

- Professor David Kaplan elected Councilor-at-Large for North America for TERMIS.
- Professor Mark Cronin-Golomb elected Fellow of the Optical Society of America and elevated to Senior Member of IEEE.
- Mark Cronin-Golomb promoted to Professor.
- Irene Georgakoudi tenured and promoted to Associate Professor.
- Adjunct Professor David Walt (Chemistry) elected to National Academy of Engineering.

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The BME Bulletin

VOLUME 3

SPRING 2009

From the Department Chair...

We welcome 2009! While we all face challenging economic times, this can also serve as an opportunity to impact the future. We see this opportunity to do so via biomedical engineering, an opportunity borne from the expanding unique and important roll that biomedical engineers will have in the future of medical research and technology. Interdisciplinary science and engineering meshed with clinical needs, the next generation of biomaterial approaches for tissue regeneration, new noninvasive diagnostic imaging approaches and the next generation of miniaturized biomedical devices to improve human health are just some examples where biomedical engineers will have a major impact as the field of biomedical engineering continues to evolve into the next decade. These research areas are also our areas of strength here at Tufts University,

allowing us to provide tremendous opportunities for our students to impact the future, based on their cutting edge research and multidisciplinary activities to foster creativity and progress. Further, in this era of globaliza-



**David L. Kaplan;
Professor & Chair**

tion, our program has vibrant international links to allow students to prosper in multi-cultural environments. In terms of interdisciplinary programs, we are a major component of the new Advanced Technology Lab here at Tufts where faculty and students from many disciplines

come together in larger multifaceted projects such as soft body robots, biosensors and biomedical textile engineering among others.

We look forward to these challenging economic times as a tremendous opportunity to shape the future, where a new generation of innovative technologies will provide a stimulus for new jobs, new companies, and new improvements in human health. We look forward to mentoring our students who will lead this effort, led by a tight knit program consisting of caring and capable faculty and administrators in partnership with our outstanding undergraduate students, graduate students and post doctoral associates. We welcome your participation and look forward to keeping you posted on our progress.

Graduate Student Awards & Fellowships

Biomedical Engineering boasts numerous award winners for graduate student research and teaching over the past year.

- **William Rice** (PhD) was awarded the Outstanding Graduate Contributor to Engineering Education (Spring 2008). This

award focuses on graduate students who through TA work, voluntary service or other activities, significantly enhance the education programs of the department. Bill has not only contributed as a teaching assistant for two courses, but also serves as the primary member of the department to train students,

post docs, and collaborators on the use of the confocal microscope. Bill developed an extensive training program, which includes an instruction video (that he created independently and made available on the Internet), and one-on-one time.

Grad Student Awards



Taylor Williams' winning photograph

Con't from pg 1— Bill was also instrumental in the success of the CELLutions summit organized in part by the NIH Tissue Engineering Resource Center at Tufts in 2006 and 2007. In short, this award recognized Bill's innovative and effective methods for transferring his knowledge on a wide array of subjects to fellow students, post docs, and collaborators.

- **Hannah Perry** (MS) received the Outstanding Graduate Researcher Award (Spring 2008), which distinguishes students in research and technical publications. Hannah was the point of reference for micro and nanofabrication using biocompatible polymers such as polydimethylsiloxane (PDMS) for a variety of undergraduate and graduate students, instructing them on the

required approaches and illustrating the relevant outcomes and goals that should be obtained. Even as an undergraduate, Hannah had been coordinating an experimental effort in micromachining, overseeing a small group of people that included one graduate student and 4 undergraduate students. By the end of her first semester in graduate school, Hannah's work had resulted in one first author publication and one patent.

- **Stan Eosakul** (MS) and **Kosta Tsioris** (PhD) were winners of the Sustainability Innovation Student Challenge, sponsored by The Dow Chemical Company (Fall 2008). Their project was entitled "Green Microfabrication Technology for Use in Silk-Based Polymer Photovoltaics." The concept was to use silk as a

matrix to embed biological photoactive dopants such as bacteriorhodopsin. Since these solar cells would be made of silk, they could be micropatterned through reactive ion etching and microfabricated using embedded electrons through an all aqueous microfabrication process.

- **Taylor Williams** (MS) won first prize in the Tufts' 2007-2008 Graduate Student Photo Contest (picture at left).

- **Cassie Baughman** (PhD) received a fellowship from the American Heart Association.

- **Michael House** received renewal from NIH for his Mentored Clinical Scientist Development Program Award (K12).

- **Keiji Numata** received a two-year post-doctoral fellowship from the Japanese Society for the Promotion of Science.

Biologist Michael Levin Joins BME

The Biomedical Engineering Department welcomes **Dr. Mike Levin** as an adjunct Professor (Biology). Mike was a dual computer science/biology major as an undergraduate student at Tufts; his background was in software engineering, complex system modeling, and artificial intelligence. As a graduate student and post-doc at Harvard Medical School, he worked in developmental biology, uncovering the molecular pathways by means of which embryos establish the consistent left-right asymmetry of the

heart, brain, and internal organs. His lab currently works on a set of interdisciplinary problems at the interface of molecular genetics, cell biology, and cognitive science. In merging the tools of computer modeling, engineering, and biophysics, his group is investigating the basic properties of information storage and processing in living tissues. A particular focus is the natural bioelectric fields and ion currents by means of which biological pattern is established in 3 dimensions during development and regeneration. This has biomedical applications in

birth defects, regenerative medicine, and cancer. Recent discoveries include bioelectrical switches in cell microenvironments that convert embryonic stem cells into a cancer-like phenotype, the use of induced ion pumps to drive the regeneration of spinal cord and muscle, and development of novel devices with which to understand the dynamics of memories during brain regeneration. More information is available at his lab webpage. <http://www.drmmichaellevin.org>, and the website for his Center: <http://www.cellregeneration.org>.



Dr. Mike Levin in his lab.

Spotlight on Silk Optics



Above: Hologram made from silk; Left: Silkworm cocoons with fiber optics.

Work by BME professors Fiorenzo Omenetto and David Kaplan has recently attracted attention in the scientific and popular press. The work combines the expertise of both faculty members and transforms silk, the protein long used in Kaplan's laboratory for tissue engineering applications, into high technology material, specifically into a material platform for optics and photonics, the area of expertise of Omenetto's laboratory.

Purified silk was transformed into high quality optical elements composed entirely of the organic, biocompatible and implantable protein matrix. With all water-based, room

temperature processing, and the mechanical stability and robustness of silk set this material apart from glasses, polymers or plastics and from other biopolymers. Most notably, however, the ambient processing environment allows for the simple entrainment of biological components into the optical devices while preserving their function opening unforeseen opportunity in sensing and medical devices.

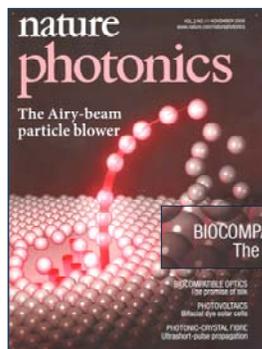
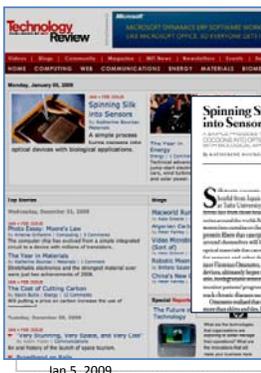
Omenetto and Kaplan have written a commentary on the topic in the November 2008 journal *Nature Photonics* which describes an overview of the technology. The work has been featured by ABC News, MSNBC, Fox News, the Discovery Channel and featured on the radio on AAAS Science update and NPR syndicated stations. Silk optics has also been the subject of a print story in the January issue of MIT's *Technology Review* Magazine.

Related Publications:

1. F.G. Omenetto and D. L. Kaplan, "A New Route for Silk," *Nature Photonics*, 2 (11), 2008
2. B.D. Lawrence, J.K. Marchant, M.A. Pindrus, F.G. Omenetto, D.L. Kaplan, "Silk film biomaterials for cornea tissue engineering," *Biomaterials*, 30 (7), 1299, 2009
3. H. Perry, L. Dal Negro, A. Gopinath, D.L. Kaplan,

and F.G. Omenetto, "Nano- and micro-patterning of optically transparent, mechanically robust, biocompatible silk fibroin films," *Adv. Mater.*, 20, 3070–3072, (2008)

4. S.T. Parker, J. Lewis, P. Domachuk, J. Arnsden, J. Bressner, D.L. Kaplan, and F.G. Omenetto, "Biocompatible silk fibroin printed optical waveguides", accepted for publication in *Advanced Materials*
5. B. Lawrence, M. Cronin-Golomb, I. Georgakoudi, D.L. Kaplan and F.G. Omenetto, "Bioactive Silk Protein Biomaterial Systems for Optical Devices," *Biomacromolecules*, 9 (4), 1214–1220, 2008
6. S. Boriskina, A. Gopinath, L. Dal Negro, "Optical gap formation and localization properties of optical modes in deterministic aperiodic photonic structures", *Optics Express*, 16, 18813 (2008)
7. S. Boriskina, L. Dal Negro "Sensitive label-free biosensing using critical modes in aperiodic photonic structures", *Optics Express*, 16, 12511 (2008)
8. S. Lu, X. Wang, Q. Lu, X. Hu, N. Uppal, F. Omenetto, D.L. Kaplan, "Stabilization of Enzymes in Silk Films, to be published in *Biomacromolecules*
9. P. Domachuk, N.A. Wolchover, M. Cronin-Golomb, A. Wang, A.K. George, C.M.B. Cordeiro, J.C. Knight, F.G. Omenetto, "Over 4000 nm Bandwidth of Mid-IR Supercontinuum Generation in sub-centimeter Segments of Highly Nonlinear PCFs," **accepted for publication** in *Optics Express*
10. P. Domachuk, M. Cronin-Golomb, F.G. Omenetto, "Numerical Characterization of Transverse Optical Trapping in PCFs", **accepted for publication** in *Applied Physics Letters*
11. P. Domachuk, H. Perry, M. Cronin-Golomb, and F.G. Omenetto, "Towards an Integrated Optofluidic Diffractive Spectrometer," *IEEE Photonics Technology Letters*, 19(24): 1976-1978, Dec. 2007



BIOCOMPATIBLE OPTICS
The promise of silk

A new route for silk

FIORINZO OMENETTO AND DAVID L. KAPLAN
The use of silk as a platform for optical devices is a new route for silk-based optical devices. The silk-based optical devices are biocompatible and can be used in a variety of applications.

Professor Vo Van Toi Retires



Professor Vo Van Toi.

Professor Vo Van Toi has been with Tufts University since 1984. He was first affiliated with the Engineering Design Department, and then moved to the Electrical Engineering and Computer Science Department, where he created the Biomedical Engineering program. In 2002, Professor Vo was instrumental in establishing the Department of Biomedical Engineering. He would later receive the Lillian and Joseph Leibner Award for

Distinguished Teaching and Advising in 2004.

His research interests include the design and applications of medical instrumentation, human vision and ophthalmology, and the applications of information technology in health-care. He is the author or co-author of many scientific articles and patents.

Professor Vo has also been involved in establishing biomedical engineering activities

and programs with Hanoi University of Technology, Ho Chi Minh City University of Technology and Can Tho University, all in Vietnam. He will continue with these activities as a full professor at International University, which is a part of Vietnam National University in Ho Chi Minh City, Vietnam. He will be the Chair of the new BME department at the University and advise on the development of relations with international universities.

BME Graduates 'First' First Majors

Our inaugural class of first majors will be graduating this spring. It has been great to see these students engaging in their rigorous curriculum and getting involved in hands-on research projects that are culminating in senior theses, as follows.

Brian Aguilar—Silk Fibroin Models for Long Term IgG Delivery

Alissa Brandon—Osteogenesis Effects of Growth Factors on In Vitro Osteogenesis imperfecta Disease Model

Brian Fallica—Novel Method for Culturing Artificial Vascularized Muscle Tissue

Julianne Grainger—Nerve Growth Factor Release from Silk Scaffolds for Peripheral

Nerve Regeneration

Lauren Nadkarni—Bioactive Nanocomposites for Dentinogenic Restoration

Judith Rubenstein—Differentiation of Cartilage Tissue and Implantability of Cartilage Grown In Vitro

Parid Sava—Effects of Inflammation on Development and Remodeling of Bone Tissue

2008 BME Retreat

The fourth Annual BME Retreat took place during the weekend of September 20-21 at Point Sebago Resort, Sebago, ME.

Graduate students, post-docs, faculty and staff gathered at the lakeside resort for a day full of mini-golf, kayaking, basketball, and golf that was topped off by a

cruise around the lake and a traditional Maine lobster dinner. The birthdays of professors **Fantini**, **Cronin-Golomb**, and **Kuo** were also celebrated.

All the fun and play was followed by a poster session by graduate students and faculty to introduce some of the exciting

research going on in each of the faculty members' groups.

It was a great opportunity, especially for the new crop of graduate students to hear from their peers about what everyone is doing. Even more importantly, it was a time to get to know each other better.

Pictures from the Fourth Annual BME Retreat; September, 2008; Pt. Sebago Resort, ME



Graduating Grad Students

Spring 2008—

Christopher Bayan, MS (Advisor: Georgakoudi) - *Quantification of Collagen Fibril Alignment and Density in Second Harmonic Generation Images of Cellular Collagen Matrices*

Adam Collette, PhD (Advisor: Altman) - *Study of Rapidly-Generated, Injectable Fibroin Hydrogel with Tailored Properties for in vivo Application*

Tim Harrah, PhD (Advisor: Goldberg) - *Engineering Bacteriophage T4 Tail Fiber Proteins for Nanotechnology*

Derrick Hwu, MS (Advisor: Georgakoudi) - *Assessment of the Role of Circulating Breast Cancer Cells in Tumor Formation and Metastatic Potential Using in vivo Flow Cytometry*

Brian Lawrence, MS (Advisor: Kaplan/Omenetto) - *Methods to Produce Silk Fibroin Film*

Biomaterials for Applications in Corneal Tissue Regeneration

Rich Matulewicz, MS (Advisor: Fantini) - *Assessing the Ability of Near Infrared Spectroscopy to Detect Testicular Torsion in Rabbits.*

Hannah Perry, MS (Advisor: Omenetto) - *Biomedical Optofluidics and Biophotonics: A study of fabrication and functionalization*

Yunjie Tong, PhD (Advisor: Fantini) - *Functional Study of the Brain and Peripheral Nerves Using Near-Infrared Spectroscopy*

Summer 2008—

Heenam Kwon, MS (Advisor: Kaplan) - *3D in vitro Model for Human Prostate Cancer Metastasis to Bone: The impact of BMP-2 on Metastasis*

Clemens Alt, PhD (Advisor: Lin) - *Detection of Intracellular Cavitation During a Selective*

Targeting of the Retinal Pigment Epithelium with a Laser Scanner

Fall 2008—

Shuai Yuan, PhD (Advisor: Boas) - *Sensitivity, Noise, & Quantitative Model of Laser Speckle Contrast Imaging*

Spring 2009—

Vijayanand Alagappan, PhD (Advisor: Wald) - *RF Coil Technology for Parallel Excitation and Reception in High Field MRI*

Jonathan Levitt, PhD (Advisor: Georgakoudi) - *Towards Automated Early Cancer Detection: Non-invasive, fluorescence-based approaches for qualitative assessment*

Michael Lovett, PhD (Advisor: Kaplan) - *Small Diameter Silk Fibroin Tubes For Vascular Tissue Engineering*

New Assistants in the BME Office

The Department welcomes its newest staff members: **Milva Ricci** and **Ilse Allen**.

Milva's experience before joining the BME Department includes 8 years at Wild Oats where she was Store Director. She oversaw daily operations, including budgets, in-

ventory, and scheduling. As staff assistant, Milva is responsible for overseeing all purchasing, travel, IDRs, access requests and reimbursements. She will also schedule department events such as study topics, presentations, and group meetings.

Ilse had been working as a staff assistant in the Civil & Environmental Engineering department before becoming a liaison throughout the School of Engineering, assisting in our department, as well as others as needed.



Milva Ricci

BMES Meeting 2008

Several students and faculty members attended the 2008 Annual Fall Meeting of the Biomedical Engineering Society in St. Louis, MO in October 2008. It was an opportunity to meet colleagues from most major biomedical engineering programs in North America, hear advances in a number of research and educational areas, and present some of the latest research performed at Tufts.



From left to right: Jumbo visiting the Arch in St. Louis; faculty and students enjoying dinner out; view of the Arch from downtown.



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We want your feedback!

Name: _____ Tufts degree(s)/Year: _____

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Mailing Address: _____

Current Employer: _____

News you'd like to share/Feedback: _____
