annual report

School of Biological and Health Systems Engineering

Engineering solutions to improve human health

IRA A. FULTON SCHOOLS OF engineering
ARIZONA STATE UNIVERSITY

IRA A. FULTON SCHOOLS OF engineering
ARIZONA STATE UNIVERSITY

School of Biological and Health Systems Engineering

Enrollment Fall 2015

Doctoral
73

Master
100

Bachelor
916

40%
Undergraduate Students in Barrett, The Honors College

Total Enrollment
1,089

39%
Female

Degrees Granted 2014

Total
181

Bachelor
103

Master
66

Doctoral
12

Harrington Bioengineering program
sbhse.engineering.asu.edu

Biomedical Engineering, B.S.E, MS., Ph.D.
Biological Design, Ph.D.

Faculty Members
36

Professors
4

Associate Professors
12

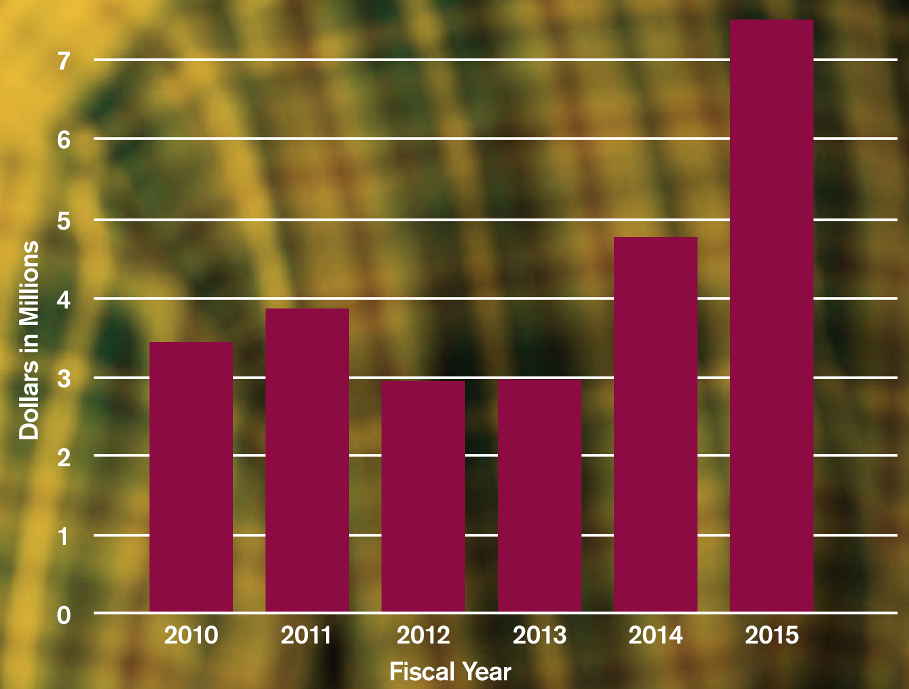
Assistant Professors
13

Professor of Practice
1

Lecturers
3

Research Faculty
3

Research Awards



Dear friends and colleagues,

I am happy to share with you our annual report about the School of Biological and Health Systems Engineering at Arizona State University. It has been another exciting year for the school as we continue to strive to provide the next generation of biomedical engineers with the skills necessary to become problem solvers, innovators, leaders and entrepreneurs.

The school continues to expand the breadth and depth of expertise by hiring new faculty and engaging in many collaborative initiatives with industry and clinical partners. Honors, awards, publications in prestigious journals and competitive extramural funding exemplify the quality and impact of contributions made by our faculty and students. The school is firmly dedicated to improving the quality of life and health of our community. To attain this objective, we continue to engage the biomedical industry and clinical community in tackling challenging clinical problems, while leveraging our faculty's interdisciplinary expertise and attracting talented students and faculty.

We invite you to visit our website at **sbhse.engineering.asu.edu** to learn about recent events and achievements. Or drop by for a visit to experience firsthand what makes our students and faculty unique.

We look forward to hearing from you.

Marco Santello, Ph.D.

Director, School of Biological and Health Systems Engineering

vision

To become a **leading biomedical engineering program** that effectively engineers **novel solutions to improve human health** and provides unique **interdisciplinary training** for the next generation of biomedical engineers.

What’s Ahead

At the core of the School of Biological and Health Systems Engineering lives a single concept — the search for solutions to problems that impact human health and well-being.

We strive to achieve impact through innovative solutions to problems ranging from stroke and Parkinson’s disease to cancer and diabetes. Along the way we are committed to preparing the next generation of biomedical engineers to face the health challenges of the 21st century and beyond.

In the last five years enrollment has almost doubled — up to 1,090 students in 2015. Our freshman retention (over 90%) shows that our students are excited about our program and ASU. Through strong academic leadership and teamwork, we offer a high quality of instruction, as evidenced in our perfect score during the recent Accreditation Board for Engineering and Technology review.

With a series of strategic hires, our faculty is growing and adapting to address challenges in biomedical engineering such as brain cancer, paralysis, amputation, stroke, and concrete solutions like specialized point-of-care devices, low-cost diagnostics, focused delivery of chemotherapeutic agents and reengineering of stem cells. The school is gaining critical mass in neural engineering; molecular, cellular and tissue engineering; synthetic biology; biomedical imaging; and biosensors, biomarkers and biomimetic materials.

By taking novel approaches to important biomedical problems, our faculty have been successful in securing financial support in a very competitive environment, drawing from federal funding sources, including National Science Foundation, National Institutes of Health and the Defense Advanced Research Projects Agency, as well as clinical partners, industry and foundations. And this is just the beginning: our faculty awards are trending upward. In 2015, SBHSE researchers received awards of $7.4 million in research funding, more than double of the awards from five years ago.

We continue to build relationships with industry and the clinical communities, both locally and nationally. Two initiatives exemplify our synergies with industry and clinical partners. One of these initiatives is an annual workshop in rehabilitation robotics — now in its fourth year — which brings together industry, academia, and clinicians in the multidisciplinary field of robotics, including human-robot interaction and human motor control. Another initiative is a new National Science Foundation Industry/University Collaborative Research Center in partnership with the University of Houston, BRAIN (Building Reliable Advances and Innovation in Neurotechnology). The BRAIN center will address rigorous testing of efficacy, safety, and long-term reliability of neurotechnology that would not be otherwise possible within the traditional ‘silos’ of academia, industry, regulatory agencies, and clinical communities. The planning grant meeting will involve academics, industry, clinical institutions and federal agencies and will be held in March on the ASU Tempe campus.

As the school looks ahead, we will continue to work at the intersection of engineering, medicine, physiology, biology and policy to develop use-inspired technologies with the potential to improve human health and well-being. Stay tuned and we look forward to sharing our exciting news with you!

Faculty Awards

Sarah Stabenfeldt has earned a prestigious National Science Foundation CAREER award that recognizes emerging education and research leaders in engineering and science.

Neural repair research earns NSF CAREER Award for Stabenfeldt

When it comes to traumatic brain injury, the human body responds in a variety of ways, often attempting to heal itself.

Assistant professor Sarah Stabenfeldt is working to better understand the neural repair/regenerative signals created as part of the body's injury response and develop therapeutic strategies that harness these signals. The end goal is to enhance and amplify the body's natural regenerative efforts.

The research is being supported by a National Science Foundation (NSF) CAREER award earned by Stabenfeldt. The prestigious NSF grant recognizes emerging education and research leaders in engineering and science. The award provides $500,000 over five years to support both research and educational outreach activities including undergraduate and graduate student research experiences.

After a traumatic brain injury, the body initiates a host of molecular and cellular signals as part of a concerted complex response to the injury. This response includes recruitment of existing neural stem cells to the area of neural injury. This cell recruitment is believed to promote healing and repair.

Stabenfeldt will work to better understand this cell recruitment process, in part, by developing computational models in collaboration with her colleague, Michael Caplan, a SBHSE associate professor. Stabenfeldt plans to use the knowledge to design therapies that capitalize on similar signaling mechanisms to enhance and potentially expedite the neural repair.

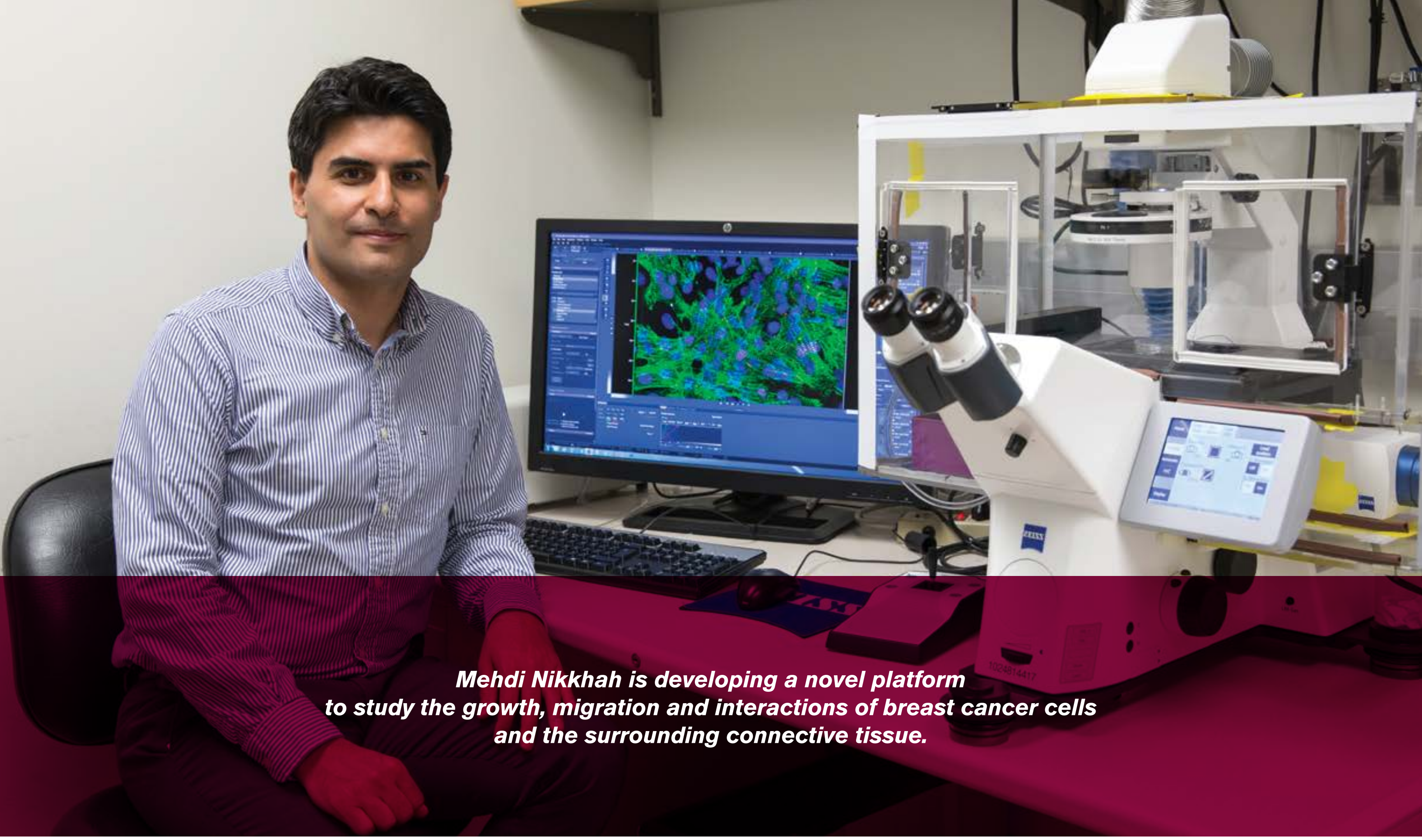
"We are interested in understanding how the body makes an effort to repair itself," she said. "We can then tap into similar signaling mechanisms to potentially modulate and amplify cell recruitment mechanisms."

The CAREER award also includes a component designed to train the next generation of researchers and engineers.

Stabenfeldt will build on a current undergraduate laboratory course she developed with SBHSE Lecturer Casey Ankeny that employs a guided inquiry teaching method.

Guided inquiry is a student-centric teaching style that trains students how to pose and probe scientific questions as opposed to providing a predetermined step-by-step set of instructions for the students to follow. The CAREER award will enable Stabenfeldt to also develop and implement similar laboratory sessions geared for high school students.

"Most labs are like cookbooks, where you just follow the recipe," she said. "The idea here is to provide a scientific topic/workspace and let the students formulate the hypothesis and experimental design. This type of course enables students to not only learn scientific method, but also put it into practice. It resembles a more authentic research experience."



Mehdi Nikkhah is developing a novel platform to study the growth, migration and interactions of breast cancer cells and the surrounding connective tissue.

Research brings cancer cell invasion studies into 3D micro-engineered model

A research team is working on the micro level to shed new light on how cancer invades the body.

The research project, led by Mehdi Nikkhah, an assistant professor of bioengineering, is focusing on development of a novel microscale 3D platform to study the growth, migration and interactions of breast cancer cells and the surrounding connective tissue. The research offers a precise look at how cancer cells begin to transform and invade the surrounding healthy tissues.

When a cancer cell invades the body, it responds to numerous biophysical and biochemical signals within the surrounding connective tissue or stroma — which includes an intricate extracellular matrix with blood vessels, immune cells and fibroblast cells, among others. The signals also cause various changes in biomechanical signatures of the cells. In total, these changes facilitate the migration process of the cancer cells.

Nikkhah has developed a microscale platform, to localize cancer cells and the surrounding tissue. While other research has focused on the development of similar platforms, Nikkhah's effort is novel in the inclusion of the surrounding tissue along with a nanoscale force tomography technique — a mapping of the cells on a nanoscale giving a more complete look at how the changes occur.

The microscale environment also allows the researchers to see how the cells react under different biological conditions.

"What is not known is how these cells react in presence of stromal cells in a 3D gel," says Nikkhah. "The tissue inside the body is 3D, not just 2D as it is typically studied. We will be also able to monitor the changes in biomechanical properties of a single cancer cell during invasion."

The team includes ASU physics professor Robert Ros of the Center for Biological Physics who serves as the co-principal investigator on the grant.

The work could ultimately lead to advances in the understanding the invasive phenotype and biomechanical signatures of the cancer cells and provide a new platform for biological and therapeutic testing.

The research is funded by a three-year grant for $449,884 from the National Science Foundation.

Professor Marco Santello is continuing his work on understanding the sensorimotor mechanisms underlying learning and execution of dexterous hand movements. Santello and his collaborator, Dr. Andrew Gordon, have earned their fourth NSF grant since 2006 for research in this area.

Study explores hand's complex, skillful movement

Engineers hope what is learned could lead to advanced prosthetics and robotics.

Picking up an object, such as an orange from a table, for many would seem a simple task. For motor control researchers, however, the underlying movement mechanics and sensory feedback needed to accomplish that task — and repeat it in a variety of situations — is extremely complex.

A team of researchers, led by Marco Santello, a biomedical engineering professor and director of the School of Biological and Health Systems Engineering, is attempting to quantify this process in a new research study. The objective is to gain a better understanding of the neural mechanisms underlying how we perform and learn dexterous manipulation. The knowledge drawn from this current project could lead to new options in advanced and human-like prosthetics, neuroprosthetics, robotic manipulators and research tools.

The study, a partnership with Andrew Gordon, a professor of movement science and neuroscience and education at Teachers College, Columbia University, and funded by a $650,000 grant from the National Science Foundation (NSF), will focus on the specific force used in the fingertip in relation to the position of the finger.

The team will be looking at three primary ideas.

First, the concept will be explored from a sensory perspective. Various senses, such as visual feedback and tactile feedback, are known as important factors. The researchers want to determine if they may play a relatively more important role, at some points in the task, than others.

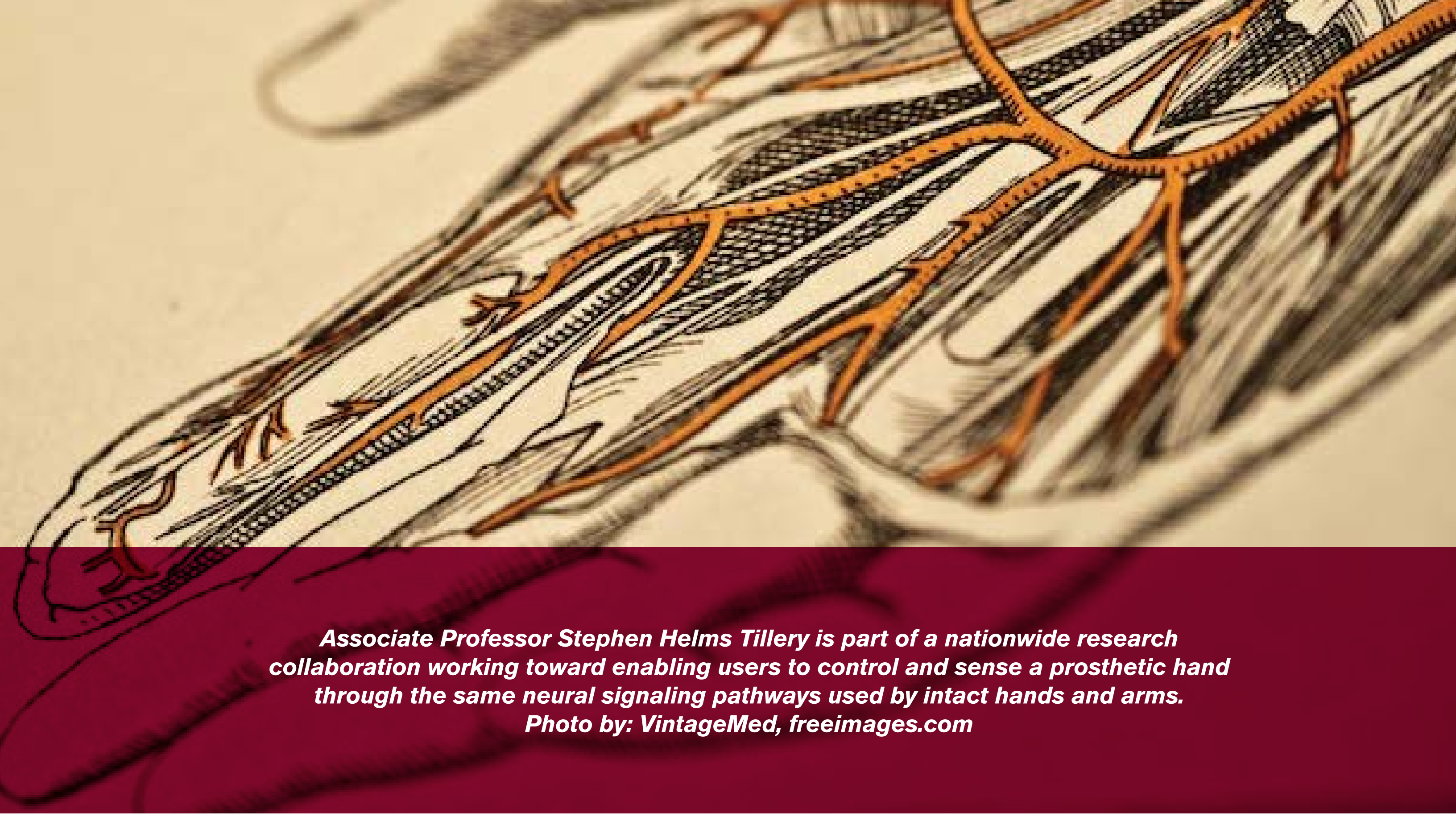
Second, how does the learned application of fingertip force transfer to other grasping tasks? Researchers will examine whether the same control mechanisms apply when a subject is using only a few fingers or even both hands.

Third, the team will explore if the concepts can be generalized over different contexts. The researchers want to understand whether subjects are "stuck" with learning one thing in one context only. Does the brain apply the lessons learned in picking up an object to all circumstances, or is there a relearning effort under different conditions?

"When you learn a given manipulation task, say, grasping an object with thumb and index fingertip, the question is whether what you learned in that context can be transferred to a different context," said Santello. "If subjects are able to transfer the learned manipulation across different object orientations, it means that the central nervous system can adapt what was learned to novel relations between fingertip and forces by using a high-level representation of the task goal, rather than the specific fingertip forces or position that was originally learned."

During the three-year study, researchers from ASU and Columbia will run experiments concurrently.

This is the fourth NSF grant Santello and Gordon have been awarded since 2006. Their work has stimulated the design of novel hardware (grip devices), biomechanical analyses and software for grasp control analyses, and has contributed to the design of a low-cost artificial hand.



Associate Professor Stephen Helms Tillery is part of a nationwide research collaboration working toward enabling users to control and sense a prosthetic hand through the same neural signaling pathways used by intact hands and arms. Photo by: VintageMed, freeimages.com

Project aims for prosthetic that senses like real hand

Nationwide research collaboration pursues technological advances for better user control.

One of the major challenges in prosthetics technologies is to create an artificial hand capable of the same tactile sensations and motion perception as a natural hand.

Neurophysiologist and Associate Professor Stephen Helms Tillery is a member of one of the teams involved in a nationwide research collaboration to produce systems and devices enabling users to control and sense a prosthetic hand through the same neural signaling pathways used by intact hands and arms.

Called HAPTIX (Hand Proprioception and Touch Interfaces), it is the first program for the new Biological Technologies Office of the Defense Advanced Research Agency (DARPA), a part of the U.S. Department of Defense.

DARPA is undertaking the project as part of its mission to provide support for wounded U.S. military veterans. The program is expected to have significantly broader impacts on the development of next-generation prosthetic technologies.

"We want to make a prosthetic hand that can do all the amazing things a human hand can do," said Helms Tillery.

That means finding ways for a prosthetic hand to able to sense the shape, texture and weight of whatever it touches and to perceive how much or how little pressure or force is needed to grasp, lift or manipulate objects.

The teams, awarded $345,565, will work to help figure out how a prosthetic hand could do all of this wirelessly, so that it can be operated solely with internal controls. Researchers will then focus on testing the use of the system's performance in providing tactile sensation.

Doing that will require developing a system of electrodes, complete with intricate circuitry and tiny microprocessors, that provides a power source and an interface between the electronics and the body's nervous system — a system that will be implanted into the forearm at a point where a removable prosthetic hand would attach.

The goal is to establish a reliable and accurate communication loop between electrodes and nerves.

For an artificial hand to be capable of giving the user perceptions of weight, shape, texture, hardness or softness, researchers must solve the challenge of "getting that sensory information to go from the prosthetic hand and through the interface system to the nervous system and to the brain and back to the hand," Helms Tillery said.

Helms Tillery is collaborating directly on the project with Nerves Incorporated, a Dallas-based manufacturer of electromedical equipment. The team will be led by Edward Keefer, a neurophysiologist and engineer at Nerves Inc., and joined also by Jonathan Cheng, a plastic surgeon whose expertise includes reconstructive hand surgery.

The first phase of DARPA's HAPTIX program is planned to last a year and a half, which includes time for testing prototypes of the new prosthetic hands.

Helms Tillery said prototypes will be equipped with data-collection devices enabling researchers to assess how the neural interface system is functioning and how users are adapting to the new prosthetic hand technology.

Young faculty build a track record of innovation and high performance

High-performing innovation teams require the perfect combination of bright new talent and more experienced players.

It's a strategy that is paying off for the Ira A. Fulton Schools of Engineering and the School of Biological and Health Systems Engineering. Junior faculty members in SBHSE have netted several grants from federal agencies and foundations over the past five years, bringing approximately $7 million to support research and education.

"These highly-competitive and prestigious grants are awarded to young faculty with the best ideas in the U.S. Our young faculty are amazingly innovative and are already pushing the boundaries of their fields," said Paul Johnson, dean emeritus of the Ira A. Fulton Schools of Engineering. "In addition to being outstanding researchers, they are exceptional teachers, and their grant activities involve outreach to inspire the next generation of engineers."

The National Science Foundation (NSF) Early Faculty Development (CAREER) Award "supports junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations."

This year's CAREER Award winners in SBHSE include Sarah Stabenfeldt, an assistant professor who received the National Institute of Health (NIH) Director's and Career Development Award last year. [Read about Stabenfeldt's award on p. 8.]

National Science Foundation (NSF) Faculty Early Career Development Award (CAREER Award) Winners in SBHSE *within last 5 years*

2014-2015 Sarah Stabenfeldt

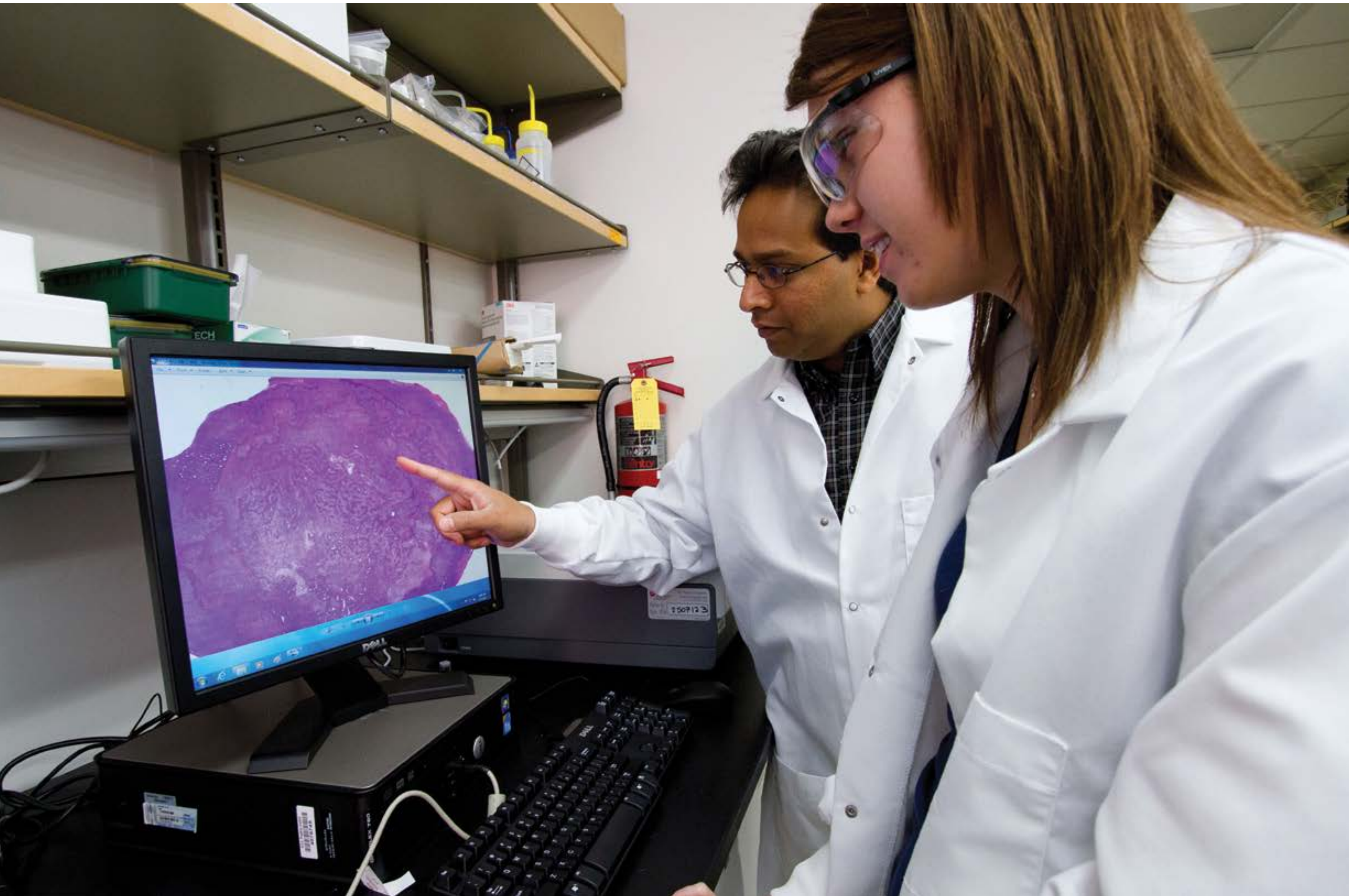
"Elucidation and modulation of chemotactic signaling after brain injury"
$504,909

2013-14 Vikram Kodibagkar

"Quantitative Imaging of Tissue Oxygenation"
$440,000

2011-2012 David Frakes

"Imaging-Driven Fluid Dynamic Engineering of Modified Biomedical Systems"
$429,474



Mo Ebrahimkhani

Assistant Professor
MD, Tehran University of Medical Sciences (2005)

Expertise: Engineering human liver organoids, Tissue regeneration, Integrated tissue response to injury, Human physiome on a chip, Emergent behaviors in complex biological systems

Samira Kiani

Assistant Professor
MD, Tehran University of Medical Sciences (2007)

Expertise: Synthetic biology, Genome Engineering, Cell-based Therapies, CRISPR technology, TALE technology, Genetic Devices and Layered Circuits, Engineering Mammalian Cell-Cell Communications, Exosomes, Secreted Proteins-based engineering

Michael Van Auker

Lecturer
J.D. Santa Clara University School of Law (2012) and
Ph.D. University of Pittsburgh (1997)

Expertise: Cardiovascular mechanics, prosthetic heart valves, targeted drug delivery systems

Student Awards

ASU graduate student Fuqing Wu (left) has received a predoctoral fellowship from the American Heart Association for his work in developing a process to study changes in stem cells used as a therapy for heart attack patients.

Graduate student wins fellowship to study changes in therapeutic use of stem cells for heart attack patients

Wu has received a predoctoral fellowship from the American Heart Association.

The two-year award will support Fuqing Wu's research in the lab of Xiao Wang, assistant professor of biomedical engineering. The funded research aims to use synthetic biological approaches to engineer gene networks regulating stem cell differentiation, which could eventually help promote regenerative therapies for damaged heart muscle.

During a heart attack the heart loses significant numbers of cardiac muscle cells that the body is unable to replace on its own. Synthetic biology researchers are developing a promising technique of introducing stem cells into the affected area that would change or differentiate into the needed muscle cells. Wu says that while the technique has potential, successful stem cell therapies require accurate and quantitative understanding of the cell differentiation process.

Cell differentiation is a common biological process in which a cell changes from one type to another, but researchers are still attempting to understand the process.

Wu's research is developing a gene network that can regulate and control this differentiation process. The network also gives Wu the ability to test variables and modulate the system in the living cells of Escherichia coli. The platform allows Wu to develop mathematical modeling to better understand the fundamental mechanisms of the cell differentiation.

The results of the work will be a new way to quantitatively and experimentally probe the conditions of the cell differentiations in the system. Practical application will help future researchers better understand the process and, ultimately, better target therapeutic interventions.

"It is a prestigious award and I am very excited about it," Wu said. "I have been working on this project for two years, and I am finally getting results to demonstrate this idea works. This award gives me more confidence to continue the project and prepare for my future career."

Wu earned his master's degree from the Wuhan Institute of Virology, Chinese Academy of Sciences in Wuhan, China. He came to ASU — and Wang's lab — in 2012 because of its reputation for interdisciplinary work, including in the emerging field of synthetic biology.

He is working toward operating his own lab in the future and is expected to graduate with a doctoral degree in 2017.

Nitish Peela (left) working alongside Assistant Professor Mehdi Nikkhah in the Nikkhah Lab. Their research focuses on creating 3D breast tumor models on a chip.

Undergraduate earns poster award at cancer research conference

Peela highlights development of physiologically relevant 3D tumor model.

Nitish Peela, a sophomore studying biomedical engineering, received a top 10 award for his poster presentation at the American Association for Cancer Research (AACR) Annual Meeting in Philadelphia, Pennsylvania.

Held in April 2015, the conference brought together researchers from all over the world to discuss and highlight the latest and most exciting discoveries in areas of cancer research — including treatments, diagnostics and prevention.

Peela's presentation was entitled "Breast Cancer Cell Invasion in a Highly Organized Three-Dimensional (3D) Tumor Model."

It highlighted a portion of the research he conducts in Assistant Professor Mehdi Nikkhah's lab as an undergraduate researcher.

"[In the Nikkhah Lab] we're creating a physiologically relevant 3D breast tumor model on a chip," said Peela.

"This enables us to conduct accurate controlled studies on cancer invasion and develop causal relationships between microenvironmental cues and cancer cell behavior," he added.

Another benefit of the research is its potential to reduce the necessity of animal models in cancer research.

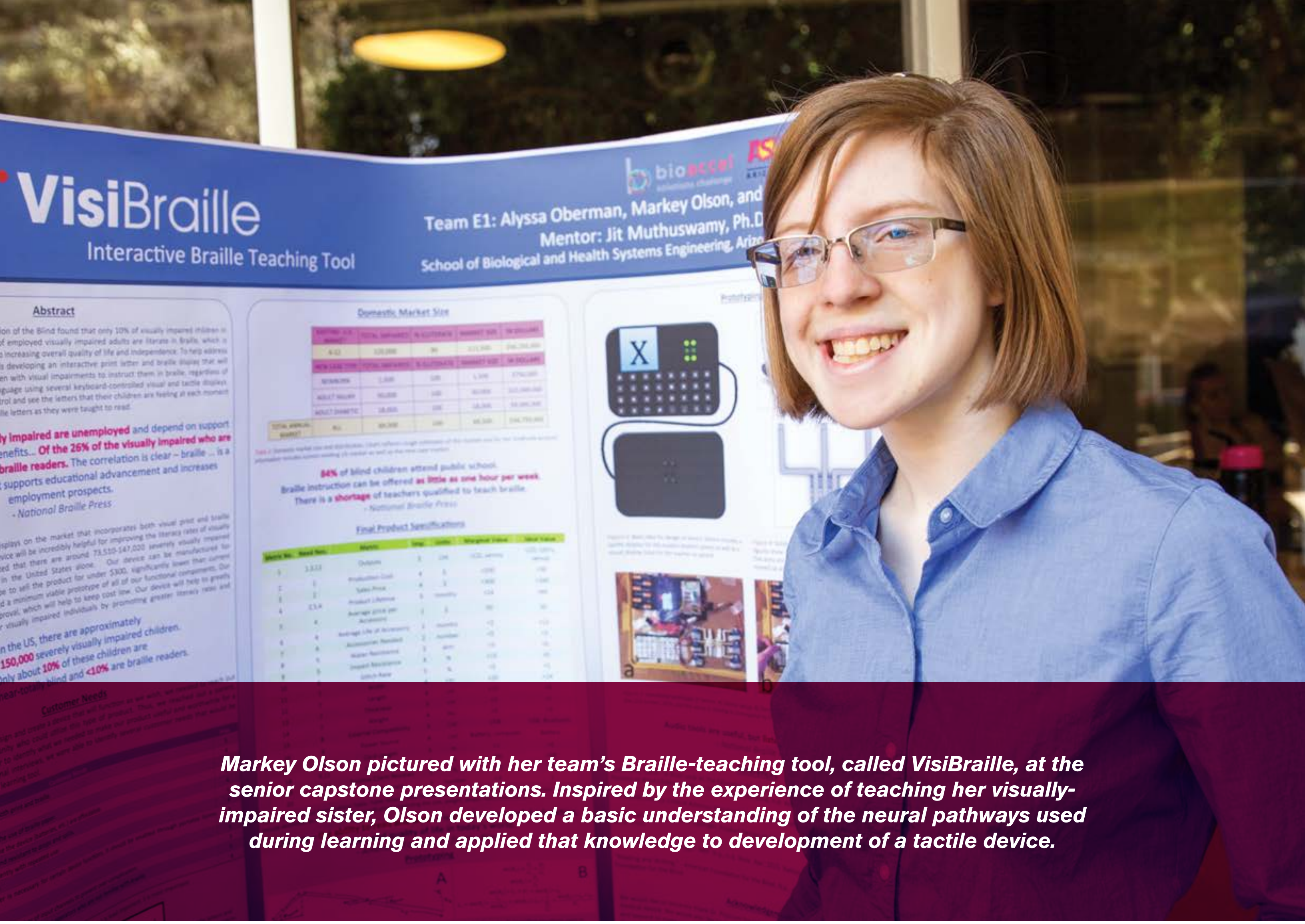
"Peela takes an active role in designing and independently conducting experiments and gathering biological data relevant to his project," said Nikkhah. "He is eager to assist his colleagues in bringing their projects to fruition and he is a great contributor in lab meetings," he added.

Peela's research is supported by the Fulton Undergraduate Research Initiative (FURI), a competitive program that supports funded undergraduate student participation in research under the mentorship of ASU engineering faculty members. In addition to offering a research stipend, FURI fully funded Peela's travel costs and conference fees.

"From FURI I received valuable insight, motivation and funding to complete my research project," said Peela.

Peela said what he most enjoyed about the conference was its focus on implementing research in clinical settings.

"It was inspiring to see scientists focus on translating research to a clinical setting in order to bridge the gap between cancer research and viable treatment options for cancer patients," said Peela.



Markey Olson pictured with her team's Braille-teaching tool, called VisiBraille, at the senior capstone presentations. Inspired by the experience of teaching her visually-impaired sister, Olson developed a basic understanding of the neural pathways used during learning and applied that knowledge to development of a tactile device.

Grand Challenge Scholar takes on big problems, starts business venture

Olson's focus on neural connections aids efforts to help others.

Reverse-engineering the brain was continually on Markey Olson's mind as she engaged in research, community service and entrepreneurial efforts as part of ASU's Grand Challenge Scholars Program (GCSP).

In 2008, the National Academy of Engineering (NAE) identified reverse-engineering the brain as one of 14 "Grand Challenges for Engineering in the 21st Century."

The Ira A. Fulton Schools of Engineering is among 20 leading engineering schools to establish an undergraduate program guided by the NAE's Grand Challenges. GCSP now serves as the Fulton Schools of Engineering Scholar Academy, an individualized program for high-achieving engineering students.

In spring 2015, Olson became the GCSP's second graduate, receiving a bachelor's degree in biomedical engineering. That made her the first to graduate from the inaugural group of freshmen students invited into GCSP.

"As a Grand Challenge Scholar I participated in a variety of experiential learning opportunities generally not afforded to an undergraduate student," Olson said.

Five program components that each student must complete provide the variety: conducting research related to each student's chosen Grand Challenge; exploring interdisciplinary coursework; gaining an international perspective; engaging in entrepreneurship; and giving back to the community through service learning.

"Students completing the program become well-rounded engineers who not only have technical expertise, but also an interdisciplinary perspective and social consciousness that prepares them to work on global problems that impact society," said Amy Trowbridge, GCSP program director and lecturer in the Fulton Schools.

Brain function research

Olson decided to focus on reverse-engineering the brain because the brain is critical to a multitude of bodily functions.

"By reverse-engineering the mechanisms that help our brains operate properly, engineers can help treat a wide variety of disabilities in a range of ways," she said.

Since her sophomore year, Olson has been conducting research in neural connections to help develop ways of providing tactile feedback to users of prosthetics.

“A non-amputee is able to use tactile feedback to grasp and discriminate between objects without visual cues, but prosthetic users are often unable to accomplish tasks that involve grasping and identifying while they are looking at something else,” she explained.

Olson’s research aims to solve this problem by using sensory cues as opposed to visual cues.

“I have been working to better understand the neural connections that help people orient their grasp relative to object size in hope of creating a prosthetic hand capable of providing haptic cues that can simulate tactile feedback,” Olson said.

Interdisciplinary, global-minded coursework

To meet GSCP’s interdisciplinary and global dimension components, Olson completed a variety of relevant coursework. In a class on complex legal and societal issues related to the field of genetics, Olson brought her biomedical engineering background to a classroom composed of students in law, medical and physical sciences programs.

“This ensured that we approached the issues from a variety of angles, including policy considerations, scientific limitations, moral and human rights concerns, and even insurance coverage implications,” Olson said.

Interdisciplinary coursework taught Olson that engineers cannot solve the world’s problems on their own.

“Engineers, like all professionals, need to communicate with the public and with people in other disciplines to learn from different vantage points,” said Olson.

In addition, Olson met GCSP’s global dimension component by taking classes related to global health and worldwide issues in science and technology.

Olson’s main takeaway from those classes was the realization that research and product development efforts must take into account the effects a product can have across a range of cultures, political climates and ideological beliefs.

Service-learning through EPICS

ASU’s Engineering Projects in Community Service (EPICS) program helped Olson to complete the GCSP’s service-learning requirement. During her freshman year she worked with a local warehouse operation that ships used medical equipment from hospitals and medical centers in the United States to countries without adequate medical supplies.

During her last three semesters, she joined a team called Project Maji, which was developing a product to treat water for the Nyagoma School for the Deaf in Bondo, Kenya.

Unfortunately, the project failed to produce a successful prototype due to a lack of communication between the Project Maji students and the school in Kenya, which lacked access to modern communications technology.

Despite the difficulties, Olson credits her EPICS experience with helping her develop a level of leadership, product design and presentation skills that she would likely not have obtained in a traditional classroom setting.

Recently, those skills have proved invaluable as Olson works on her own entrepreneurial venture.

Venture for the visually impaired

Classes on topics related to entrepreneurship and her biomedical engineering capstone course enabled Olson and two other biomedical engineering seniors, Alyssa Oberman and Robert Valenza, to turn their senior capstone project into a startup company called VisiBraille.

“VisiBraille is a Braille-teaching tool that allows parents and teachers, who may not know Braille themselves, to teach Braille to visually impaired students,” Olson said.

The idea developed as she taught Braille to her visually impaired sister.

Although the tool is designed to facilitate learning, Olson relates it to her chosen Grand Challenge because “it’s essential to first understand the neural mechanisms at play,” she said.

“To create this device we had to develop a basic understanding of the neural pathways that are active during learning, and while reading Braille. Then we studied what educational methods can be used to stimulate these pathways,” she explained.

The venture team is now at work on the manufacturing and distribution systems needed to get the VisiBraille device into the marketplace.

Olson said her work in the Grand Challenge Scholars Program has equipped her to contribute to solving some of society’s most critical problems.

She plans to continue work toward the solutions through her startup venture and by beginning a doctoral program in biomedical engineering at ASU.

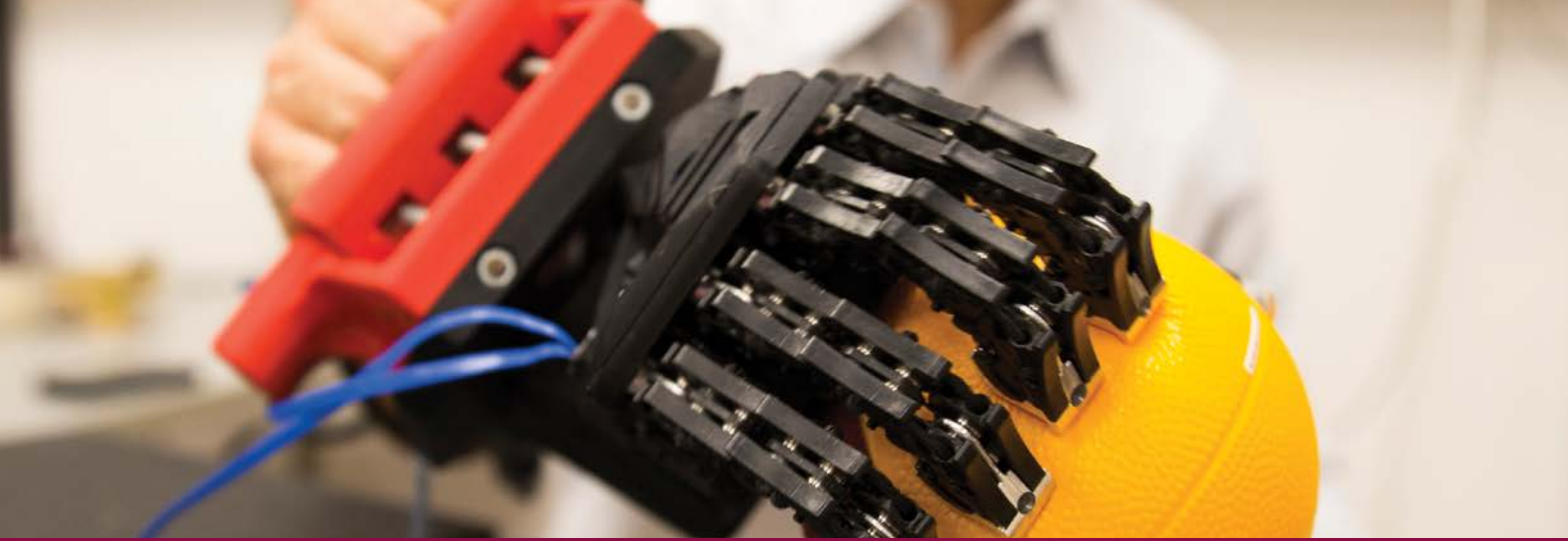
Student Organizations

Biomedical Engineering Society Chapter selected Fulton Schools of Engineering Chapter of the Year

The Biomedical Engineering Society (BMES) took home the title of 2014-2015 Outstanding Fulton Student Organization at the annual Student Organization Awards and Recognition (SOAR) ceremony. BMES is a professional, educational and social organization that aims to build and support the biomedical engineering community here at ASU, as well as help members achieve their goals by building connections and experiences.

In addition to the help they provide for their members, BMES continuously gives back to their community, both inside and outside of ASU. BMES has participated in Night of the Open Door and DiscoverE Day. Members volunteered at the Fulton Schools Career Fair, FURI Symposium, EPICS Design Reviews, and many more Fulton events. The organization has also participated in events such as Project CURE, Pat's Run, and Walk to Cure Multiple Sclerosis.

The organization is heavily involved in outreach for ASU and the Fulton Schools. Last summer, they created a mentorship program for incoming freshmen. New students were paired with BMES upperclassmen in order to make their transition smoother. The club has begun reaching out to local high schools and giving interactive presentations in order to introduce students to biomedical engineering, the Fulton Schools and ASU.



Workshop helps to spark pursuit of rehabilitation robotics progress

Third annual event draws larger, more diverse participation.

Organizers of the first Rehabilitation Robotics Workshop at ASU in 2013 hoped it would generate at least enough interest to justify a second workshop two years later. Favorable reaction from many who attended the first event led to a change of plan. A second workshop was organized for the following year.

The events have resulted in participants forming research collaborations and teaming up to develop grant proposals, and to propose ideas for taking new directions for studies, research and technology development in the field, said neurophysiologist Marco Santello, professor and director of the School of Biological and Health Systems Engineering.

“We received overwhelmingly positive feedback from the people who came to speak and present, from both faculty and students,” said Santello.

The workshop is supported by a Virginia G. Piper Charitable Trust Health Solutions grant to the school.

After the third ASU Rehabilitation Robotics Workshop 2015, the workshop is expected to be an annual event for the foreseeable future.

The first two workshops attracted several leading experts in the booming field of applying robotic technologies to improving devices and systems for physical rehabilitation therapy.

ASU’s workshop explores the state-of-art robotics technologies being used in healthcare, the challenges in advancing rehabilitation robotics, and looks at a multitude of areas in science and engineering that are increasingly studying the potential of human-robot interaction.

“Rehabilitation robotics is drawing more people from various fields and different branches of engineering, including physiologists, physical therapists, medical clinicians and others,” Santello said. “So interest should be high enough that we can continue to do the workshop every year.”

For students, the event has offered a valuable opportunity. “They are able to meet and talk to leading experts, something they would rarely be able to do otherwise,” he said.

Robotics advances open life-enhancing possibilities

Improvements in robotics are being made at a steady pace, promising progress particularly in technologies to help restore human physical capabilities.

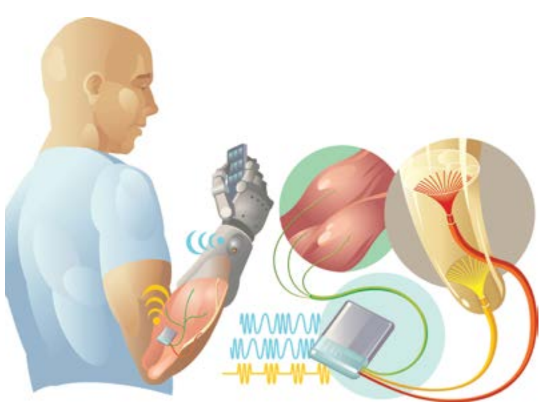
The topic was explored prior to the third annual Rehabilitation Robotics Workshop at Arizona State University, when SBHSE Associate Professor Bradley Greger and Polytechnic School Professor Thomas Sugar were interviewed on “Horizon,” the news and public affairs program on KAET-Channel 8, the PBS affiliate in the Phoenix metropolitan area.

They described how experts in a variety of engineering, science and medical fields are collaborating on research and technology development to make devices that are breaking ground in human-robotic interaction.

Greger and Sugar pointed to advances in sensors, microprocessors, batteries, biomechanical and neural interface systems, exoskeletons and other wearable robotics.

Together the improved technologies are enhancing physical therapy treatment, and expanding capabilities to restore motor functions and rehabilitate stroke victims, they said.

In coming years, they see robotics as primary components of systems that link the brain and nervous system to robotic prosthetics and other devices that could restore vision, sense of touch and other natural functions.



Recent biomedical engineering graduate Erica Engelschall is one of about 30 ASU graduate and undergraduate students who have worked with Assistant Professor Jeffrey La Belle to advance development of technology enabling the use of tear fluid samples to diagnose and monitor people's health.

Emerging technology would improve diagnosis, treatment of eye

Industry partnership provides student research opportunities in La Belle Lab.

Biomedical engineering researchers at ASU are working with an industry partner to advance technology enabling the use of tear fluid samples to diagnose and monitor people's health.

Advanced Tear Diagnostics, a medical products company based in Birmingham, Alabama, is providing funding and technical support for research led by Assistant Professor Jeffrey La Belle to improve and expand the use of tear fluid as a biomarker to detect various ocular (eye) disorders.

For the past few years, La Belle's lab has been refining a device that allows people living with diabetes to monitor their conditions by taking tear samples to measure their blood sugar (glucose) levels, rather than pricking through the skin to draw blood.

The project has led to research collaborations and funding support from Mayo Clinic in Arizona. A patent on the device was recently awarded to La Belle and co-inventor Daniel Bishop, who graduated from ASU in 2009 with a degree in biomedical engineering. Bishop is now co-founder and chief innovation officer of Qualaris Healthcare Solutions, a Pittsburgh-based medical product development company.

For the project with Advanced Tear Diagnostics, La Belle's lab team will be measuring concentrations of immunoglobulin E and lactoferrin in tear fluid. The measurements would help in the diagnosis and treatment of a variety of ocular surface disorders — particularly in detecting and differentiating between bacterial and viral infections, including one of the most common infections, conjunctivitis, also called pinkeye.

Measuring concentrations of immunoglobulin E can confirm the presence of an active ocular allergen, such as ocular conjunctivitis, while measuring lactoferrin can confirm aqueous deficiency (dry eye) and a suppression of the ocular immune system, La Belle said.

The team has been testing prototype biosensor devices for their accuracy in detecting biomarkers for eye infections.

In the next phase, extensive experiments will be conducted to test the reliability of the biochemical data the new technology provides. That project will rely on Mark Spano, a biomedical engineering research professor, and Jennifer Blain Christen, an assistant professor in the School of Electrical, Computing and Energy Engineering, to develop an interface and a meter for the sensors that La Belle's team is making to detect biomarkers in tear fluid.

Over the past several years, La Belle has had about 30 graduate and undergraduate engineering students assist in research for the tear fluid glucose meter project.

His team for the ocular diagnostic biomarker detection technology includes seven students, and he expects to give more students opportunities to contribute to the research and tech development as the project progresses.

Advanced Tear Diagnostics is providing support for the project and plans to commercialize the final product. But collaborative efforts with ASU researchers may not end at that point. La Belle said the company "is also very interested in developing more kinds of chemical analysis tests that would improve ophthalmic diagnosis, as well as other diagnostic biomarkers that show promise for use in general medicine."

Building Reliable Advances and

BRAIN

Innovations in Neurotechnology

An NSF Industry/University Cooperative Research Center (I/UCRC)

The School of Biological and Health Systems Engineering, one of the Ira A. Fulton Schools of Engineering at Arizona State University, and the Cullen College of Engineering at the University of Houston have been awarded an Industry/University Cooperative Research Center (I/UCRC) Planning Grant by the National Science Foundation (NSF). This is great news for neuroscience researchers, industry collaborators, and clinicians. This NSF I/UCRC will focus on neurotechnology and be called Building Reliable Advances and Innovations in Neurotechnology or BRAIN. The center will develop safe, effective and affordable personalized neurotechnologies for the restoration, enhancement and rehabilitation of sensory, motor, affective and cognitive functions.

BRAIN center members, which will include clinical, industrial and federal partners, will have expertise that spans single cells to systems using surgical and non-surgical approaches, and both human and non-human models. This partnership will allow rigorous testing of the efficacy, safety and long-term reliability of neurotechnology that would not be otherwise possible within the traditional 'silos' of academic, industry, regulatory and clinical communities.

Join us as an industry partner

Industry partners play a key role in the BRAIN center's mission. The center will support and facilitate industry/university collaborative projects on technology aimed at advancing national health and improving quality of life.

The value proposition to BRAIN industrial members:

1. Access to top faculty and resources to address fundamental research of common interest.
2. Invest in pilot studies for large collaborative federal/state grant proposals.
3. Get early access to potential top recruits.
4. Access to medical partners and liaisons with federal partners.
5. Early disclosure and right to first refusal (IP) for center members.
6. 90 percent of membership fees are invested in joint research; only 10 percent will be used for administration.

BRAIN's research focuses on diagnostic, assistive and therapeutical wearable biomedical devices, engineered biosensors, big data analytics and management, powered wearable prostheses and exoskeletons, peripheral and brain stimulation, neuromodulation, clinical trials and fundamental research on these topics.

Join us at ASU in March 2016

Please join us for the BRAIN I/UCRC Planning Grant meeting on March 10-11, 2016, at Old Main on the ASU Tempe campus — 400 E. Tyler Mall, Tempe, Arizona 85281.

Interested in becoming a BRAIN industrial partner?

In Arizona, contact Professor Marco Santello at Marco.Santello@asu.edu.

In Texas, contact Professor Jose L. Contreras-Vidal at jlcontreras-vidal@uh.edu.

Together, we will revolutionize the treatment of brain disorders.

engineering.asu.edu/brain

www.egr.uh.edu/brain

ASU IRA A. FULTON SCHOOLS OF engineering
ARIZONA STATE UNIVERSITY

UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING

ASU IRA A. FULTON SCHOOLS OF engineering
ARIZONA STATE UNIVERSITY

School of
Biological and
Health Systems Engineering

P.O. Box 879709 Tempe, AZ 85287-9709
sbhse.engineering.asu.edu

4th ASU Rehabilitation Robotics Workshop

For more information about this event go to
events.engineering.asu.edu/rehabrobotics

Supported by the Virginia G. Piper Charitable Trust
February 8-9, 2016 | Hosted by Arizona State University
Location: Memorial Union, Tempe campus, Arizona State University

The main theme of this workshop is rehabilitation robotics. However, the workshop will include a wide range of topics aimed at improving quality of life and covering the multidisciplinary field of robotics, including human robot interaction and human motor control. The main goals of the workshop are to discuss the state of the art in rehabilitation robotics and to identify the main challenges in this field.