

INDUSTRIAL ADVISORY BOARD NEWSLETTER

Director's Message

Product Development Technologies (PDT) Advances Medical Technologies with BMES

By Joel Delman, PDT's Los Angeles Design Director

Product Development Technologies, Inc. (PDT) is composed of a team of more than 100 strategy, research, industrial design and engineering experts dedicated to helping clients in the development of medical, defense and consumer products. We have joined as a technology partner with BMES to assist the organization in advancing its cutting edge medical devices towards commercialization.

When we were first invited to become a technology partner by BMES, we felt PDT was a natural fit. The purpose of the National Science Foundation's 10 year funding of the center was to develop core science and technology for creation of new industries and disruptive technologies, and these activities are part of our daily work with corporate clients. We were excited to put our experience to work to advance America's position as a leader in medical technology, and impressed that the BMES ERC is the only center (of 15 currently funded ERC's in the nation) focused on medical device technology and innovation.

When PDT joined BMES, our goal was twofold: to stay in touch with new medical developments created by academic researchers, and to help bring important new medical developments to fruition via a partnership with academia. This partnership has afforded us the unique opportunity to contribute to cutting edge, potentially life changing ad-

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Cellular Prosthesis Testbed

By Robert Chow, PhD

The newest testbed of our Biomimetic Microelectronic Systems (BMES) ERC is that of Cellular Prosthesis. This testbed, headed by Drs. Robert Chow and Mark Humayun, has the goal to develop novel photochemical approaches to confer light sensitivity on nerve cells that are normally not light sensitive. This interdisciplinary collaboration involves chemists, biophysicists, bioengineers, and cell biologists at Caltech (Bob Grubbs, Harry Gray, Dennis Dougherty), University of Southern California (Bob Chow, Mark Humayun, Ted Berger) and Oakridge National Laboratory (Elias Greenbaum). To confer the ability to detect light on nerve cells, we are using novel photovoltaic compounds synthesized at Caltech, as well as biological complexes purified from plants at Oakridge National Laboratories.

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BiomimeticMicroElectronicSystems



Welcome to the latest edition of the BMES Industry newsletter. We are about to embark on Year 8 of the center. We are happy to report that our Year 7 National Science Foundation (NSF) Site Visit this past June went well. We had an exciting industry turnout and are grateful for your attendance.

With summer coming to a close, we have given much thought and energy to the long-term goals of the BMES. Foremost on our agenda are our research goals and self-sustainability plans. In an effort to address the NSF Site Visit Team report, we have taken further steps to strengthen our interaction with our industry partners. By fostering an exchange of ideas and collaborative research efforts, we are looking towards our partners to help us to achieve our research goals and plans on becoming a self-sustaining entity. Please refer to Dr. Jack Whalen's update on the efforts currently underway in the Industry Pro-

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gram.

In order to increase industry interaction with our students and faculty, we launched an Industry/Student Mentorship Program. We hope this program will yield synergistic projects with our partners but also opportunities for our students, such as internships, job placements, constructive feedback on their research, or simply to serve as a positive role model. Dr. Joseph Coccozza has contributed a piece on the benefits of mentoring, using the Engineering for Health Academy as an example.

The NSF Site Visit Team was pleased with the progress made by the Retinal and Cortical Prosthesis Testbeds. Additionally, they were impressed by the creativity and imagination of the Cellular Prosthesis Testbed with its vision of integrating innovative cellular devices into the retinal and cortical prostheses. Please refer to Dr. Robert Chow's article where he addresses the basic premise of the cellular prosthesis, his team's approach and what they hope to gain from their research.

We have introduced a new segment to our newsletter: "Snapshots" of the BMES Team. We will be featuring members of the BMES family in order for the audience to get to know our researchers. This issue will highlight members of the Cortical Prosthesis Testbed team. Also included in this issue are pieces by our Student Leadership Council and Product Development Technologies (BMES industry partner) where they discuss their current collaboration with our center.

We look forward to Year 8 of the BMES and thank you for contributing to our success!

Update from the Industry Program Director

By Jack Whalen, PhD



The summer has seen us make significant headway with the Industry Program. We hosted our Year 7 Annual Site Visit by the NSF and Summer Industrial Advisory Board meeting. The Site Visit Team (SVT) was pleased with our membership make-up and size and also with the Industry Program's performance. Overall, they were pleased with the Industry Program's performance in Year 7 and challenged us to further integrate our industry partners into more center activities.

The Industry Program continues to address our two-part mission and our value proposition to our industry partners: namely, to advance innovative medical device technologies towards commercialization and to transition talented individuals to careers in biomedical engineering.

Over the summer, we have engaged several of our industry partners with the aim of setting a development project in motion with each of them. We are making progress and are excited to announce our accomplishments in the near future. We are also excited to kick-off our Industry/Student Mentorship Program this fall. This program is designed to introduce more of our industry partners to our graduate students and the projects on which they are working. The goal here is to create a dialog between the two groups and to promote interest and interaction. Please visit our website to learn more about this program.

In keeping with the Industry Program's objective to increase student-industry interaction, Abbott Medical Optics graciously hosted a dozen of our BMES students for a half-day to learn more about the company and to tour their facilities. Also, two BMES-affiliated students completed internships with two of our industrial partners, another great example of integrating our partners with the center. The BMES also had a significant presence at the annual Neural Interfaces Conference, hosted in Long Beach, CA this year, with Drs. Huma-yun and Weiland chairing the event.

The Industry Program continues to undergo updates and improvements. If you visit our website (<http://bmes-erc.usc.edu>), you will see that we have been updating it to provide more current information on our activities. More importantly, we have been including more information to help you – our industry partners – to identify potential synergies. We invite you to visit our website frequently as more updates will continue to be made.

As always, the industry program team continues to focus on ways to add value to you, our industry partners.

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These two classes of "photovoltaic nanoswitches" share the property of absorbing photons and generating an electrical dipole. When attached to the surface of nerve cells at strategic locations, these photovoltaic nanoswitches should enable light to control the electrical activity (action potential firing) of the cells. If successful, we will produce tools that would further the goals of the Retinal Testbed by restoring light-detecting nerve cells to the retina of blind patients suffering loss of photoreceptors due to neurodegeneration. Moreover, these photovoltaic nanoswitches may also provide a new light-based approach for signal transmission at the interface between human central nervous tissue and prosthetic devices such as the ones being developed by the Cortical Prosthesis Testbed of our BMES ERC.

Faculty and Students in the News

- Dr. Robert H. Grubbs (Caltech) has received the following awards and honors:
 - * ACS Presidential Task Force on Innovation in the Chemical Enterprise
 - * ACS Polymer Division Fellow (Founding POLY Fellow)
 - * Gold Medal of the American Institute of Chemists, Chemical Heritage Foundation
 - * Honorary Degree of DSc from University of Warwick, Coventry, UK
 - * ACS Roger Adams Award in Organic Chemistry (Organic Reactions, Inc. & Organic Syntheses Inc.)
- Dr. Mark Humayun (USC) has received 2 of the top 10 grants awarded to USC's Keck School of Medicine: "Stem Cell Based Treatment Strategy for Age-Related Macular Degeneration" and a renewal of the "Engineering Research Center for Biomimetic Microelectronic Systems".
- BMES ERC researchers Drs. Mark Humayun (USC), James Weiland (USC), Wentai Liu (UC Santa Cruz), Armand Tanguay, Jr. (USC) and Yu-Chong Tai (Caltech) have been awarded the 2010 *Popular Mechanics* Breakthrough Award. Print coverage will appear in the November issue of *Popular Mechanics*.
- USC Viterbi School of Engineering graduate students Viviane Ghaderi and Sushmita Allam won a \$100,000 grant from Qualcomm which will allow them to research how parts of the brain without neurons contribute to its function.



**BMES ERC
Technology
Transfer To
Date:**

**Inventions
Disclosed 129**

**Patent
Applications Filed
154**

**Patents Awarded
47**

**Licenses Issued
19**

**Spin-off
Companies
Started 8**

Visit
<http://bmes-erc.usc.edu>
for the most current
updates on the
BMES ERC.

From Academia to Industry: Student Success Stories in the Making...

By Samantha Cunningham & Christian Gutierrez,
BMES Student Leadership Council



The BMES ERC Industry Program staff and Student Leadership Council have been working to cultivate a collaborative spirit between industry and students, while providing students with internship and job opportunities. Through notifications of internship openings, tours of company laboratories, a student-industry mentorship program, and various other networking events, we aim to ensure that industry-focused students gain the exposure necessary to pursue their careers. As a result of these efforts, several of our ERC students have made the successful transition from academia to industry over the course of the summer.



Lauren Hickey

Degree Program: Bachelor of Science in Biomedical Engineering—Electrical Emphasis (USC)

Industry Position: Intern at Abbott Medical Optics, Summer 2010

During the summer of 2010, Lauren worked as an intern in AMO's Phacoemulsifier Research and Development department, where she helped to evaluate and design features for the AMO Whitestar Signature Phacoemulsifier System. The ERC provided Lauren with experience and exposure to the medical device field, which ultimately led to her being chosen for this internship over other applicants.

While Lauren aspires to pursue a Master's and/or Doctorate degree, she would first like to gain more experience working for a medical device company.

Advice for fellow ERC students: "Working for a company is a great experience for a student because it links our academic work to actual practice... Just being an ERC student and working on projects that are innately industry related is a huge advantage in searching for a position."



Genaro Sepulveda

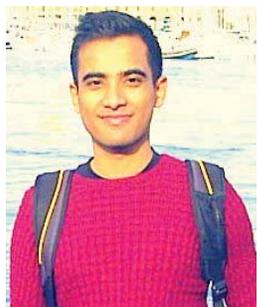
Degree Program: Master's of Science in Biomedical Engineering (USC)

Industry Position: Intern at Genefluidics, Summer 2010

Genaro obtained an engineering internship at Genefluidics, a biotech startup company developing automated molecular analysis devices that employ electrochemical detection technology. His diverse range of responsibilities included CAD design, running genetic and immune-assays, metal and plastics machining, assembly, and trade show exhibition preparation. Though our ERC did not directly lead to him obtaining a position at Genefluidics, he credits Rosie Soltero (BMES ERC Industry Project Manager) with supporting him through the internship search process (from keeping students informed of position openings to helping him with his submitted documents).

Genaro intends to work part-time with the company until the end of his final semester, and will most likely continue working with Genefluidics through their commercialization process.

Advice for fellow ERC students: "Use whatever resources you have that others don't... The ERC is another such resource that gives you an upper hand in job seeking, as they may be the first to find out about internships, and may have information on lesser known companies that may lead to even more fruitful experiences. Also, don't be too proud when seeking opportunities. Getting a foot in the door and having exposure to new contacts and new corporate experiences is priceless. I took a position initially described as a wet-lab technician (pipetting 8 hours a day), and by showing interest in the company's projects, I quickly became a part of crucial engineering projects. Get out of your comfort zone, and don't be afraid to learn new skills and take on new projects."



Vivek Pradeep

Degree Program: Doctorate of Philosophy in Biomedical Engineering (USC)

Industry Position: Intern at Honda Research Institute, Summer 2009; Full-time Researcher in Microsoft's Applied Science Group, beginning 2011

During the summer of 2009, Vivek completed a 3-month internship with the Honda Research Institute, where he participated in the research and development of a new technique for solving a computer vision-based navigation problem for Honda's proprietary humanoid robot, Asimo. This work was closely related to his thesis project of robot vision for the visually impaired, and resulted in two publications and a patent application. Vivek credits the interdisciplinary nature of his research work and the fact that it was application-based for helping him catch the eye of the recruiters: "I think the ERC offers a unique opportunity to students to work on such kinds of projects, which are not just academic solutions to difficult problems, but also require a societal/human impact."

Vivek recently accepted a full-time Researcher position with Microsoft Corporation's Applied Science Group in Redmond, Washington.

Advice to other ERC students: "My experience at Honda was fabulous – I had not expected research in industry to be as open and accessible as it is in academia. It probably varies between specific disciplines and associated applications, but for anyone looking to get into industry at some point, an internship is highly recommended. It not only gives you the opportunity to make a more informed decision about your own future, but if you do finally decide to pursue a non-academia position, it really helps your resume!"



Aditi Ray

Degree Program: Doctorate of Philosophy in Biomedical Engineering (USC), recent graduate

Industry Position: Senior Research Engineer with Alcon Labs, beginning Summer 2010

After completing her PhD in Biomedical Engineering this summer, Aditi accepted a Senior Research Engineer position with Alcon Labs Medical Affairs/Retina Group in Irvine, CA; her responsibilities include running performance evaluation studies of surgical equipment as part of the company's Phase 4 post-market surveillance. Multidisciplinary projects under the ERC helped her to develop a wide range of skill sets while exposing her to a variety of disciplines. While her current work involves more mechanical testing than electrical stimulation (the focus of her thesis research), Aditi learned enough through other student projects in the ERC and her lab to be able to master the basics of her new work.

In the future, Aditi would like to pursue work with a product development/emerging indications team.

Advice to other ERC students: Expose yourself to a diverse range of skill sets, as this will enable you to better adapt to a variety of industry positions.

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vancements lead by BMES, including those in development for our military.

The increased prevalence of eye and head trauma caused by battlefield injuries, e.g. IED-related injuries, is driving the need for new technologies for injury diagnosis, injury treatment, surgical instrumentation and imaging technology. The BMES ERC has strategically partnered with PDT to accelerate these developments by leveraging our experience in design research, strategy and product development for both medical and military applications.

PDT looks forward to a long relationship with BMES ERC and the opportunity to continue advancing the organization's innovative medical technologies.

Neural Interfaces Conference



The 39th Annual Neural Interfaces Conference was held on June 21-23, 2010 at the Long Beach Convention Center in Long Beach, CA. The conference featured over 170 papers from a wide variety of scientists, clinicians and researchers from areas such as neuromodulation, auditory prosthesis, cortical prosthesis, microelectrode array technology, including many others.

The event was co-chaired by Drs. Mark Humayun and Jim Weiland. Primary support of this conference was provided by the National Institutes of Health. Additional support was generously provided by several sponsors, including, but not limited to, Medtronic (BMES Senior Industry partner), the National Science Foundation and USC's Alfred Mann Institute. Details for the 2012 event will be announced on www.neuralinterfaces2010.com this summer.

The Role of Mentoring

By Joseph D. Coccozza, Co-Director, Education and Outreach

The first cadre of Engineering for Health Academy (EHA) students will begin their yearlong research experience in USC laboratories in September 2010. These young scholars have successfully completed the first two years of the EHA program at Francisco Bravo Medical Magnet High School. During these initial years, the students were enrolled in the EHA core courses of chemistry, computer sciences, and physiology. Each of these classes related science theory to biomedical engineering applications and thus helped the students understand the connection between academic study and real world issues. The EHA core curriculum also prepared the students to successfully transition into the university research setting as part of the EHA Research Experience Capstone Class taken in the third and final year of the EHA curriculum.



Mentoring is central to the education of the EHA students. USC medical and graduate students serve as mentors and meet with EHA students on a weekly basis to help the high school students in their core classes. The mentors provide a supportive environment where EHA students receive additional help with their class work. Often times the mentors provide a different perspective than the classroom teacher and the mentors may view the solution to a problem from a different angle. This is an important lesson in itself as the EHA students become aware that there may be more than one way to approach and/or solve a problem. The mentors also serve as role models to the EHA students. All of the mentors are current USC students who have developed the knowledge and skills necessary to gain admission to and be successful at a top tier research institution. The mentors freely share their own experiences, life stories and academic strategies with the aspiring high school students. They offer advice on study habits, give tips on time management strategies and make suggestions related to the college application process.

Mentors will continue to play a vital role in the education of the EHA students as they begin their research experience capstone class this year. The EHA students will spend two class periods a day (2 hours) in USC research laboratories becoming integral members of research teams. The principal investigators of the various labs hosting EHA students have selected mentors to work with the high school students. Together the mentors and high school students will develop appropriate research projects to be investigated during the academic year. The EHA students, under the guidance of the mentors, will for-

ulate scientific hypotheses, design experiments to test those hypotheses, collect and analyze data generated from experimentation and draw logical and defensible conclusions. At mid semester, the EHA students will present their findings during a seminar series hosted at USC and, at the end of the year, the students will defend a poster of their work at the annual USC/Bravo Science and Engineering Fair.

Mentors play a significant role in the EHA students' attainment of knowledge, mastery of technical acumen and development of communication skills. Through their example, mentors help initiate the young scholars into the culture of the science and engineering communities and their influence will have lifelong positive implications, not only for the EHA students, but for the future generations of aspiring scholars.

“Snapshots” of the BMES Team

Ho Man (Rosa) Chan earned her undergraduate degree in Automation and Computer-Aided Engineering and minor in Computer Science at the Chinese University of Hong Kong. She has earned Master's degrees in Biomedical Engineering and Electrical Engineering and is currently working towards her PhD at USC.



Rosa has been active in the BMES, frequently serving as a mentor in the Science for Life (SFL) outreach program, which is a collaborative science education initiative between USC and Murchison Elementary School located near the USC Health Sciences Campus. SFL introduces young children to the excitement and relevance of science and engineering in their everyday lives.

Rosa is part of the Cortical Prosthesis Testbed team led by Dr. Ted Berger. Her primary research interest is to develop biologically constrained mathematical models of mammalian neural systems. First, stationary models developed from well-trained animals will be used to build micro computer chips (neural prostheses) to repair damaged brain functions. Second, time-varying models of how functions of information transmission across brain regions evolve during behavior will explain when and where learning and memory occur in vivo. The focus of her current study is the hippocampus, a neural system essential for learning and memory functions.

Rosa's dream job is to become an astronaut. She enjoys eating dim sum and traveling. Rosa plays the classical guitar, electric guitar and electone and her favorite guitarists are Django Reinhardt, Xuefei Yang, Jimi Hendrix and Slash. Her favorite composers include Bach, Astor Piazzolla and Heitor Villa-Lobos.



Phillip Hendrickson earned his Bachelor's degree in Biomedical and Electrical Engineering from the University of Southern California in 2006. He earned his Master's degree in Biomedical Engineering from USC, where he is currently working to complete his PhD.

Phillip is a member of Dr. Ted Berger's Cortical Prosthesis Testbed team. His research consists of developing a large-scale computer model of the hippocampus, a region of the brain associated with the formation of long-term memories. He is developing this model on a 4,000-processor compute cluster that the lab recently acquired, and wants to use it to better understand the signal processing that occurs in the hippocampus.

When Phillip is not busy with his research, he splits his time between his family and his hobbies. He is a dedicated family man, having been married for five years, and having two children whom he loves greatly. He enjoys making music, whether it be playing the piano or singing in a choir. He also loves playing tennis. The mountains are one of his favorite places to go because there he can spend time in the peace and quiet of nature.

Phillip has also been an asset to the BMES, serving as a mentor in the Science for Life outreach program, a collaborative project between USC and Murchison Elementary School.

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Upcoming Events

Please **SAVE-THE-DATE** and mark your calendars for the following:

- Biomedical Engineering Society Meeting**
October 6-9, 2010 (Austin, TX)
 Visit <http://www.bmes.org/aws/BMES/pt/sp/meetings> for more information.
- American Academy of Ophthalmology**
October 15-19, 2010 (Chicago, IL)
 Visit http://www.aao.org/meetings/annual_meeting/ for more information.

The BMES would like to acknowledge and thank all of its Industry Partners for their continued support:

Senior Partners:

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Technology Partners:



Harvest Precision Components

