; biosensors; optical imaging; lasers, fiber optics, and optical instruments; microscopy; other medical imaging techniques such as x-ray, MRI, and ultrasound; biostatistics; tissue engineering; nanomedicine, optical tweezers; and bioethics.

Please contact the department for more information.

## Fellowships Awarded

A number of our students and post-docs have been awarded fellowships:

Amanda Murphy: NIH Ruth L. Kirschstein NRSA Fellowship

Sarah Sundelacruz: NSF Graduate Research Fellowship

Michael House: NIH Mentored Clinical Scientist Development Program Award (K12)

Sang-Hyug Park: Postdoctoral Fellowship from the Korea Research Foundation

Shenzhou Lu: Fellowship from

the National Fund for Study Abroad (China)

Monica Serban: Molecular Cardiology Research Institute Postdoctoral research fellowship (NIH-supported training program)

# Bioengineering Methods

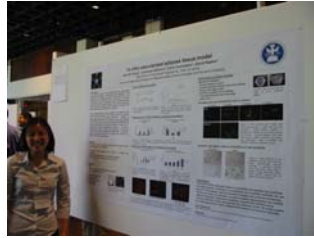


**Back Row:** Mike Lovett, Xiaoqin Wang, Marie Tupaj, Doug MacDonald, Chris Bayan, Jonathan Levitt, Bill Rice  
**Front Row:** Shenzhou Lu, Jen Kang, Sarah Sundelacruz, Lisa Yanushefski, Cassie Baughman.

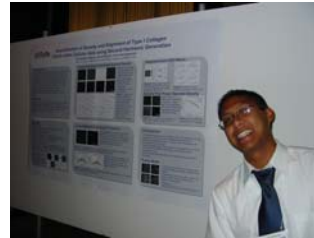
The annual Bioengineering Methods Conference was held again this summer at MIT. Tufts BME was well-represented via the Tissue Engineering Resource Center

(TERC), with a dozen graduate students attending and presenting posters, a booth to disseminate information about TERC, and a talk was given on the ongoing research activities

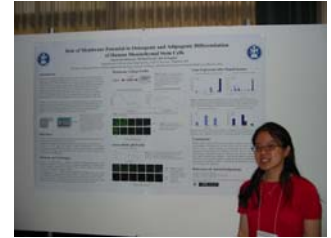
in the NIH-funded P4I Resource Center. The conference was attended by close to 400 students, faculty and industry representatives.



**Jen Kang**



**Chris Bayan**



**Sarah Sundelacruz**

## Ultrafast Optics—High Field Short Wavelength 2007

The 2007 joint Conference on Ultrafast Optics—Applications of High Fields and Short Wavelengths was held in Santa Fe, NM for September 2nd to September 9th, 2007. The meeting was managed by Keleigh Sanford and organized by co-chairs Professor Fiorenzo Omenetto (Tufts), Professor Todd Ditmire (University of Texas), Professor Jorge Rocca (Colorado



**Santa Fe, NM**

State University), and Dr. Dan Kane (Mesaphotonics, Inc.). Professor Irene Georgakoudi was also present as a session

chair and a subtopic organizer. The weeklong conference featured more than 100 talks. Work was presented by PhD candidate Jonathan Levitt (Non-invasive Cancer Detection Using Multi-photon Fluorescence and Fourier Domain Imaging Processing) and post-doctoral associate Peter Domachuk (Controlling Supercontinuum for Biomedical Research and Applications).



**Peter Domachuk**



**Jonathan Levitt**

## BMES Meeting

Several students and faculty members attended the 2007 Annual Fall Meeting of the Biomedical Engineering Society in Los Angeles, CA at the end of September 2007. It was an opportunity to meet colleagues from most major biomedical engineering programs in North America, hear advances in a number of research and educa-

tional areas, and present some of the latest research performed at Tufts. It was also an opportunity to test state of the art oxygen delivery systems as provided by local stands right outside the scientific conference venue (see picture, right).



**Professors Fantini (left) and Kaplan (right) getting an oxygen treatment.**



**Tufts**  
UNIVERSITY

Biomedical Engineering  
4 Colby Street, Room 229  
Medford, MA 02155

Phone: 617.627.2580  
Fax: 617.627.3231  
E-mail: [bme@tufts.edu](mailto:bme@tufts.edu)  
Website: <http://ase.tufts.edu/biomedical>

**CORE FACULTY:**

David Kaplan, Professor & Chair	david.kaplan@tufts.edu; 617.627.3251; Room 251
Mark Cronin-Golomb, Associate Professor	mark.cronin-golomb@tufts.edu; 617.627.4355; Rm 246
Sergio Fantini, Professor	sergio.fantini@tufts.edu; 617.627.4356; Room 247
Irene Georgakoudi, Assistant Professor	irene.georgakoudi@tufts.edu; 617.627.4353; Room 245
Catherine Kuo, Assistant Professor	catherinek.kuo@tufts.edu; 617.627.4321; Room 232
Fio Omenetto, Associate Professor	fiorenzo.omenetto@tufts.edu; 617.627.4972; Room 241
Toi Vo, Associate Professor	van.vo@tufts.edu; 617.627.5191; Room 243

**RESEARCH FACULTY:**

Greg Altman, Research Assistant Professor	gregory.altman@tufts.edu
Chris Cannizzaro, Research Assistant Professor	christopher.cannizzaro@tufts.edu; 617.627.0900; 200 Boston Ave.
Bruce Panilaitis, Research Assistant Professor	bruce.panilaitis@tufts.edu; 617.627.3607; Rm 143
Rob Peattie, Research Associate Professor	robert.peattie@tufts.edu; 617.627.0900; 200 Boston Ave.
Angelo Sassaroli, Research Assistant Professor	angelo.sassaroli@tufts.edu; Room 238

**STAFF:**

Martin Hunter, Lab Coordinator	martin.hunter@tufts.edu; 617.627.4783; Room 235
Carmen Preda, Senior Technician, TERC	c.preda@tufts.edu; 617.627.4320; Room 230
Keleigh Sanford, Department Administrator	keleigh.sanford@tufts.edu; 617.627.0852; Rm 251A

**We want your feedback!**

Name: \_\_\_\_\_ Tufts degree(s)/Year: \_\_\_\_\_

Email: \_\_\_\_\_ Phone: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

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