



BMES ERC

INDUSTRIAL ADVISORY BOARD NEWSLETTER

This issue



Director's Message P.2



ILO Update P.3

Faculty & Student Awards P.4



Outreach P.4

Events P.8



Snapshots of the BMES Team P.5



SLC News P.6-7

Industrial Advisory Board Report on SWOT and Value Creation

By Fred Kimock, PhD, Morgan Technical Ceramics, IAB Co-Chair

I'm very pleased and honored to have been named IAB co-chair, and wish to thank Mark Humayun, Jack Whalen and Jim Weiland for their vote of confidence in appointing me to this role.

Let me begin by highlighting the excellent, clear and concise presentations given by all the students at the meeting. Congratulations to each student presenter, and to those who assisted with development of the presentation format. The IAB looks forward to future presentations of this kind.

At this year's February IAB meeting, we approached the SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis with the aim of identifying areas for improvement, consistent with the mission of the organization. Beginning with last year's analysis, we characterized each SWOT item by its source: the people, facilities, systems or product output of BMES. We then added items to fill in gaps in the prior analysis.

A significant number of strengths in the people, facilities, systems and product output of BMES were identified, indicating a well-balanced and strong organization.

A number of low probability "potential threats" were identified, along with one major threat – loss of funding leading to lack of sustainability for BMES. We believe a key factor in sustainability is demonstrating value creation for funding sources, including the NSF and Industry Partners.

To address value-creation for NSF, we first characterized BMES' response to the NSF ERC Mission into five elements: (1) venue created for collaboration, (2) focus on medical device product development lifecycle; (3) BMES knowledge base; (4) multi-disciplinary approach to development of complex engineering systems; (5) relevance of BMES technologies to industry. The identified SWOT Strengths overlapped well with all five elements, indicating BMES performance is consistent with NSF's Mission.

Using feedback provided to BMES' industry liaison as a guide, we developed a value-creation survey, which has been completed by all 18 industry partners. Each industry partner cast a total of five votes among six categories indicating where they perceived most value creation from BMES. Categories included: (1) licensing of technologies from the Center, (2) access to start-up companies for acquisition, (3) collaboration for outside R&D funding, (4) talent pool of students as future employees, (5) access to facilities and equipment, (6) business-to-business (B2B) activities with industry partners. While the top value-generating activities were licensing and B2B, each category had a significant number of votes, indicating that BMES provides value to its industry partners in multiple ways. The survey also uncovered another potential value-creation category: access to faculty who are key opinion leaders for future innovations.

The SWOT and value creation surveys have provided some fresh insight into the Center. Details are available for review. We plan to continue emphasis on improvement areas identified in the SWOT, providing value-creation for partners, and supporting BMES' efforts leading to sustainability.

BMES ERC TECHNOLOGY TRANSFER TO DATE:

**Inventions
Disclosed**
132

**Patent
Applications Filed**
177

Patents Awarded
52

Licenses Issued
20

**Spin-off
Companies Started**
8

NEW INDUSTRY PARTNER ANNOUNCEMENT

**Welcome
technology
partner Virginia
Technologies,
Inc.!**

Director's Message



Mark S. Humayun, MD, PhD

The BMES is now well into its eighth year of existence. We have been steadfast in our mission and vision to develop and translate implantable microelectronic devices towards commercialization.

As we approach Year 10 of the center, we are giving considerable thought to a self-sufficiency plan that will sustain the center beyond the last year of the center. Our approach is three-fold:

1. Continue creation of BMES value for our industry partners;
2. Creation of a model for self-sufficiency;
3. Enabling of the self-sufficiency initiative.

The BMES will continue to add value for its industry members.

We will also continue to advance our core disciplines through continued garnering of research funding, and creation of new research initiatives relevant to the center's mission.

Our model for self-sufficiency requires formation of an NSF-independent fiscal budget for administrative operation of the center. This budget will help us assess what the center will need, in terms of hard-dollars, to become self-sustaining. Once this dollar value is defined, the BMES will create a fund-raising strategy to identify and secure its funding. The fastest change that can be adopted is a restructuring of the center's industry membership fees. Already we are looking at stratifying membership fees by company size and possibly adding a third type of membership for companies that can provide contract or vendor services at discounted rates to advance our technology projects. Our hope is that our continued technology transfer success will justify increases in membership dues. Other avenues for support may be personal donors and foundation support. The high visibility of our center and its researchers will be key to this effort. We will also invest considerable time in identifying large corporate donors. Lastly, the BMES will look to government support like grants from the city of Los Angeles, the state of California and potentially other federal funding initiatives.

Our first steps have been the initiation of this conversation of beyond Year 10 without industry partners. In the near future we will begin to enact our plan to restructure membership dues and creation of our NSF-independent fiscal administrative budget. The rest of our fund raising campaign can then be set in motion. We believe this plan is a clear and realizable approach to self-sustainability for the BMES.

With the support of our partners, we launched a mentoring program last year which has already spun relationships between our graduate students and industry partners. One of our goals with this program is to expose the students to strategies and concepts used in industry that extend beyond the classroom.

We continue to produce journal publications and develop technology at a pace above other ERC's. We hope that our accomplishments in creating transferred technologies will continue to demonstrate our competence in the area, and help the center continue with its membership expansion.

As we move forward, we thank all of our industrial partners for their commitment to the center. We are grateful not only for your membership dues which help us run the day-to-day operations of the program but for your participation, constructive feedback, and innovative ideas for collaboration. These relationships help shape and sustain our program and we look forward to our collaboration in the years to come.

Update from the Industry Program Director



Jack Whalen, PhD

Thank you all for making it out to the 2011 winter IAB meeting. This year's event had quite a turn out, with eleven of our eighteen members attending the meeting and seven of the eight senior members in attendance. We received a lot of positive feedback on the format of this year's meeting as well. Everyone appreciated the student research presentations for their content and succinct nature. We also announced and introduced the IAB's new co-chair, Dr. Fred Kimock. Dr. Kimock is originally from the Diamonex business of our senior partner, Morgan Technical Ceramics.

For those who were unable to attend, the research presentations were given in ten minute oral presentation formats. Students presented on topics ranging from novel microelectrode designs for neurostimulation/sensing, to light-switching molecules for creating light sensitive cell membranes, to multi-channel chip connection technologies, to computer modeling of neural networks. These presentations covered both the latest findings by our student researchers, as well as introduced our industry partners to the various capabilities and facilities available and used by BMES. Copies of the student's presentations are available to our industry partners on request.

Following the research presentations this year, Dr. Kimock led our senior member SWOT analysis. For those that are new to BMES, the NSF requires that each ERC's senior industrial members conduct a review of the center's Strengths, Weaknesses, Opportunities and Threats (SWOT). The goal of this exercise is to help guide the center towards meeting its objectives, including adding value for its industry members. Dr. Kimock's experience with program management and evaluation of ongoing programs helped to make this year's SWOT significantly more productive.

As you know, we continue to push the industry program's effort to create value for you, the industry partners, and to think forward regarding the center's sustainability beyond Year 10. Our last session at the meeting was an open forum discussion about sustaining the center's activities beyond its ten years of NSF support. One of the significant conclusions from this conversation was that the center continues to be relevant to the medical technology field. This gives us motivation to continue to explore ways to carry BMES beyond 2013. We hope that you all will help us with this effort!



Student presentation during IAB meeting.

Update on the Student/Industry Mentorship Program



The BMES launched its Student / Industry Mentorship Program in the fall of 2010. One of our goals is to match the student with a mentor that introduces the student to concepts in industry beyond the classroom. In addition, this program fosters student-industry interaction and exposes our current research activities and projects to our industry partners; hence, potentially enhancing research collaboration between the BMES and its industry partners

To date, we have successfully matched two students with industry partners. We are currently working with other industry partners to identify more mentoring opportunities for our students. The time commitment is flexible and is mutually agreed upon by both parties. Feedback on the program has thus far been positive and we anticipate expanding it in the coming months given the enthusiasm of both our students and our industry partners.

Faculty and Students in the News

- **Dr. Ted Berger (USC)** and his lab were awarded “best paper” at the 2010 IEEE International Conference on Technologies for Homeland Security (November 8-10, 2010 - Waltham, MA). Presentation title: Intelligent acoustic and vibration recognition/alert systems for security breaching detection, close proximity danger identification, and perimeter protection.
- **Dr. Azita Emami (Caltech)** was the recipient of the 2010 Okawa Foundation Research Grant Award for “High Performance Compressive Sensing Receiver Design and Analysis” This prize honors top young researchers working in the fields of information and communications (November 2010).
- **Dr. Robert Grubbs (Caltech)** was awarded the 2011 Roger Adams Award in Organic Chemistry by the American Chemical Society Awards Program (March 27-31, 2011 – Anaheim, CA).
- **Dr. Norberto Grzywacz (USC)** received the following honors:
 - Elected secretary of the Council of Chairs (COC) of Biomedical and Bioengineering (BME/BE) (March 2011).
 - Led an interdisciplinary team to win the prestigious Coulter Translational Research Partnership Grant. USC Viterbi School of Engineering, Keck School of Medicine at USC, USC Stevens Institute for Innovation, and the Los Angeles Basin Clinical Translational Science Institute have been selected to participate in the program (April 2011).
- **Dr. Mark Humayun (USC)** was elected a member of the National Academy of Engineering (February 2011).
- **Dr. Ellis Meng (USC)** is among 53 of the nation’s most innovative young engineering educators selected to participate in the National Academy of Engineering’s 2nd Frontiers of Engineering Education Symposium (December 13-16, 2010 – Irvine, CA).
- **Artin Petrossians (USC)** won 2nd place for oral presentations at USC’s Mork Family Department of Chemical Engineering and Materials Science Sixth Annual Student Research Symposium (November 5, 2010 – Los Angeles, CA). Presentation title: Electrodeposition and Characterization of Thin-Film Platinum-Iridium Alloys. Artin works in the labs of Drs. Florian Mansfeld and Jim Weiland.
- **Dr. Giselle Ragusa (USC)** received the following grants in December 2010:
 - Funding agency: Institute for Educational Science US Department of Education, Postsecondary Education. PI’s: William Tierney, Gisele Ragusa, and Tracy Fullerton. Funding amount: \$1.3 million.
 - Funding agency: National Science Foundation GK-12: PI: Krishna Nayak, Co PIs: Gisele Ragusa, Maja Mataric, Andrea Hodge. Project title: BE- LA G K-12, Funding amount: \$1.23 million.
 - Funding agency: National Science Foundation REESE: PI’s: Gisele Ragusa and Jihie Kim. Project title: Measuring the impact of online discourse in STEM courses: Semi-automatic assessment of large discussion board corpora; Funding amount: \$300,000.
- **Dr. Yu-Chong Tai (Caltech)** and researchers at USC’s Norris Comprehensive Cancer Center were awarded a three-year \$1.6 million grant for clinical trials of a new drug to treat prostate cancer by the National Institutes of Health (October 2010).
- **Dr. Armand Tanguay, Jr. (USC)** was a winner of the 2010 Higher Education Grant program awarded by Edmund Optics (December 2010).
- **Dr. Mark Thompson (USC)** was ranked the 12th most influential chemist worldwide over the past 10 years according to the Special Report on High-Impact Chemists conducted by Thomas Reuters (February 10, 2011).
- **Dr. Jim Weiland (USC)** is among 100 outstanding engineers under the age of 45 that will participate in 2011 US Frontiers of Engineering Symposium in Mountain at Google headquarters in Mountain View, CA on September 19-21, 2011. Title of presentation: Historical Use of Electrical Stimulation of the Nervous System and Recent Clinical Development of Retinal Implants.

An Engineering for Health Academy Success Story

By Joseph Cocozza, PhD, BMES Co-Director, Education and Outreach



Ruqayyah Malik

In order for the United States to remain competitive in science and engineering, the education and preparation of the next generation of students in Science Technology and Science (STEM) is critical. In an effort to help increase awareness and support of science and engineering among pre-college students, the BMES ERC has partnered with a Los Angeles high school to establish the Engineering for Health Academy (EHA). Students who participate in the EHA make a 3-year commitment beginning as 10th graders and enroll in a series of integrated core classes that focus on biomedical engineering.

The inaugural cohort of EHA students are currently in their senior year. As is true all across the nation, the EHA seniors have some very important decisions to make. They need to decide which college to apply to, declare a major, and find the means to finance their education. EHA students have set their goals high and are applying to the nation’s premiere institutions. After sending in their applications and financial aid documents, the nerve-racking waiting game begins. For one student, however, the waiting game is over. Her name is Ruqayyah Malik and she has been offered admission to the University of Pennsylvania. Adding to that impressive accomplishment is the fact that Ruqayyah has also been awarded a QuestBridge scholarship. The QuestBridge National

College Match helps outstanding low-income high school seniors gain admission and full four-year scholarships to some of the nation’s most selective colleges.

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Ruqayyah came to the US with her family from Nigeria when she was four. She is from the Yoruba tribe in South-Western Nigeria and is bilingual in English and Yoruba, her native tongue. Ruqayyah has a passion for math, science and language arts and loves to draw in her spare time. She is a stellar EHA student who excels in all her class work. As part of the EHA research experience capstone class, Ruqayyah is working in Dr. Carolee Winstein's laboratory in the Department of Biokinesiology and Physical Therapy at the University of Southern California. Ruqayyah is investigating functional upper-extremity movement using accelerometers. This information will help in the development of more effective physical therapy strategies for patients who have suffered the debilitating effects of a stroke.

In addition to her academics, Ruqayyah is also very interested in learning about diverse cultures and is a member of the Black Student Union, the Russian Club, and the Desai Club, which explores Indian culture and music. To hone her leadership skills, Ruqayyah participated in People to People Summits at George Washington University (2007) and at Johns Hopkins University (2008). Last summer she completed a 6-week internship at the Children's Hospital Saban Research Institute in Los Angeles.

This September, Ruqayyah will matriculate into the College of Arts and Science at the University of Pennsylvania and major in biology with a minor in History. The QuestBridge scholarship will fully cover her tuition, room and board, books as well as offer her a stipend for living expenses. One of Ruqayyah's role models is Mahmut Gazi Yaşargil, the founder of microneurosurgery. Yaşargil's passion and drive for neurosurgery and his determination to move the field forward has instilled in Ruqayyah a desire to follow his example and become a neurosurgeon herself. Through the EHA, Ruqayyah has learned about the intersection between engineering and medicine. This convergence is of great interest to her and she is considering an M.D./biomedical engineering Ph.D. program after her undergraduate studies at Penn..

Ruqayyah is an exemplary student who has leveraged the opportunities afforded her to pursue her educational and professional goals. The BMES ERC is very proud of Ruqayyah and wishes her the very best as she continues on her educational trajectory on becoming a member of the nation's future STEM workforce.

“Snapshots” of the BMES Team



Dr. Norberto Grzywacz is professor of Biomedical and Electrical Engineering, and at the Neuroscience Graduate Program (NGP) of USC. He is also the Dwight C. and Hildagarde E. Baum Chair of the Department of Biomedical Engineering. Moreover, until 2010, he was the director of the NGP. Before joining USC, he worked at both the MIT and the Smith-Kettlewell Eye Research Institute in San Francisco. He completed his Ph.D. at the Hebrew University of Jerusalem, Israel, in 1984.

He currently directs the USC Visual Processing Laboratory and the Center for Vision Science and Technology. In these research units, he performs work on normal and pathological aspects of early visual processing, especially in the retina. Directly tied to BMES are his studies of how the retina codes natural images. By combining electrophysiological and computational studies, he is developing highly accurate mathematical models for this code.

These models can then be incorporated in the microprocessors connecting the camera to the electrode array in the retinal prosthesis.

He is also collaborating with Dr. Eun Jin Lee from BME to study retinal reorganization in some relevant visual disorders. For instance, they unraveled some of the cellular and molecular mechanisms mediating the reorganization of the array of cones in retinitis pigmentosa. Based on these mechanisms, they developed a computational model for the observed changes. This model makes predictions on how to manipulate the retina to repopulate the array of cones.

When he is not working, he enjoys soccer, reading voraciously, traveling to exotic places, and meditating.



Wan-Qing Yu first got a Bachelor's Degree in Physics and then a Master's Degree in Biophysics from Nanjing University, China. Currently, she is a Ph.D. student in the USC Neuroscience Graduate Program under the supervision of Dr. Norberto Grzywacz.

Her research focuses on mechanism of retinal processing of natural images, combining both experiments and modeling. Currently, she is designing neurophysiological experiments to find out how the retina responds to textures in natural images. In parallel, she is building computational models based on existing experimental data. The mechanisms implemented by the model will be tested using recordings with multi-electrode arrays. She hopes that these models will help the design of better retinal implants.

Besides working on her PhD project, the rest of her life is occupied by music and food. She plays the piano, especially enjoying chamber music. For her, it is a great experience to communicate with other musicians with music instead of words. She would also like someday to become a gourmet to taste different cuisines from around the world. In the meantime, she prefers to cook all kinds of food for herself and sometimes, to try to create some "chaos".



SLC Co-Chairs:
Samantha Cunningham and
Navya Davuluri

Student Leadership Council (SLC) News

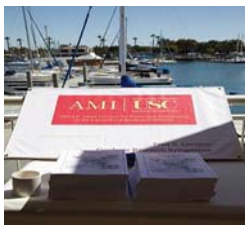
Inspiring Innovation through the 15th Annual Grodins Graduate Research Symposium

By Samantha Cunningham, Student Leadership Council Co-Chair

The 15th Annual Fred S. Grodins Graduate Research Symposium was held at the stunning Marina del Rey Hotel on Saturday, April 9th. Doctoral students in the USC Biomedical Engineering department were provided the opportunity to showcase their research to fellow students and faculty through poster presentation sessions and podium talks, several of which received awards for outstanding work in their field. Victor Chan—a Systems Team Leader at Qualcomm—ended the day with a lecture on “The Promise of Neuromorphic Computing—an Industry Perspective,” in which he outlined the use of fundamental concepts in biology to add intelligence to everyday devices.



Students present their work to fellow participants and faculty during one of four poster sessions.



AMI was the largest sponsor at Grodins.

Sponsors of this year’s event included organizations from both academia and industry, including the Alfred E. Mann Institute for Biomedical Engineering at USC (AMI), the USC Graduate and Professional Student Senate (GPSS), the Viterbi Graduate Student Association (VGSA), our own BMES ERC, Replenish Inc., The Mathworks, and the USC Stevens Institute for Innovation. Sponsors received a range of benefits depending on the amount of their donation, including recognition on all symposium publications. In addition to providing funding for the symposium, several of these institutions played a vital role in fostering an environment of innovation—Mathworks provided a brief podium introduction to products relevant to biomedical research, while the Stevens Institute presented a Most Innovative Award to an outstanding student participant. When asked for their reasons behind consistently sponsoring the Grodins Symposium, Ian Murphy—Director of Communications with the USC Stevens Institute—responded: “The curious, idealistic, and relentless

mind of a student is fertile ground to begin planting the seeds that will develop into a lifelong pursuit to make impact with their ideas. We feel recognizing students for their innovative work encourages them to focus on practical and realistic solutions that can fill a need in society and/or the market.”

Sustaining Innovation Within ERC's: Student Perspectives from Annual NSF ERC Meeting

By Navya Swetha Davuluri, Student Leadership Council Co-Chair

The 2010 NSF ERC Annual meeting took place at Bethesda, MD from Dec 1– 3, 2010. The BMES-ERC Student Leadership Council had the distinct privilege to host the student retreat this year which brought together student leadership council members from all the ERC’s nationwide. The closed door session served as a platform for the students to discuss ideas on how to sustain innovation within an ERC. It also gave them an opportunity to explore solutions to some of the student related concerns amongst their respective ERC’s.

The student retreat was divided into two sessions. The first session had the students’ debate on various topics that conformed to the annual meeting’s theme of innovation and sustainability. The topics included:

- Who’s more innovative: academia or industry?
- Does the recession help or hinder innovation within the ERC’s, industry, and academia?
- Does the ERC-Industry relationship promote innovation?
- Does innovation thrive in open-source work environment or one with strong intellectual property protections?

Each topic increased the students’ awareness of the role and importance of each component such as academia, industry, within and beyond the ERC in successfully implementing an innovative idea. The debate on intellectual property rights led to an especially lively discussion. Towards the end of the debate on this topic, students were left with a lot of food for thought on how to take advantage of both an open-source environment and IP laws in fostering innovation.

The second session saw roundtable discussions on topics that were brought up as concerns/issues among students within their respective ERC’s such as low student participation in ERC-related events, how to keep individuals informed of the resources/research within the ERC, etc. Many of these concerns were voiced by students from relatively “newer” ERC’s and the roundtable discussions gave them an opportunity to find out the opinions of students from each ERC on how they addressed these concerns.

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The end of the student retreat was marked by a remarkable interactive session with the keynote speaker, Dr. Erez Lieberman. Dr. Lieberman was a graduate student at MIT and Harvard and got his PhD in Applied Math and Bioengineering. The first half of his lecture focused on his research on the folding principles of human genome. During the second half of his talk, Dr. Lieberman taught the students the importance and usefulness of discussing innovative ideas in order to come up with ground breaking inventions. The interactive roundtable discussions during the second half of the talk enabled the students to understand the invention process.

Towards a More Fulfilling Relationship Between Industry and the BMES ERC Student Body: Student Impressions on Improving Student-Industry Interactions

By Samantha Cunningham, Student Leadership Council Co-Chair

The 2010 NSF ERC Annual Meeting provided a unique opportunity for students to interact with administrators from all divisions of the ERC program. In such an atmosphere, students were given an outlet to voice their concerns and ideas during the closed-door student session. The BMES ERC Student Leadership Council was given the honor of hosting this year's retreat and, in accordance with the meeting's theme of Innovation, divided the day into a series of innovation-related debate topics and roundtable discussions.

It became increasingly clear during several conversations that the majority of students yearn for a structured and concrete connection with their ERC industry partners. The benefits of such a relationship are invaluable and include mentoring from industry representatives, research and internship guidance, and increased awareness of the functions surrounding industry research and development. Both industry and academia-bound students believe these items will enhance their graduate school experience, as well as enable them to communicate more effectively with industry in their post-graduate careers.

Despite the conviction that an industry-student relationship will benefit both parties, students remain unclear on how to go about pursuing such interactions and what they should realistically expect from the relationship. PhD students often encounter conflict, for example, when pursuing internships with industry: an internship unrelated to their thesis research will interfere with their degree progress, while industry cannot feasibly find a thesis-specific internship project for every interested student. While many students express interest in completing internships unrelated to their research—as a means of gaining experience outside of their own projects—this often comes at the dismay of their collaborators and faculty advisors.

Students agreed that the solution is a gradual development of the relationship, where maturation one step at a time trumps jumping head-first into murky waters. Several SLCs shared solutions that have helped bridge the industry-student divide within their ERC's. These included:

- Mentorship programs consisting of 1 mandatory meeting between a student and their mentor each semester
- Tours of industry facilities
- Monthly technical talks for students and industry to present highlights of their work to one another
- Social events with industry representatives
- Regular webcast meetings as an opportunity for students to ask industry specific questions concerning their research

Not yet implemented ideas include appointing SLC and industry liaisons from each industry partner to communicate directly for student-industry activities, and developing an “internship track” for PhD students where it is accepted by faculty that such a student will eventually complete an internship with an ERC industry partner.

It is the hope of the ERC Student Leadership Councils that successful implementation of these ideas will create a more cohesive relationship that students, faculty, and industry can benefit from, and ultimately help students understand how to best utilize industry resources and knowledge.

BMES Industry Staff Contact Information



Biomimetic MicroElectronic Systems (BMES)
Engineering Research Center (ERC)
University of Southern California
1355 San Pablo Street, DVRC 130
Los Angeles, CA 90033
<http://bmes-erc.usc.edu/industry>

J. Jack Whalen, PhD
Director of Industry Partnerships
and Business Development
323.442.6788
jjwhalen@usc.edu

Rosie Soltero
Project Manager,
Industrial Relations
323.442.6791
rsoltero@usc.edu

Upcoming Events

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

- American Ophthalmological Society 147th Annual Meeting
May 19–22, 2011 (Dana Point, CA)
- International Conference on Spinal Cord Medicine and Rehabilitation
June 4–8, 2011 (Washington, DC)
- BMES Industrial Advisory Board Meeting & NSF Site Visit
June 14–15, 2011 (Caltech — Pasadena, CA)
Please RSVP to Rosie Soltero (rsoltero@usc.edu)
- American Society of Retina Specialists 29th Annual Meeting
August 20–24, 2011 (Boston, MA)

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

Senior Partners:



Technology Partners:

Abbott Medical Optics



Harvest Precision Components

