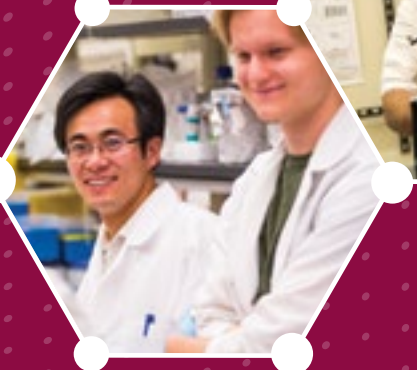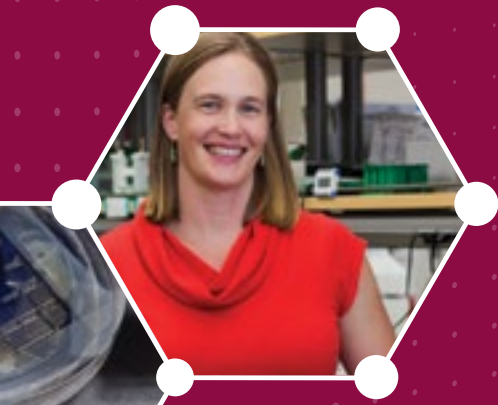School of **Biological and Health Systems Engineering**

Designing the future.
Improving the quality of human life.

2017 Report

ASU Ira A. Fulton Schools of **Engineering**
Arizona State University

ASU

Ira A. Fulton Schools of Engineering

Arizona State University

The Ira A. Fulton Schools of Engineering at Arizona State University offers **25 undergraduate programs and 41 graduate programs in its six schools:**

School of Biological and Health Systems Engineering	School of Computing, Informatics, and Decision Systems Engineering	School of Electrical, Computer and Energy Engineering	School for Engineering of Matter, Transport and Energy	School of Sustainable Engineering and the Built Environment	The Polytechnic School

In the U.S., **one** in **72** graduating undergraduate engineers is a **Sun Devil**

$104M Research expenditures FY2016-2017

19 NSF CAREER awardees in the last three years

#3 Licenses and Options
Behind only Purdue and Carnegie Mellon

#4 IP Disclosures
Behind only Carnegie Mellon, Caltech and Purdue

#4 Startups
Behind only Purdue, Carnegie Mellon and Stanford

Comparative data per $10 million in research expenditures, based on the Association of University Technology Managers annual report of top national engineering schools.

Lead institution on two and partner on two National Science Foundation Engineering Research Centers

QESST   CBBG Center for Bio-mediated & Bio-inspired Geotechnics   NEWT   FREEDM SYSTEMS CENTER

Lead institution on the Department of Homeland Security Center of Excellence

CAOE | CENTER FOR ACCELERATING OPERATIONAL EFFICIENCY
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

#1 in the U.S. for innovation

ASU ahead of Stanford and MIT

– U.S. News & World Report 2016, 2017, 2018 and 2019

BEST COLLEGES
U.S. News & WORLD REPORT
MOST INNOVATIVE
2019

Dear colleagues and supporters,

I am excited to share the 2017 Report for the School of Biological and Health Systems Engineering, within the Ira A. Fulton Schools of Engineering at Arizona State University.

This report will detail the next phase of our development — innovation and impact. It all sources from our belief that we must reflect the needs of the marketplace to be a truly effective partner. We are challenging the way we conduct research and deliver education by expanding our breadth and depth of expertise, taking direct feedback from our students and engaging deeply with industry and clinical partners.

The following pages are filled with examples of the people behind our school's innovation and impact. You will undoubtedly read about their honors, awards, publications and research grants, but also please pay attention to the ideas, discoveries and energy behind it all.

We have a strong desire to be more, discover more and impact more. We will never be satisfied with where we are. We are dedicated to improving the quality of life and health of our community and providing biomedical engineers who are problem solvers, innovators, leaders and entrepreneurs.

Please visit our website at sbhse.engineering.asu.edu or drop by for a visit to witness firsthand what makes our students and faculty unique.

Join us for some exciting discoveries,

Marco Santello, PhD

Director, School of Biological and Health Systems Engineering

SBHSE | School of **Biological** and **Health Systems Engineering**

Degrees granted
2016

DOCTORAL
8

MASTER'S
59

BACHELOR'S
146

TOTAL
213

41%
Undergraduate students in Barrett, The Honors College

44%
Female

Fall enrollment
2017

DOCTORAL
85

MASTER'S
75

BACHELOR'S
721

TOTAL
881

Research expenditures

	8,750,000
	7,000,000
	5,250,000
	3,500,000
	1,750,000

2014

2015

2016

2017

Key statistics

Contributors

Marco-Alexis **Chaira**

Monique **Clement**

Marc **Collins**

Cheman **Cuan**

Terry **Grant**

FJ **Gaylor**

Rhonda **Hitchcock-Mast**

Jessica **Hochreiter**

Joe **Kullman**

Charlie **Leight**

Elaine **Miller**

Rose **Serago**

Craig **Smith**

Erik **Wirtanen**

Pete **Zrioka**

Volunteer

Join us at E2, Homecoming and other events throughout the year. Reconnect with alumni, learn about new research initiatives and meet our outstanding students.

Awards

Casey **Ankeny**

ASEE Biomedical Engineering Division Teaching Award
This highly competitive award recognizes new faculty for excellence in BME education as evidenced by innovation in teaching materials, publications and commitment to ASEE.

Outstanding Lecturer

Received 1 of 4 Keen Professorship awards
Implementing the Entrepreneurial Mindset in an Introductory Biomedical Engineering Laboratory Course.

David **Brafman**

NIH R01 Award
Investigating the mechanisms of a multi-state model of Wnt signaling.

Arizona New Investigator Award from the Arizona Biomedical Research Commission

Chris **Buneo**

5-year NSF grant
Collaborative Research: Multimodal State Estimation through Neural Coherence in the Parieto-Frontal Network.

SBHSE Celebration of Excellence 2017 Metin Akay Graduate Service Award

Michael **Caplan**

Received 1 of 4 Keen Professorship awards
Development and Assessment of Curiosity, Connections and Creating Value Mindsets in BME282 and BME417.

SBHSE Celebration of Excellence 2017 Eric Guibeau Outstanding Teaching Award

Mo **Ebrahimkhani**

Practice Innovation – Mayo Accelerated Regenerative Medicine Award

Arizona New Investigator Award from the Arizona Biomedical Research Commission

David **Frakes**

Engineer of the Year Award for 2016 from IEEE Phoenix
Recognition of his contributions to Image Processing, Cardiovascular Fluid Dynamics and Machine Vision.

Arizona New Investigator Award from the Arizona Biomedical Research Commission

Tony **García**

SBHSE Celebration of Excellence 2017 William J. Dorsen Jr. Outstanding Research Award

NSF grant
Bridge to Doctorate: WAESO LSAMP, Self Efficacy and Academic Community for Underrepresented Minority Student Success, Multidisciplinary STEM Solutions 2017-2019

5-year NSF grant
Western Alliance to Expand Student Opportunities (WAESO) to Parity Capstone Operational, Research, Evaluation, Documentation and Institutionalization 10+ LSAMP Alliance.

Bradley **Greger**

U.S. Army Medical Research and Material Command (USAMRMC)/Medical Technology Enterprise Consortium (MTEC) Award

Karmella **Haynes**

Nature Partner Journal Genomic Medicine Article

SBHSE Celebration of Excellence 2017 Outstanding Assistant Professor Award

Samira **Kiani**

DARPA Young Faculty Award
Clustered Regularly Interspaced Short Palindromic Repeat (CRISPR)-Based Synthetic Gene Circuits as Next Generation Gene Therapy of Inner Ear.

Jeffrey **La Belle**

Keen Professorship Award

Troy **McDaniel**

2017 IEEE MultiMedia Best Department Article Award

Mehdi **Nikkhah**

NSF CAREER award
Cardiac Ischemia On-a-Chip: Probing Mechanisms Underlying Molecular, Cellular and Tissue-Level Adaptive Responses After Injury.

Young Investigator Award American Chemical Society (ACS), Division of Polymeric Materials Science and Engineering, 2017

Barbara **Smith**

Arizona New Investigator Award from the Arizona Biomedical Research Commission

NSF I-Corps grant: System of multimodal imaging and point-of-care biopsies.

Mark **Spano**

Office of Naval Research grant
Nonlinear dynamics of large electronic neuronal arrays.

Sarah **Stabenfeldt**

PLuS Alliance Fellow, Arizona State University

Emerging Investigator, Journal of Materials Chemistry B

Emerging Investigator, Biomaterials Science

Brent **Vernon**

NIH Small Business Innovation Research Award
Sustained release gel enabling one-stage treatment of prosthetic joint infection.

Sonoran Biosciences, company founded by Dr. Vernon and collaborators, awarded

Collaborative awards

Jamie **Tyler**, Jeff **Kleim** and Marco **Santello**

NSF BRAIN Industry/University Cooperative Research Center grant.

This 5-year grant will support a new center in neurotechnology, BRAIN (Building Reliable Advances and Innovations in Neurotechnology), aimed at building industry-university research collaborations.

Marco **Santello** and Rosalind **Sadleir** along with Mayo MN collaborators Drs. Kristin **Zhao** and Karen **Andrews**

Mayo-ASU Team Science seed grant: A multi-disciplinary approach to optimize integration of sensory feedback for prosthetic applications in persons with upper limb loss.

Tony Hu

Tony Hu, a biomedical engineering associate professor, is an expert in biomarker discovery, nanoengineering, biomaterials and analytical chemistry. The **director of the Precision Diagnostics Lab** applies his expertise in the development of nanotechnique-based strategies for disease marker discovery and molecular diagnostics for personalized medicine. Hu and his team aim to fill gaps in current real-time therapy monitoring, early detection and effective prognostics with their innovative solutions and interdisciplinary team.

Hu and his colleagues in the Biodesign Virginia G. Piper Center for Personalized Diagnostics recently published their research findings for a method of finding tiny bubbles of material called extracellular vesicles that can identify pancreatic cancer in its initial stages in the journal Nature: Biomedical Engineering. Pancreatic cancer, which kills about 40,000 people per year, has few symptoms, spreads quickly and typically isn't diagnosed until it's in an advanced stage — about 95 percent of

patients die within five years of diagnosis. It's difficult to diagnose a cancer with few to no symptoms, but Hu's approach uses a particular protein, EphA2, that is a telltale marker for pancreatic cancer tumors. Accurate methods of detection allow for early diagnosis and perhaps can lead to future screening exams that could save lives. The technique could also be generalized to detect other diseases and has already been proven by Hu's team to detect tuberculosis.

Tuberculosis has also been the subject of Hu's research to develop the first rapid blood test, called the NanoDisk-MS assay, to diagnose and quantitate the severity of already active tuberculosis cases. This effort — a collaboration between ASU's Biodesign Institute and seven other research groups, including the Houston Methodist Research Institute and scientists at the National Institutes of Health — has the potential to help treat the 10 million people affected by tuberculosis infections worldwide each year. ✿

Rosalind Sadleir

Rosalind Sadleir, an **assistant professor of biomedical engineering and director of the Neuro-Electricity Lab**, is an expert in neural engineering and neural rehabilitation whose research has been supported by the Defense Advanced Research Projects Agency and the National Institutes of Health.

One particular area of interest for Sadleir is noninvasive transcranial electrical stimulation, or tES. This technique uses electrodes placed on the scalp to direct a low current through the brain in an attempt to treat a variety of ailments and improve cognitive function and learning ability. Sadleir received a four-year, $2 million award from the NIH to gain a better understanding of this treatment process. She and her research team use an MRI-based technique called magnetic resonance electrical impedance tomography to measure where the currents spread during treatment. She also uses functional MRI, or fMRI, to see which parts of the brain are active based on whether blood is oxygenated or deoxygenated.

Sadleir's work to understand how the brain operates was published in the journal IEEE Transactions on Medical Imaging. The journal published Sadleir's paper that presents the first images of the electrical conductivity distribution generated inside the human brain using magnetic resonance electrical impedance tomography. Her team's findings may help improve the study of brain activity using electroencephalograms, or EEG. ✿

David Brafman

David Brafman, an **assistant professor of biomedical engineering and director of the Stem Cell Bioengineering Lab**, focuses his research on applying bioengineering approaches to the study of stem cell microenvironments for use in disease treatment. Brafman focuses on stem cell applications of neurological diseases, particularly Alzheimer's disease. He and his research team are developing methods to generate large quantities of cells for treatment studies.

Human pluripotent stem cells are often used in tissue and organ replacement, but an exciting application also lies in developing pharmacological interventions. Brafman's work that combines stem cell research and neurodegenerative disease treatment earned him a spot on a $5 million project from the U.S. Department of Defense's Advanced Regenerative Manufacturing Institute,

a collaboration with Massachusetts-based Biogen, Inc. and Ohio-based Trailhead Biosystems. He and the team are developing a biomanufacturing platform that will allow researchers to generate human neurons with hPSCs to develop and test drug treatments for Alzheimer's disease, Parkinson's disease and amyotrophic lateral sclerosis, or ALS.

Brafman's work with hPSCs also caught the attention of the National Institutes of Health, which awarded him to take discoveries related to hPSCs into a clinical setting to study and treat devastating neurological diseases.

He has also earned $1.5 million from the National Institutes of Health to study the mechanisms of early human neurodevelopment. Brafman credits the hard work, creativity and dedication of his lab's graduate students as crucial to securing these grants. ✿

Replicating heart attacks and tumors

Organ-on-a-chip simulates the biological activities of a specific organ, making them ideal for studying the organ's behaviors and for performing drug screening studies.

But Assistant Professor Mehdi Nikkhah is encouraged by the possibility of taking microengineered chip research in a different direction. Rather than creating a heart-on-a-chip to understand the function of the heart, what if researchers could create a heart attack-on-a-chip to better understand the disease that is a leading killer in the United States?

The National Science Foundation is excited by Nikkhah's vision and is supporting the effort with a CAREER Award that funds over the next five years. Currently, there is a significant shortage of available donor hearts relative to the demand for transplant surgery among heart attack patients, so developing a treatment or therapies that don't rely on donations would be valuable.

"Imagine what we can learn from a heart tissue model that lives outside of the body and is capable of replicating what the heart experiences during a heart attack," says Nikkhah, describing his vision for the microengineered chip. "If we can understand the biology better, then we can develop better therapeutic treatments."

Nikkhah also finds the education and outreach aspect of his work highly motivating, and it was well-detailed in his proposal. He worked for two years to define the outreach component of this research, which includes the creation of summer workshops for high school students — many of them from underrepresented groups — to come work in his lab.

"An important part of this research effort is the opportunity to educate young students on the biological fundamentals of heart diseases and how technologies can come to the rescue," says Nikkhah.

When not focusing on heart disease, Mehdi Nikkhah turns his attention to 3-D bio-mimetic modeling, which makes it quicker and easier to test new drugs and treatments than traditional animal research. Nikkhah is at the forefront of this research. He has developed a series of 3-D tumor models that replicate the way cancer behaves in the human body.

Traditional in-vivo modeling — research done on animals — requires the researcher to form tumors in the animals' bodies and study how the tumors grow, migrate and interact with healthy cells. However, it is difficult to control the micro-environment because there are so many confounding factors in living organisms the researcher cannot isolate single variables. And because of the physiological differences between human and animal bodies, research results are not always transferable to humans. To add to the difficulties, research using animal models is slow and expensive.

These factors have prompted ASU engineers to find new ways to develop tumor models in the lab and study cancer in a well-controlled experimental setting.

Conducting research with 3-D models is highly efficient because scientists can selectively isolate and control the variables of their experiments. Because the models are bio-engineered, these experiments also produce consistent results that are highly replicable. This means the results have greater reliability and are far more readily transferable from the lab to real-world applications.

"We can replicate these devices, so we can keep repeating the same experiment over and over in identical conditions. This means we can reproduce the results consistently," Nikkhah said.

3-D modeling also helps researchers better understand how cells and tissues form and function, as parts of whole living organs that are highly dynamic and variable in terms of their structure, mechanical properties and biochemical microenvironment.

"Now we can play around or change any factor we want. For example, we can change matrix stiffness, or we can incorporate just stromal cells such as fibroblasts along with cancer cells in our models, or fibroblasts plus cancer and immune cells," Nikkhah said. "And we can perform studies in a well-controlled experimental setting. We try to mimic what actually happens inside the human body."
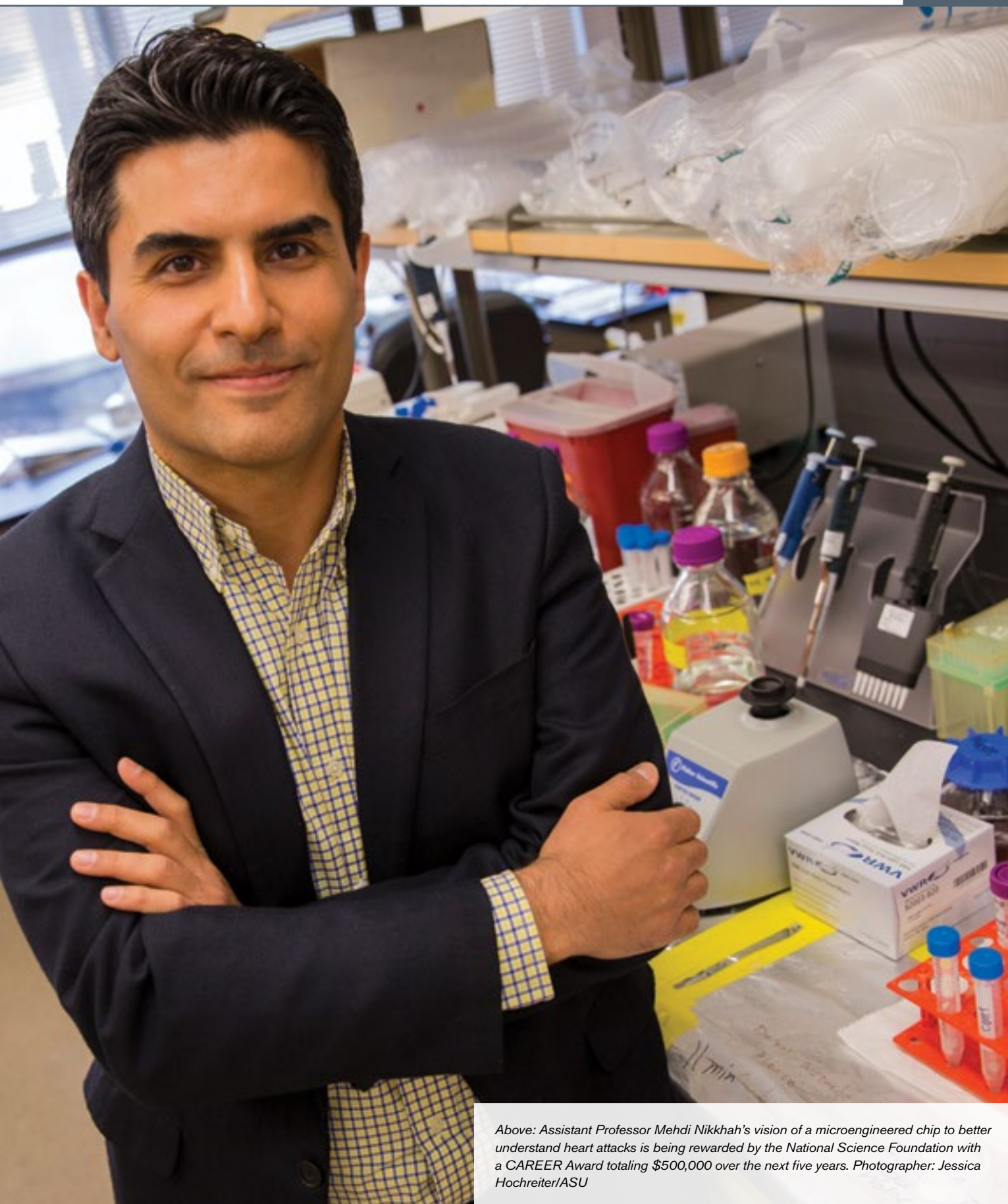
Above: Assistant Professor Mehdi Nikkhah's vision of a microengineered chip to better understand heart attacks is being rewarded by the National Science Foundation with a CAREER Award totaling $500,000 over the next five years. Photographer: Jessica Hochreiter/ASU

Engineering sight for people who are blind

Bradley Greger, an associate professor of biomedical engineering, is working with a California company to develop a brain implant that will help people who are blind to see.

Intended for use by people without a retina — the largest segment of the blind population — the device is expected to enable people who are blind to see light and shapes and, in a best-case scenario, allow them to read a large-print book.

Second Sight Medical Products makes a retinal prosthesis that is on the market in 12 countries. It works by converting images captured on a miniature video camera mounted on glasses into a series of small electrical pulses. The pulses are transmitted wirelessly to an electrode array implanted on the retina.

The pulses stimulate the retina's remaining cells, giving the perception of patterns of light. Patients learn to interpret the patterns, gaining some useful vision.

The implant Greger is working on is for people born without a retina, or whose retina was destroyed by cancer, trauma or glaucoma.

"I'm helping them take that technology to a cortical implant," Greger said. "Some people just don't have a retina. I'm taking their technology and expanding it so where we can go straight into the visual cortex of the brain and then get those people to see. It's a much larger segment of the blind population."
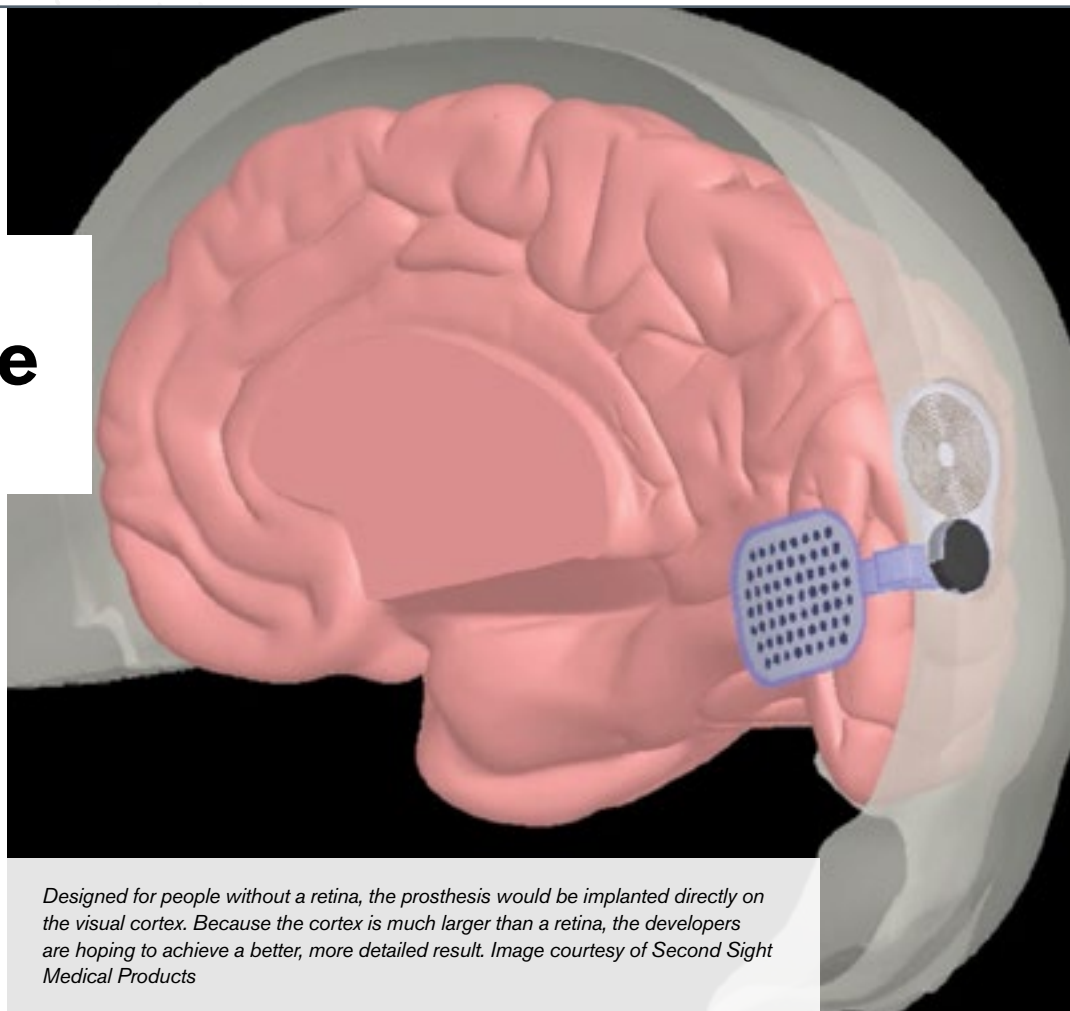
Designed for people without a retina, the prosthesis would be implanted directly on the visual cortex. Because the cortex is much larger than a retina, the developers are hoping to achieve a better, more detailed result. Image courtesy of Second Sight Medical Products

The cortex is much bigger than the retina, freeing up space to attach the implant. The retina is much smaller, and workspace, so to speak, is limited.

"That's one of the things we're helping to sort out," Greger said. "Can we really restore better vision by going into the cortex versus the retina? It's a larger target, so we can get more electrodes per visual angle. We're hoping to get a little bit better; maybe they could read a large-print book. That would be awesome if we could get that sort of thing."

Greger estimates Second Sight will push for a clinical trial in the next year or two. The company announced a successful trial implant in a 30-year-old patient in October, providing the first human proof of concept.

The patient was implanted with a wireless multichannel neurostimulation system called the Orion I on the visual cortex and was able to perceive and localize individual spots of light with no significant adverse side effects.

"It is rare that technological development offers such stirring possibilities," Dr. Robert Greenberg, chairman of the board of Second Sight, said in a press release. "By bypassing the optic nerve and directly stimulating the visual cortex, the Orion I has the potential to restore useful vision to patients completely blinded due to virtually any reason, including glaucoma, cancer, diabetic retinopathy or trauma. Today these individuals have no available therapy, and the Orion I offers hope, increasing independence and improving their quality of life." ✪

Marco Santello leads the BRAIN Center with research focused on neurological signals and predicts desired hand movements in real time. Photographer: Jessica Hochreiter/ASU

Collaboration for solutions to neural disease and injury

Neurological disorders like Parkinson's, the aftermath of stroke, limb loss and paralysis significantly diminish the length and quality of life — affecting about one in six people worldwide.

But a growing number of biomedical innovations, driven in large part by an aging population dealing with debilitating health issues, are improving both cognitive and motor function.

The National Science Foundation Industry/University Cooperative Research Center will focus on developing and testing new neuraltechnologies with the potential to dramatically enhance patient function across a wide range of diseases and injuries while both lowering costs and increasing accessibility.

The Building Reliable Advances and Innovation in Neurotechnology Center, better known as the BRAIN Center, is led by researchers from Arizona State University and the University of Houston who work with industry partners to speed technologies to market. The BRAIN Center aims to develop safe, effective and affordable personalized neurotechnologies for diagnostics, restoration, enhancement and rehabilitation of sensory, motor, affective and cognitive functions.

"The BRAIN Center is a way to bring together top faculty at both institutions to address critical challenges in the biomedical field," says Jose Luis Contreras-Vidal, professor of electrical and computer engineering at the University of Houston. "The best way to do that is working with industry."

Marco Santello, director of the School of Biological and Health Systems Engineering, leads the project, which involves more than 50 researchers from both institutions, along with 14 members from industry, including several hospital systems. The researchers come from a wide range of disciplines, from engineering and law to data science and physiology.

"Medical advances have dramatically increased life expectancy in the 21st century," says Santello. "The BRAIN Center will enable us to develop safe, reliable neurotechnologies to address the rise in chronic, degenerative diseases associated with an aging population."

The BRAIN Center was launched with a $1.5 million grant from the National Science Foundation, shared equally by the universities; industry collaborators pay $50,000 a year to partner with faculty, using university laboratories to co-develop and validate new technologies.

With dedicated space on both campuses, the center will host two meetings a year. Teams of faculty and industry members will present proposals for developing collaborative research projects. Research areas range from Big Data to neurorehabilitation and neuromodulation device development, to robotic-assisted therapy and regulatory science. ✺

Fighting diseases and disabilities by controlling cell fates
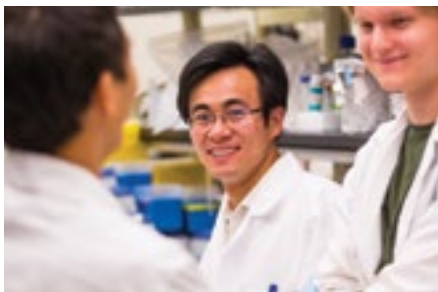
Biomedical engineering doctoral student Fuqing Wu conducted the experiments to test Xiao Wang's theories about the mechanisms of cell differentiation. Photographer: FJ Gaylor/ASU

Much of what happens inside the human body at its most basic biological level is determined by how its cells transition from one state to another.

In particular, stem cells — the primal cells common to all multicellular organisms— have the ability to divide and differentiate into a range of specialized kinds of cells that are essential to critical bodily systems and functions.

A thorough understanding of what controls the cell differentiation process would unlock secrets to "guiding" cell fates, and open up the potential for developing more and better cell-based medical therapies, says Xiao Wang, an associate professor of biomedical engineering and director of the Systems and Synthetic Biology Lab.

eLife journal editors write that the team has successfully charted how the environment in which cell fates are altered will change in the presence of various chemicals, and that cells' transitions can be guided by introducing certain chemicals into that landscape in specifically ordered sequences.

The upshot is that by changing the order in which mixtures of particular chemicals and protein molecules are introduced into the environment, one kind of cell can be manipulated into turning into other specific kinds of cells.

With the ability to do that, he envisions being able to someday control the mechanisms that determine cell fates for the purposes of treating infections and diseases, and repairing body tissues and organs. He sees potential uses for improving therapies and treatments for Alzheimer's disease, spinal injuries and even blindness. The most dramatic impact could be on reducing the need for transplants. ✿

Within earshot of something big

The Defense Advanced Research Projects Agency is a beacon for engineers and scientists yearning to take a bit of a walk on the wild side in their research pursuits.

DARPA describes its mission as being an enabler of endeavors to "expand the frontiers of technology and science" for the purpose of ensuring the country's defense tools remain the most sophisticated, effective and resilient.

Samira Kiani will employ her expertise in synthetic biology and gene therapy in trying to develop a safer, more controllable and effective way to restore hearing loss caused by traumatic injury.

Hearing loss due to the booming noises of explosions in combat zones has become a major health threat to troops, and the costs of treatment for the injured is a major economic drain on the U.S. Department of Veterans Affairs. She plans to experiment with the new gene-editing tool known as CRISPR — clustered regularly interspaced short palindromic repeats — to test her ideas for using the technology to manipulate genes in the inner ear.

"By controlling gene expression, specifically by increasing or decreasing the gene expressions that produce certain proteins, we hope to enhance the regeneration of certain cell pods within the ear that get damaged by trauma caused by explosions or other very loud noises," says Kiani, an assistant professor in the biomedical engineering program. ✿

Assistant Professor Samira Kiani will use support from her DARPA grant to integrate advanced technologies and treatment methods in efforts to improve treatment for hearing loss. Kiani (top, left) works in her lab with ASU biomedical engineering student Suyen Go (top, center) and biochemistry student Warner Kostes (top, right).

Boosting cognitive performance

A dramatic leap into a new dimension of human learning capability appears to be within reach through the promise of advances in neuroengineering.

"We're excited because we anticipate developing noninvasive methods of enhancing cognitive performance, motor performance and sensory performance that would make people a lot better at a lot of things," says Stephen Helms Tillery, associate professor of biomedical engineering.

Helms Tillery is the principal investigator for one of eight new multi-institutional research projects being coordinated under the Targeted Neuroplasticity Training program of DARPA. The ASU-led project — Transdermal Electrical Neuromodulation for Performance Optimization — is tasked with developing applied neurotechnologies for propelling expansion of human learning and performance abilities.

Neuromodulation is a process already used to regulate activity in the nervous system by controlling the physiological levels of several classes of neurotransmitters. Electrical stimulation or chemical agents are commonly used to stimulate nerve activity for therapeutic purposes.

Helms Tillery and his collaborators will employ that process in experimenting with arrays of electrodes placed in various configurations on the scalp. Electrical current will then be passed through the scalp to targeted neuromodulatory centers in the brain stem.

The goal is to activate specific parts of the brain in the hope of producing physiological changes that stimulate cognitive powers, heightening an individual's mental awareness and concentration.

The work focuses on applications for boosting the performance of troops involved in military operations, especially those deployed in combat environments. But the treatment could also be used to "improve performance in athletics, or even potentially academic
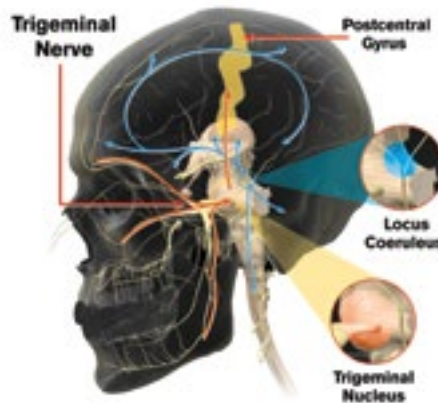

Researchers will develop methods to non-invasively stimulate a brainstem nucleus, the locus coeruleus, that is involved in arousal and attention.

performance or musical performance. This could benefit a broad swath of humanity," Helms Tillery says.

Associate Professor of Biological Engineering W. J. Tyler will seek to develop cranial nerve stimulation protocols that enhance the processing of sensory information in primary brain circuits, such as the visual cortex, auditory cortex and somatosensory cortex. His main focus will be on verifying tests of the new neuromodulation methods on humans.

Tyler will help to explore how learning can be improved by electrically regulating the level of neurochemicals such as norepinephrine and serotonin, using a technique called transdermal electrical neurostimulation. That will involve targeting different groups of nerves with pulsed electrical signals at specific times during learning activities.

Tyler is among the project's co-principal investigators along with Associate Professor Christopher Buneo, Associate Professor Vikram Kodibagkar and Assistant Professor Rosalind Sadleir. ⚙
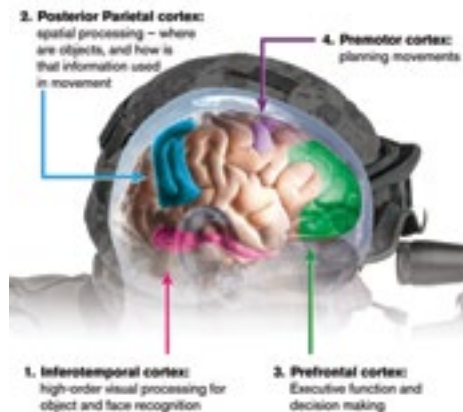
The project will focus on increasing the brain's capabilities by enabling more intense concentration, and enhancing neuroplasticity to expand an individual's ability to learn more quickly and thoroughly.

Tony García recognized for contributions to latina/o success

For 2017, the Victoria Foundation announced Tony García, associate director of the Hispanic Research Center and professor of bioengineering, as an Arizona Higher Education Award winner.

The Victoria Foundation, the first Latina/o community foundation in the United States, was established to promote the advancement and support of higher education among youth of socially and economically impoverished communities as well as underserved ethnic groups. The foundation seeks to increase access to higher education so these youth groups can pursue advanced degrees and make a positive difference for neighborhoods and communities throughout Arizona.

García also has received the Dr. William Yslas Velez Outstanding STEM in Higher Education Award. He has worked for 27 years on education and human resource projects aimed at improving math, science and engineering education in order to help meet the demand for a skilled and diverse U.S. technological workforce.

With colleagues in the School of Biological and Health Systems Engineering, Tony García has helped create curricular and laboratory experiences for first-year students in bioengineering aimed at enhancing problem-solving skills, fostering creativity in engineering design and expanding the context of engineering research, development and practice. ⚙

Stabenfeldt's research aimed at improving the diagnosis and treatment of traumatic brain injury "could saves the lives of thousands of patients," says fellow biomedical engineer Mehdi Nikkhah. Photographer: Cheman Cuan/ASU

Royal society of chemistry: Stabenfeldt's research impactful

Sarah Stabenfeldt is earning international recognition among her professional peers for research that promises to speed advances in regenerative medicine.

Stabenfeldt, an associate professor of biomedical engineering, published research papers in two Royal Society of Chemistry journals, Journal of Materials Chemistry B and Biomaterials Science.

The publications describe research by Stabenfeldt and her team of biomedical engineering graduate and undergraduate students to develop and evaluate biodegradable particles used to release small doses of therapeutic proteins to the brain over time. Such therapeutic methods, along with the techniques and tools used to implement them, hold out hope for better ways to diagnose and treat traumatic brain injury and other neurological injuries and traumas.

"All of her recognition indicates the significant impact of Sarah's work to develop next-generation diagnostics and therapeutics for neurological-related disorders such as traumatic brain injury," says colleague David Brafman, an assistant professor of biomedical engineering.

Stabenfeldt says being selected to publish in two of the society's journals highlighting emerging research leaders should boost opportunities for additional support for her projects and possibly generate invitations to present her work at medical science and bioengineering conferences. ✿

Above: ASU graduate and undergraduate students are getting valuable research experience in Associate Professor Sarah Stabenfeldt's lab. Her work on developing new and improved approaches to treating neural injury has been highlighted by a leading international science organization. Photographer: Jessica Hochreiter/ASU
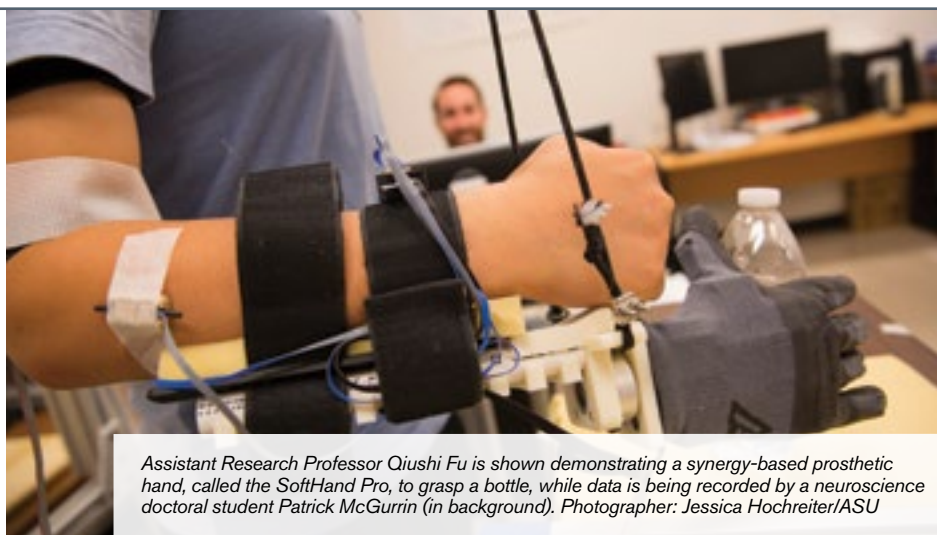
Assistant Research Professor Qiushi Fu is shown demonstrating a synergy-based prosthetic hand, called the SoftHand Pro, to grasp a bottle, while data is being recorded by a neuroscience doctoral student Patrick McGurrin (in background). Photographer: Jessica Hochreiter/ASU

Get a grip: new prosthetic hand technology

Prosthetics have advanced from the simplistic apparatuses of only several decades ago to today's complex interfaces of devices and biological systems that are designed to resemble missing body parts and replicate their functions.
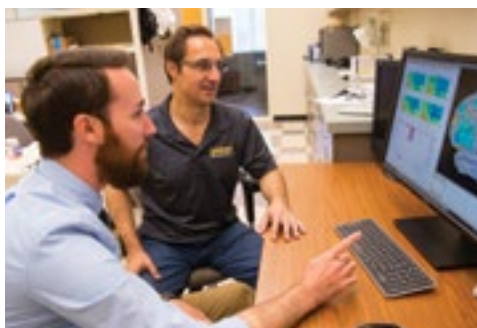
Professor Marco Santello and his research colleagues want to help break through the functionality barriers that still persistently burden people with artificial hands. Santello is the director of the School of Biological and Health Systems Engineering and a neurophysiologist who directs the Neural Control of Movement Laboratory.

Working with researchers at the Mayo Clinic, the Italian Institute of Technology and Florida International University, Santello and colleagues Qiushi Fu and James Abbas are applying some of the latest advances in bioengineering, robotics and brain-machine interface systems to development of prosthetic hands that enable users to feel sensations by which they can judge how much or how little force to exert in gripping, lifting, moving and holding particular objects.

With new technologies that directly connect with the body's nervous system, they hope to provide feedback by using mechanical or electrical stimuli that can send task-relevant information to the brain by exerting pressure on the skin or stimulating peripheral nerves. Such a feedback loop would give artificial hand users the critical information to enable performance of a wide range of normal daily living activities.

The challenge is to construct a seamless integration of the nervous system with a myoelectric prosthetic hand — one that is controlled by electrical signals generated naturally by one's muscles. The National Institutes of Health, ASU-Mayo Clinic Team Science Seed Grant and Defense Advanced Research Projects Agency are all funding sources for a variety of prosthetic-based research projects. ✪

Professor Marco Santello (at right), director of the Neural Control of Movement Laboratory at ASU, is leading research that aims to develop advanced prosthetic hands that function and feel like natural hands. He is pictured here with neuroscience doctoral student Patrick McGurrin, discussing brain activity data collected during performance of dexterous object manipulation tasks for prosthetic hands. Photographer: Jessica Hochreiter/ASU

Custom-built therapeutic proteins for cancer treatment

Recent findings from Assistant Professor of Biomedical Engineering Karmella Haynes may chart a new course in cancer treatment with the use of custom-built, therapeutic proteins.

Haynes is the principal investigator and David Nyer, a research technician, is the lead author. Biological design graduate students Rene Daer and Daniel Vargas and biomedical engineering alumna Caroline Hom are co-authors.

Two foundational discoveries from the broader research community paved the way for the team's research. When cancer cells propagate, they shut down anti-cancer genes by altering histones, a type of protein involved in chromosome packaging. Additionally, the discovery of histone-reading proteins with the ability to detect cancer markers aided the research.

"Using this information, we designed a custom-built protein that could attach to the modified histones and re-boot the activity of anti-cancer genes," says Haynes.

Haynes notes that the real interesting discovery was their protein could find its target genes even when the histone, which it attaches to, was far away from the beginning of the gene. This marks the first time anyone has designed a protein that controls genes by attaching to the specially-modified histones in cancer cells.

The research builds on decades of investigation into the molecules that make up human chromosomes, as well as work completed by Haynes at Harvard University. ✪

James **Abbas**
Associate Professor

PhD, Case Western University

Expertise: Neural engineering, rehabilitation, prostheses, biomimetic design

David **Brafman**
Assistant Professor

PhD, University of California, San Diego

Expertise: Pluripotent stem cells, neurodegenerative disease, developmental biology, regenerative medicine biomanufacturing, gene editing

Christopher **Buneo**
Associate Professor

PhD, University of Minnesota

Expertise: Neural engineering, neurorehabilitation, neurophysiology, sensorimotor control

Michael **Caplan**
Associate Professor

PhD, Massachusetts Institute of Technology

Expertise: Rational design of bioactive materials, local drug delivery, multivalent drug-targeting and cooperative bio-sensing

Jerry **Coursen**
Lecturer

PhD, University of Arizona

Expertise: Neuroscience, health care systems

Mo **Ebrahimkhani**
Assistant Professor

MD, Tehran University of Medical Science

Expertise: Synthetic biology and stem cell engineering, human organoids, regeneration and repair, genetic engineering

David **Frakes**
Associate Professor

PhD, Georgia Institute of Technology

Expertise: Image and video processing, cardiovascular fluid mechanics, computer vision, medical device design

Emma **Frow**
Assistant Professor

PhD, University of Cambridge

Expertise: Bioengineering, policy and society; governing emerging biotechnologies

Tony **García**
Professor

PhD, University of California, Berkeley

Expertise: Medical diagnostic devices, nanotechnology surface science

Bradley **Greger**
Associate Professor

PhD, Washington University, St. Louis

Expertise: Neural engineering, vision restoration, neuroprosthetics, epilepsy

Karmella **Haynes**
Assistant Professor

PhD, Washington University, St. Louis

Expertise: Synthetic and systems biology, programmable human cell development

Stephen **Helms Tillery**
Associate Professor and Fellow of the Lincoln Center for Applied Ethics

PhD, University of Minnesota

Expertise: Cortical neurophysiology, neural control of movement, neuroprosthetics, neuromodulation

Claire **Honeycutt**
Assistant Professor

PhD, Georgia Institute of Technology/ Emory School of Medicine, Atlanta

Expertise: Clinical neurophysiology, rehabilitation, motor control, biomechanics

Tony **Hu**
Associate Professor

PhD, University of Texas at Austin

Expertise: Biomaker discovery for personalized diagnosis, nonoengineering for biosensing and exosomal proteomics

* New faculty

Samira **Kiani**
Assistant Professor
MD, Tehran University of
Medical Science
*Expertise: Cas9/CRISPR system,
mammalian synthetic biology, genome
engineering, genetic circuits and sensors,
neuroengineering and safe CRISPR*

Jeff **Kleim**
Associate Professor
PhD, University of Illinois
*Expertise: Neural plasticity,
neurorehabilitation*

Vikram **Kodibagkar**
Associate Professor
PhD, Washington University, St. Louis
*Expertise: MRI probe and technique
development for cellular, molecular and
metabolic imaging*

Jeffrey **La Belle**
Assistant Professor
PhD, Arizona State University
*Expertise: Biosensors, point-of-care
technologies and sensing systems*

Thurmon **Lockhart**
Professor
PhD, Texas Tech University
*Expertise: Neural engineering, sensorimotor
deficits associated with aging and
neurological disorders from fall accidents*

Stephen **Massia**
Associate Professor
PhD, University of Texas, Austin
Expertise: Cell-material interactions

Troy **McDaniel**
Research Assistant Professor
PhD, Arizona State University
*Expertise: Haptics, ubiquitous computing,
human-centered computing and assistive/
rehabilitative technology*

Jit **Muthuswamy**
Associate Professor
PhD, Rensselaer Polytechnic Institute
*Expertise: Neural Interfaces,
neuromodulation, BioMEMS*

Mehdi **Nikkhah**
Assistant Professor
PhD, Virginia Tech
*Expertise: Micro and nanoscale
bioengineering, disease modeling, tissue
engineering, biomaterials, cancer, tumor
microenvironment models*

Vincent **Pizziconi**
Associate Professor
PhD, Arizona State University
*Expertise: Cell/tissue based regenerative
medicine combination products, space
bioinspired complex adaptive biosystems,
BME design innovation/regulation*

Christopher **Plaisier** *
Assistant Professor
PhD, University of California,
Los Angeles
*Expertise: Systems biology, transcriptional
regulatory networks, cancer, immunology*

Rosalind **Sadleir**
Assistant Professor
PhD, University of Western Australia
*Expertise: Neuroimaging and neural
activity detection, dynamic physiological
monitoring, computational modeling*

Marco **Santello**
Director and Professor
PhD, University of Birmingham,
Birmingham, UK
*Expertise: Neural control of
movement, sensorimotor
learning, neuromodulation,
neuroimaging, prosthetics*

Sydney **Schaefer**
Assistant Professor
PhD, Pennsylvania State
*Expertise: Motor control and
learning, cognitive neuroscience,
clinical neurorehabilitation*

Barbara **Smith**
Assistant Professor
PhD, Colorado State University,
Fort Collins
*Expertise: Imaging and biomarker
discovery, innovating
point-of-care diagnostics*

Sarah **Stabenfeldt**
Associate Professor
PhD, Georgia Institute of Technology
*Expertise: Regenerative medicine,
targeted theranostics, neurotrauma*

Xiaojun **Tian** *
Assistant Professor
PhD, Nanjing University, China
*Expertise: Quantitative systems biology,
computational biology*

William "Jamie" **Tyler**
Associate Professor
PhD, University of Alabama
at Birmingham
*Expertise: Neurotechnology development,
neuromodulation, brain plasticity,
performance enhancement*

Michael **VanAuker**
Lecturer
PhD, University of Pittsburgh
*Expertise: Cardiovascular mechanics,
prosthetic heart valves, targeted drug
delivery systems*

Brent **Vernon**
Associate Professor
PhD, University of Utah
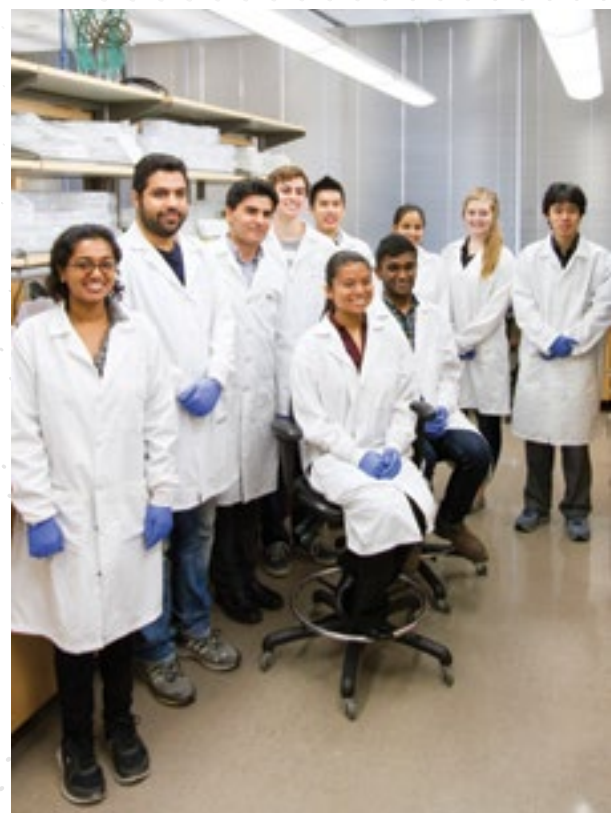*Expertise: Biomaterials, drug delivery,
tissue engineering*

Xiao **Wang**
Associate Professor
PhD, University of North Carolina at
Chapel Hill
Expertise: Synthetic and systems biology

* New faculty

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Biosensors and bioinstrumentation

Diagnostic tools to monitor human health and the environment, microactuators and microsensors for drug delivery systems

Our biosensing and bioinstrumentation faculty focus their attention on research diagnostics for monitoring human and environmental health. They build microelectromechanical systems for better neural signal recording and drug delivery, and devices for interacting in real time with biological systems.

Personalized Molecular Diagnostics Laboratory

Director: Tony García

The Personalized Molecular Diagnostics Laboratory uses global technology to develop highly sensitive, yet low cost and robust diagnostic devices using nanotechnology. Special emphasis is given to tailor devices that can make public health systems in emerging nations more effective for infectious disease prevention. Recent advances have been featured in the Spanish, English and Portuguese media outlets, and are of interest to several Latin American countries.

Hu Lab

Director: Tony Y. Hu

Research in the Hu Lab is focused on developing and validating the integrated nanotechnique-based strategies to perform marker discovery and molecular diagnostics from peripheral blood, and to provide a translatable solution for personalized medicine. Our innovations aim to fill the current diagnostic gap on real-time therapeutic monitoring, early detection and effective prognostics. Dr. Hu has brought a diverse background that combines biochemistry, mass spectrometry, nanofabrication and biomedical engineering to the team. In our research group, a multidisciplinary team has been assembled to accomplish the tasks, with wide ranging and extensive experience in nanosensing, high-throughput peptidomic analysis, and medical bioinformatics and statistical analysts.

La Belle Laboratory

Director: Jeffrey La Belle

The La Belle Laboratory is developing point-of-care medical technologies that enable more accurate detection, monitoring and management of a variety of diseases. The research is use-inspired, with the ultimate goal being to help make rapid advances in health care, through innovations that can be brought to market today.

Locomotion Lab

Director: Thurmon Lockhart

Locomotion Lab focuses on understanding the fundamental mechanisms associated with movement disorders leading to fall accidents using a combination of experimental and computational biomechanical and biodynamical techniques to reduce falls and improve human health.

Neural Microsystems Laboratory

Director: Jit Muthuswamy

The primary focus of the Neural Microsystems Laboratory is to understand the molecular and cellular mechanisms of neuronal plasticity that will naturally enable development of ways to achieve greater functional recovery through neuronal repair and plasticity, specifically the molecular interactions between the neurons and extra-cellular matrix/substrate, and the role of specific intracellular proteins in the development of spontaneous electrical activity and subsequent synaptic function in single neurons. Using in vitro primary neuronal culture models and in vivo rodent models and innovative microtechnologies developed in our lab, the goal is to understand the mechanisms of structural and functional plasticity.

Laboratory of BioInspired Complex Adaptive Systems

Director: Vincent Pizziconi

The Laboratory of BioInspired Complex Adaptive Systems seeks to understand the biodesign heuristics of integrative bionanosystems that can lead to the design and development of bioinspired advanced diagnostic and therapeutic components, devices and systems.

Bioimaging

Magnetic resonance imaging and spectroscopy, optical imaging, image processing and enhancement

Our imaging faculty work on developing new imaging techniques and contrast agents that target specific pathologies, creating translational imaging technologies, and using novel MRI phase mapping methods to measure tissue electrical properties. They collaborate closely with local medical centers across Phoenix, the Magnetic Resonance Research Center at ASU, and the Keller Center for Imaging Innovation at Barrow Neurological Institute.

The Smith Lab

Director: Barbara Smith

The Smith Laboratory focuses on engineering solutions to better diagnose problems associated with women's health and mental illness. Ongoing research in the lab utilizes imaging technologies and olfactory sensing to forge an entirely new path towards early stage detection and diagnostic monitoring. The overarching goal is to translate technologies developed in the lab for improved patient outcomes.

Image Processing Applications Laboratory

Director: David Frakes

The Image Processing Applications Laboratory (IPALab) addresses current and important image processing problems in a variety of different fields. Ongoing research at IPALab includes projects that are biomedical, industrial and military in nature. The ultimate goal is to improve human quality of life through the development and use of advanced image processing technologies.

Prognostic Biomedical Engineering Laboratory

Director: Vikram Kodibagkar

The Prognostic Biomedical Engineering (ProBE) Laboratory focuses on engineering solutions for prognostic imaging of the tissue microenvironment in the diseased state. Current research involves development of techniques for fast magnetic resonance imaging of tissue hypoxia and metabolites, engineering novel MRI and optical imaging probes, and theranostics. The group works on all aspects of MRI: physics of the acquisition, hardware development, sequence development, in vivo studies, image reconstruction and processing. Current disease states under study include cancer and traumatic brain injury. The group's emphasis is on noninvasively obtaining prognostic information early, in response to disease and treatment.

Neuro-electricity Lab

Director: Rosalind Sadleir

Research in the Neuro-electricity Lab is concerned with modeling and imaging biological conditions using targeted electrical methods. Work in the lab varies from the very practical (including device design and commercial development) to the conceptual and theoretical.

Molecular, cellular and tissue engineering

Biomaterials, molecular and cell therapies, drug delivery

Our molecular, cellular and tissue engineering faculty focus on novel biomaterials for rebuilding damaged tissue, molecular and cellular therapies, and localized drug delivery systems for hard-to-treat cancers.

Stem Cell Bioengineering Lab

Director: David Brafman

The Stem Cell Bioengineering Lab utilizes human pluripotent stem cells (hPSCs) to address fundamental questions about human development, model and study disease, and develop methods for cell-based therapies. To that end, they have developed an interdisciplinary approach that combines various aspects of developmental biology, genetic engineering, biomaterials science and bioinformatics to investigate the chemical, biological and physical stimuli that govern stem cell fate.

BioActive Materials Laboratory

Director: Michael Caplan

Caplan's lab applies engineering mathematics to understand and engineer solutions for problems related to biomaterials and drug delivery. One ongoing study, in collaboration with Dr. Alex McLaren at Banner Health, seeks to understand and control where antimicrobials mixed into bone cement go when the cement is placed in an orthopaedic wound to fight infection. Another study seeks to understand and control endothelial response to the material used to construct medical devices (such as stents or vascular grafts) and other aspects of the cell's microenvironment. A third study seeks to develop multivalent (more than one binding site) molecular probes for biosensing or drug targeting applications.

The Laboratory for Synthetic Biology and Regenerative Medicine

Director: Mo Ebrahimkhani

The Laboratory for Synthetic Biology and Regenerative Medicine studies principles of organ repair and regeneration and develops technologies to predict and modulate those processes with precision. The lab develops novel personalized human liver micro-physiological systems such as "liver bud organoids" through recapitulation of organogenetic processes and combines mouse models with systems and synthetic biology-based approaches to elucidate cellular interaction networks in tissue homeostasis, with an emphasis on regeneration-repair axis in the liver.

The Laboratory for Mammalian Synesthetic Biology and Therapeutic Gene Circuits

Director: Samira Kiani

The Laboratory for Mammalian Synesthetic Biology and Therapeutic Gene Circuits combines the promises of synthetic biology and the power of a novel genetic engineering tools, such as the Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) system, to develop innovative and next generation diagnostic and therapeutic platforms for regenerative medicine. One of the main focuses of the lab is to regenerate sensorineurons of inner ear (hair cells) through CRISPR-based gene therapies in inner ear.

Massia Laboratory

Director: Stephen Massia

Massia's laboratory focuses primarily on cell material interactions. The principles of cell biology, biochemistry, organic and inorganic chemistry are utilized to better understand the interaction of cells with synthetic materials, and to exploit this knowledge to enhance the compatibility of these materials with tissues that contact them. Current projects include developing nanofabrication methods to construct biomimetic scaffolds for tissue regeneration and replacement.

Nikkhah Laboratory

Director: Mehdi Nikkhah

Nikkhah Laboratory current research interests lie at the interface of micro/nanotechnology, advanced biomaterials and biology. Specifically, our research is centered on integration of advanced biomaterials, stem cells and micro- and nanoscale technologies to develop functional vascularized tissue substitutes. In addition, the lab is actively involved in the development of highly innovative microscale platform for cell-biomaterial interactions and cancer metastasis studies.

Laboratory of BioInspired Complex Adaptive Systems

Director: Vincent Pizziconi

Laboratory of BioInspired Complex Adaptive Systems seeks to understand the biodesign heuristics of integrative bionanosystems that can lead to the design and development of bioinspired advanced diagnostic and therapeutic components, devices and systems.

The Smith Lab

Director: Barbara Smith

The Smith Laboratory focuses on engineering solutions to better diagnose problems associated with women's health and mental illness. Ongoing research in the lab utilizes imaging technologies and olfactory sensing to forge an entirely new path towards early stage detection and diagnostic monitoring. The overarching goal is to translate technologies developed in the lab for improved patient outcomes.

Stabenfeldt Laboratory

Director: Sarah Stabenfeldt

The Stabenfeldt Laboratory specifically focuses on engineering novel targeted diagnostic and therapeutic ('theranostic') biomaterials for neural injury/disease and identifying endogenous neural stem cell homing mechanisms after injury, and incorporating such biosignals into tissue-engineered matrices.

Biomaterials Laboratory

Director: Brent Vernon

The Biomaterials Laboratory uses principles of polymer science and chemistry to design and develop in situ gelling materials for drug delivery, tissue engineering and tissue reconstruction.

Synthetic biology and systems bioengineering

Design of genetically encoded information and cell micro environments, advanced medical treatments, engineered gene networks, biological network modeling and biomaterials for multicellular systems

The field of synthetic and systems bioengineering is based on the premise that living systems are modular, and thus, able to be engineered. This idea has spurred a new movement that has made a substantial impact on molecular and cell biology. In regard to basic research, synthetic and systems biology takes inspiration from the philosophical reflections of Feynman, i.e., "what I cannot create, I do not understand." In SBHSE, we design genetically encoded information and cell micro environments to gain a deeper understanding of living things as well as to generate useful products, such as advanced medical treatments. Here, you will find research and coursework in engineered gene networks, policy and governance, biological network modeling, and biomaterials for multicellular systems.

Stem Cell Bioengineering Lab

Director: David Brafman

The Stem Cell Bioengineering lab utilizes human pluripotent stem cells (hPSCs) to address fundamental questions about human development, model and study disease, and develop methods for cell-based therapies. To that end, they have developed an interdisciplinary approach that combines various aspects of developmental biology, genetic engineering, biomaterials science and bioinformatics to investigate the chemical, biological and physical stimuli that govern stem cell fate.

Synthetic biology and systems bioengineering (continued)

Ebrahimkhani Lab for Synthetic Biology and Regenerative Medicine

Director: Mo Ebrahimkhani

The Laboratory for Synethetic Biology and Regenerative Medicine studies principles of organ repair and regeneration and develops technologies to predict and modulate those processes with precision. The lab develops novel personalized human liver micro-physiological systems such as "liver bud organoids" through recapitulation of organogenetic processes and combines mouse models with systems and synthetic biology-based approaches to elucidate cellular interaction networks in tissue homeostasis, with an emphasis on regeneration-repair axis in the liver.

Bioengineering, Policy and Society Lab

Director: Emma Frow

The Frow Laboratory in Bioengineering, Policy and Society uses qualitative social science research methods to study and influence the governance of emerging biotechnologies. Our work involves engaging with scientists performing cutting-edge research, potential users of new biotechnologies and policy actors shaping the governance landscape for bioengineering. Current research projects focus on design and automation in synthetic biology, the governance of experimental stem cell treatments and the future of engineering education.

Haynes Synthetic Biology Laboratory

Director: Karmella Haynes

The Haynes Synthetic Biology Laboratory uses synthetic systems and quantitative biology to engineer useful gene and protein-based biological devices and deepen our understanding of molecular cell biology. The ultimate goal of the laboratory is to accelerate the pace of therapeutic technologies through modular design.

Laboratory for Mammalian Synthetic Biology and Therapeutic Gene Circuits

Director: Samira Kiani

The Laboratory for Mammalian Synesthetic Biology and Therapeutic Gene Circuits combines the promises of synthetic biology and the power of a novel genetic engineering tools, such as the Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) system, to develop innovative and next generation diagnostic and therapeutic platforms for regenerative medicine. One of the main focuses of the lab is to regenerate sensorineurons of inner ear (hair cells) through CRISPR-based gene therapies in inner ear.

Laboratory of BioInspired Complex Adaptive Systems

Director: Vincent Pizziconi

Laboratory of BioInspired Complex Adaptive Systems seeks to understand the biodesign heuristics of integrative bionanosystems that can lead to the design and development of bioinspired advanced diagnostic and therapeutic components, devices and systems.

Plaisier Laboratory

Director: Christopher Plaisier

The Plaisier Laboratory uses omics-level snapshots of complex biological systems to inform computational models that: reveal biological underpinnings; describe the state space of biological systems; and allow the prediction of interventions that push the system towards beneficial states (for example non-cancerous or healthy). We focus on developing and applying experimental and computational approaches that when integrated together build predictive models of cancers derived from single tumor cells, whole heterogeneous tumors, and patient clinical data. These predictive models of tumors are then used gain insights into tumor biology and identify the best possible interventions for a given tumor, such as a drug or combination of drugs.

Tian Laboratory

Director: Xiaojun Tian

The Tian Laboratory combines multidisciplinary modeling and quantitative experimental approaches to elucidate the mechanisms of complex biological processes and complex diseases. Now the lab focuses on understanding 1) the underlying design principles of cellular phenotype transition and pathological phenotypes transition, 2) how do individual cells from multicellular organisms use multiple layers of regulation to achieve the cellular phenotypes maintenance and transition, 3) how do cells communicate with each other through paracrine and autocrine to establish complex pathological phenotypes in tissue level, and 4) optimal treatment designs for complex diseases.

Xiao Wang Laboratory

Director: Xiao Wang

Wang's laboratory seeks to understand and exploit the effects of nonlinear dynamics and stochasticity in engineered gene networks in microbes, and extrapolate this knowledge to the understanding of cell differentiation and development in higher organisms. The focus is on synthetic multistable gene networks, systems biology on small network motifs with feedback, the role of noise in cell differentiation and development and molecular evolution.

Neural/ rehabilitation engineering

Modeling and simulation of neural systems and their functions, signal processing, specialized technology for individuals with physical impairments, monitoring and treatment of nervous disorders, chaos in neural and cardiac systems

Our neural faculty work on modeling and simulation of neural systems to gain insight into neural function, neural signal acquisition and analysis, and the development of specialized technology to evaluate and treat individuals with neural and biomechanical pathologies.

Center for Adaptive Neural Systems

Director: James Abbas

The Center for Adaptive Neural Systems (ANS) seeks to design and develop technology to offset the effects of spinal cord injury, orthopedic injury, Parkinson's disease and cerebral palsy. Driven by the needs of potential users, the engineers and scientists at ANS utilize a wide variety of interdisciplinary research techniques and technologies to aid individuals whose lifestyles may be significantly affected or impaired by traumatic injury or neurological disease.

Visuomotor Learning

Director: Christopher Buneo

The Visuomotor Learning laboratory seeks to understand how the brain combines different forms of sensory and motor information to

help plan, execute and adapt movements ("sensorimotor integration"). Of particular interest is how uncertainty associated with movement planning and execution leads to variability in motor performance. The long-term goals of the lab are to improve and enhance human motor performance through the development of brain-centered training protocols and assistive technologies that interface directly with the nervous system.

Neural Engineering Laboratory

Director: Bradley Greger

The overarching goal of the lab is to utilize current neuroscientific understanding and neural engineering principles to translate clinical needs into devices which improve quality of care and patient outcomes. Electrophysiological recordings and electrical micro-stimulation are used to gain an understanding of how the nervous system processes information related to various sensory, motor and cognitive functions. The results of these experiments are then used to guide implementation of novel devices for the treatment of various neural pathologies. Neural prostheses for treating the profoundly blind or paralyzed are being developed. Additionally, the lab is undertaking electrophysiological research in human patients using penetrating and non-penetrating electrode arrays aimed at improving our understanding of epilepsy and improving the diagnostic tools available to clinicians.

Human Mobility Lab

Director: Claire Honeycutt

There are two major research thrusts of the Human Mobility Lab: fall prevention and enhancing arm function in individuals with neuological disease and injury. In fall prevention, we seek to understand what causes falls, identify those people most likely to fall and develop interventions to prevent falling. In enhancing arm function, we use robots, virtual reality systems and electromyography to evaluate motor planning both in unimpaired individuals and patient populations. We work with clinicians to enhance rehabilitation strategies at the hospital, clinic and home.

Imaging and Biomarker Discovery Laboratory

Director: Barbara Smith

Imaging and Biomarker Discovery Laboratory focuses on engineering solutions to better diagnose problems associated with women's health and mental illness. Ongoing research in the lab utilizes imaging technologies and olfactory sensing to forge an entirely new path towards early stage detection and diagnostic monitoring. The overarching goal is to translate technologies developed in the lab for improved patient outcomes.

Kleim Laboratory

Director: Jeffrey Kleim

The Kleim Lab studies how neural plasticity supports learning in the intact brain and "relearning" in the damaged or diseased brain. Research is directed at developing therapies that optimize plasticity in order to enhance recovery after stroke and Parkinson's disease.

Locomotion Lab

Director: Thurmon Lockhart

Locomotion Research Laboratory focuses on understanding the fundamental mechanisms associated with movement disorders leading to fall accidents using a combination of experimental and computational biomechanical and biodynamical techniques to reduce falls and improve human health.

Neural Microsystems Laboratory

Director: Jit Muthuswamy

The Neural Microsystems Laboratory seeks to more greatly understand brain function in order to design of technologies that would directly or indirectly restore functionality and lifestyle to patients with brain dysfunctions, disorders and injuries

Neuro-electricity Lab

Director: Rosalind Sadleir

Research in the neuro-electricity lab is concerned with modeling and imaging biological conditions using targeted electrical methods. Work in the lab varies from the very practical (including device design and commercial development) to the conceptual and theoretical.

Neural Control of Movement Laboratory

Director: Marco Santello

Work at the Neural Control of Movement laboratory focuses on the hand as a model to investigate the mechanisms underlying sensorimotor integration responsible for motor learning and control. The questions addressed by Santello's laboratory include the role of vision and tactile input for learning and controlling dexterous manipulation, neural mechanisms underlying the synergistic control of multiple hand muscles, and the effects of neurological disorders and neuropathies on neural control of the hand. This research has potential for improving the efficacy of rehabilitation of hand function following surgery as well as neuromuscular and neurodegenerative diseases such as stroke, dystonia and carpal tunnel syndrome.

Motor Rehabilitation and Learning Laboratory

Director: Sydney Schaefer

The Motor Rehabilitation and Learning Lab is focused on the principles and neural mechanisms of functional motor skill learning to better inform clinical neurorehabilitation. We are particularly interested in aging and how specific cognitive impairments do or do not interfere with older adults' ability to acquire upper extremity motor skill through experience. Our work incorporates neuropsychological, behavioral and neuroimaging approaches to studying the human nervous system.

Sensorimotor Research Group

Director: Stephen Helms Tillery

The Sensorimotor Research Group analyzes sensorimotor learning and representations in the nervous system, and neural mechanisms, which enable the brain to carry out fine motor skills. Within their research, the group duplicates the process, seeking to advance the ability to create more lifelike prosthetics that respond to brain signals.

Tyler Laboratory

Director: Jamie Tyler

The Tyler Laboratory focuses on developing neuromodulation devices and methods for enhancing human performance. An emphasis in the lab is aimed at better understanding the role of micromechanical forces in brain circuit function while developing technology for modulating or regulating these features to treat neurological and neuropsychiatric conditions, as well as to optimize healthy human functions like language learning, sensory processing, sensorimotor skill training, decision making and vigilance/attention.

Research and clinical partnerships

Industry and clinical partnerships tie our research endeavors to the needs of the communities we serve. Our strong network of partners — hospitals and health care organizations, both locally and globally — offers our students access to top physicians and researchers and hands-on experience in the field they may one day transform. Whether students choose to pursue medical school or join industry after graduation, this early exposure is invaluable.

MAYO CLINIC

PHOENIX CHILDREN'S Hospital

Medtronic

BARROW Neurological Institute

Dignity Health. St. Joseph's Hospital and Medical Center

stryker

THE CORE INSTITUTE

BD

Cactus Materials

tgen

Lundbeck

SYNTHEGO

qb robotics

MIHS MARICOPA INTEGRATED HEALTH SYSTEM

PROJECT HoneyBee

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John C. Lincoln HEALTH NETWORK
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ATD Advanced Tear Diagnostics

Sandia National Laboratories

GORE

Banner Sun Health Research Institute

Banner Health. Research Institute

Banner MD Anderson Cancer Center Making Cancer History®

ATi Anovas Technologies, Incorporated

SONORAN BIOSCIENCES

ARIZONA ARRHYTHMIA CONSULTANTS

PINNACLE TRANSPLANT TECHNOLOGIES

IML The Institute for Mobility and Longevity

Partner with us

Join the BRAIN Center and your membership will allow you to leverage research supported by federal grants and corporate members from other center-funded projects. You will also have direct access to the center's intellectual property, expert faculty, graduates, students and the infrastructure and capabilities within participating labs and universities.

Together, we will revolutionize the diagnosis and treatment of brain disorders.
brain.engineering.asu.edu

From left to right, Professors Jose L. Contreras-Vidal and Marco Santello pose for a photo with Deans Joseph W. Tedesco and Kyle Squires, of the University of Houston's Cullen College of Engineering and ASU's Ira A. Fulton Schools of Engineering. Santello and Contreras-Vidal lead the ASU and UH sites for the National Science Foundation-funded Building Reliable Advances and Innovations in Neurotechnology, or BRAIN.

BRAIN center gathers to ponder future

Millions around the world are affected by neurological and neurodegenerative diseases. In fact, a World Health Organization study found eight out of 10 disorders in the three highest disability classes are linked to neurological problems, a figure likely to increase as the global elderly population is expected to double by 2050.

Building Reliable Advances and Innovations in Neurotechnology, or BRAIN, is an Industry–University Cooperative Research Center dedicated to bringing new neurotechnologies and treatments to market. The center, a collaboration between ASU and University of Houston, was officially funded in early 2017 with a $1.5 million grant from the National Science Foundation and has already attracted nine industry partners. The Center includes more than 40 faculty members from ASU's Ira A. Fulton Schools of Engineering and UH's Cullen College of Engineering.

BRAIN held its first industry advisory board meeting in June 2017 on ASU's Tempe campus, bringing together stakeholders to begin charting the course of the collaboration.

"Neurodegenerative diseases are one of the biggest challenges society faces today," said Professor and Director of the School of Biological and Health Systems Engineering Marco Santello at the outset of the meeting. "An aim of the center is to not only develop new devices and strategies in the realm of neurotechnology, but validate existing ones as well."

The pair defined the center's five main research areas as neurological clinical research, mobility assessment and clinical intervention, invasive neurotechnology, noninvasive neurotechnology and neurorehabilitation technology.

The nine industry partners include companies such as Medtronic, the CORE Institute, Indus Instruments, Institute for Mobility and Longevity, 3SCAN, Methodist Hospital Research Institute and GOGOA Mobility, as well as medical institutions such as the Phoenix Children's Hospital and The Institute for Rehabilitation and Research Memorial Hermann Hospital.

Eric Maas, a Medtronic representative, said his company was drawn to the immense talent pool contained within BRAIN.

"This partnership not only benefits Medtronic, but the world," said Maas. "Big companies like ours like to go after big problems, but a center like this opens up paths to solve smaller, sometimes overlooked illnesses that deserve attention."

For Dr. David Adelson, director of Barrow Neurological Institute and chief of pediatric neurosurgery at Phoenix Children's Hospital, BRAIN has been a long time coming. Adelson has long since been an advocate for bringing cutting-edge research to clinical care, pushing for a center like BRAIN for some time.

"So much of medicine is focused on adults and not children, and so much of it is applicable to pediatric care," said Adelson, noting that traumatic brain injury is the leading cause of disability and death in children and adolescents in the U.S.

United with invested industry partners, the multifaceted, transdisciplinary research approach of ASU and UH caught the interest of the National Science Foundation as a way to address the big picture challenges of brain research.

"The technical expertise of both ASU and UH goes without saying, but both universities did well in bringing together industry members to get this center off the ground," said Dmitri Perkins, director of the NSF's IUCRC program. "Brain research is in general an area of great national interest. The NSF looks for centers with potential to deliver great impact in their areas of study as well as the possibility to work with other IUCRCs, universities and industries, and we see that here." ✹

Panelists (from left) Nadya Bliss, Marco Santello, Thomas Sugar and Zachary Holman and moderator Ji Mi Choi answer questions at "Engineering the Future: Entrepreneurship, Partnerships and a Commitment to Innovation" at ASU's ISTB 4 building in Tempe. Photographer: Charlie Leight/ASU Now

Engineering the future: ASU and industry come together

Businesses, meet Arizona State University's engineers.

That was the intent behind "Engineering the Future: Entrepreneurship, Partnerships and a Commitment to Innovation," an event held to introduce and promote collaboration between industry and the Ira A. Fulton Schools of Engineering. The Phoenix Business Journal co-sponsored the event.

"We wanted to share with you some of those factors that make us number one in innovation," moderator Ji Mi Choi, associate vice president of Strategic Partnerships and Programs, Office of Knowledge Enterprise Development, told the crowd of about 200. "We do invite partnership with you."

Fulton Schools Dean Kyle Squires told attendees the school looks forward to following up with them.

"We want to hear from you, companies and organizations we can move forward," Squires said.

Four engineering professors introduced and discussed their work, including Marco Santello, director of the School of Biological and Health Systems Engineering. He discussed how the brain controls and learns movements. He also detailed his work with partners, including the Mayo Clinic and roboticists, on the unmet needs of amputee patients.

The panel was asked what the biggest challenge of starting a company and taking inventions to market is. Marketing and sales are difficult, said Thomas Sugar, a robotics engineer and associate professor working on improving mobility with orthotics and prostheses for stroke victims. "Just because you have the best technology doesn't mean it's going to get sold."

Engineers don't know business, another panelist said, leaving them with two options: learn business themselves or partner with someone who is knowledgeable. ✿

In addition to faculty speakers, the "Engineering the Future" event featured displays promoting some of the work at the Ira A. Fulton Schools of Engineering. Photo by Charlie Leight/ASU Now

Mayo Clinic, ASU collaborate to advance research

In Silicon Valley, investors flock to back potentially disruptive new technology and apps — even if they are still in development.

But the funding landscape is a little different for health research. Although novel ideas have great potential to radically improve health care and medicine, funding agencies usually choose to fund well-established research. This can be a barrier for researchers with new ideas.

Arizona State University and Mayo Clinic are addressing this challenge and giving promising novel research the momentum it needs with an annual award of seed grants and acceleration grants. Since 2005, the Mayo Clinic and ASU seed grant program has translated into 57 externally funded projects worth approximately $30.5 million as well as new patents and opportunities for student training. By launching novel research on a small scale, researchers have been able to attract funding needed for larger studies and are making significant impact in their fields of study.

Recently, eight teams were selected for seed funding and will tackle research ranging from hand rehabilitation after stroke to better diagnostics for obesity-associated liver disease. Each team includes a researcher at ASU and at Mayo Clinic and draws on the strengths of each institution.

"Research drives everything we do for our patients," said Hugo E. Vargas, medical director of Mayo Clinic's Office of Clinical Research in Arizona. "The long-standing tradition of the seed grant awards allows Mayo Clinic and ASU researchers and physician-scientists to work together to find answers to unmet patient needs, with the ultimate goal of advancing care for our patients. These awards also help to highlight the strong relationship that exists between Mayo Clinic and ASU."

ASU and Mayo Clinic also collaborate to award an annual acceleration grant. This award targets a Mayo Clinic-ASU research project with established pilot data that is poised for high-impact and high-yield in the science of health care delivery. The award selection and funding is a collaboration between the Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery at Mayo Clinic and the Office of Knowledge Enterprise Development.

This year, the acceleration grant recipients will focus on improving type 1 diabetes treatment. Currently, type 1 diabetes interventions like blood glucose monitoring, food intake and insulin administration are based on a "one size fits all" approach and patients often struggle to adhere to the complex self-management.

"Our goal is to use informatics to deliver personalized interventions to improve the treatment of diabetes patients, and receiving the acceleration grant is making this possible. We are excited about the opportunity to help Mayo Clinic patients effectively manage their diabetes," said Adela Grando, assistant professor in the Department of Biomedical Informatics.

Grando and co-investigator Bithika Thompson, Department of Endocrinology at Mayo Clinic, received the acceleration grant to address challenges of type 1 diabetes treatment. Previously, the team received federal funding for a pilot study, and the acceleration grant will enable them to build on and expand their research. ✿
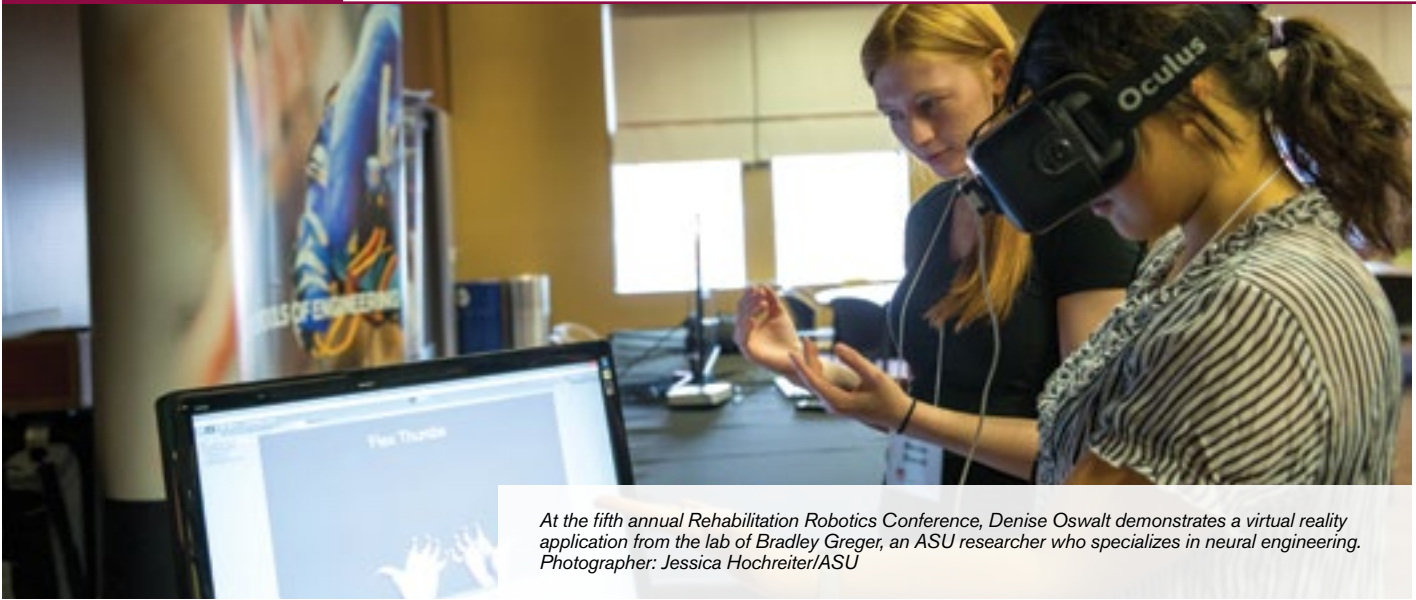
At the fifth annual Rehabilitation Robotics Conference, Denise Oswalt demonstrates a virtual reality application from the lab of Bradley Greger, an ASU researcher who specializes in neural engineering. Photographer: Jessica Hochreiter/ASU

ASU hosts Rehabilitation Robotics Conference

More than 300 rehab robotics researchers, clinicians and industry leaders gathered in February 2017 at ASU for the fifth annual Rehabilitation Robotics Conference.

There has been increased interest in the rehab robotics — driven by an aging population dealing with the aftermath of debilitating health problems — based on the promise of restored physical movement and control. Most rehab robotic therapies originated to help military veterans, but the next generation will seek to serve the general public.

The field covers a range of assistive therapies and devices, including exoskeletons that support walking and lifting, treadmill-like robots that help stroke survivors use their arms and legs, and prosthetics that allow users to sense space and dimension.

"The conference provides our junior investigators with an unprecedented opportunity to hear about three decades of research from the people who created the field," said Marco Santello, a neurophysiologist and director of the School of Biological Health Sciences. "We have collected research on neuroplasticity, locomotion dynamics and a myriad of other body-machine interfaces. The next phase will bring a new generation of rehabilitative technologies."

Widespread clinical acceptance of rehabilitation robotics is the most significant change we'll see in the next decade, said

Neville Hogan, a mechanical engineering professor at the Massachusetts Institute of Technology, who spoke at the conference.

Tech-savvy therapists recognize the value of assistive robotics and see the standardized data collection they afford as a major benefit, Hogan said.

"It's far less subjective than the clipboard methods of the past, and enhances our ability to tailor therapy to individual patients," he said.

Dario Farina, chair of neurorehabilitation engineering at the Imperial College of London's Department of Bioengineering, also presented at the workshop.

His research has enabled the simultaneous processing of hundreds of motor neurons — the signals the brain sends to muscles — without invasive procedures. The breakthrough has challenged classic views on the neural activity that drives steadiness in the performance of precise tasks and is expected to result in prosthetic devices that give patients unprecedented levels of fine motor control.

"In the near future, it will be possible to fully decode the neural information sent from the spinal cord and build man-machine interfaces for the natural and dexterous control of bionic limbs," Farina said, explaining that patients will be able to control prosthetic devices with the same, automatic mental commands used to control their natural hands.

Because health problems affect patients differently, fine-tuning rehab therapies is the next focus for Panagiotis Artemiadis, an ASU mechanical engineer whose research includes mechatronics and human-robot interaction.

"In the next five years," he said, "we'll be able to adjust robotics to be patient specific." ✪
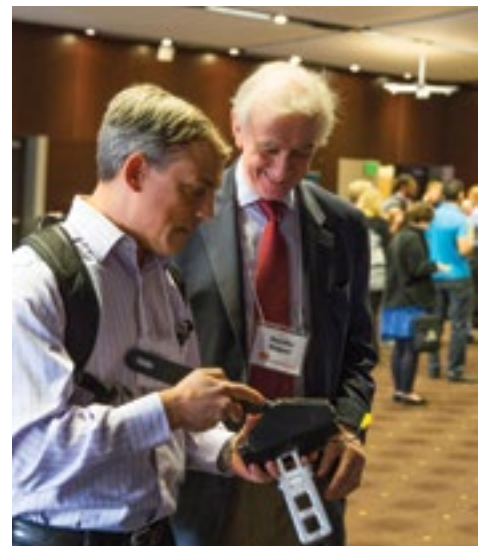
At the fifth annual Rehabilitative Robotics Conference, researchers discussed advances in the field. Thomas Sugar (left), an ASU mechanical engineer, predicts that in the next five years the public will have access to wearable robotics. Neville Hogan, meanwhile, predicts widespread clinical acceptance in the near future. Photographer: Jessica Hochreiter/ASU
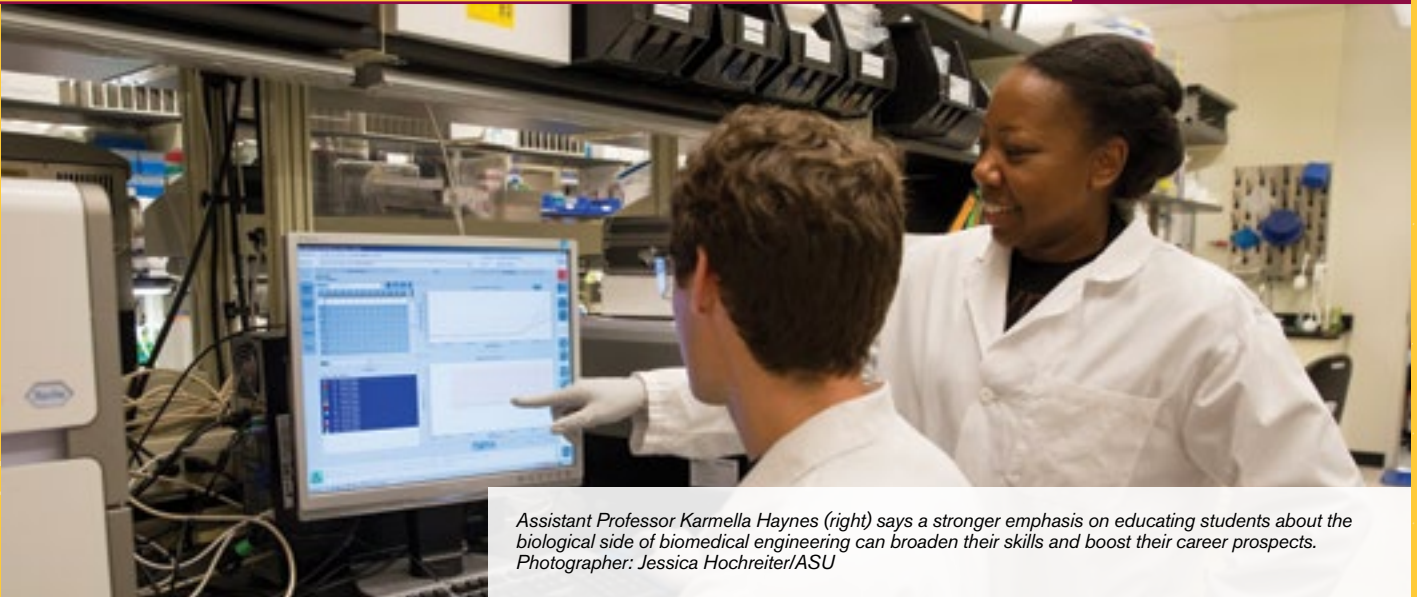
Assistant Professor Karmella Haynes (right) says a stronger emphasis on educating students about the biological side of biomedical engineering can broaden their skills and boost their career prospects. Photographer: Jessica Hochreiter/ASU

Symposium hardens focus on "soft" side of bioengineering

Arizona researchers, educators, students and representatives of industry, government agencies and health care institutions gathered at the annual ASU Molecular, Cellular and Tissue Bioengineering Symposium in April 2017 to discuss the potential these fields hold for sparking medical advances.

The symposium drew 150 participants, nearly doubling attendance from the previous year. The gatherings included not only university faculty and graduate students from across Arizona but also representatives from industry and state health agencies.

The main thrust of biomedical engineering has long involved the hardware that the field produces — devices, tools, machines, electronics and prosthetic apparatuses. Now the spotlight is rapidly being shared by engineers and scientists who are seeking to solve medical challenges through their increasing ability to manipulate cells, molecules, genes, proteins and neural systems — those so-called "soft," pliant and sometimes living biomaterials.

So, "it really started to make sense to form a group to strategize about how we could grow this area at ASU," both in the labs and the classrooms, says Karmella Haynes, a synthetic biologist and assistant professor of biomedical engineering in ASU's Ira A. Fulton Schools of Engineering.

"We needed to start connecting with each other, to share knowledge and to collaborate to bring these new things happening in the biomedical field to the forefront here," says Kaushal Rege, a professor of chemical engineering in the Fulton Schools.

Audiences saw presentations and heard talks about an expanding array of biomedical techniques being developed that hold promise for treating diseases, healing damaged organs and alleviating various disorders.

Researchers are exploring the use of certain proteins produced by our bodies to treat diseases — proteins that could potentially be more effective than the chemical compounds in the drugs that are now widely used.

"With our ability to figure out how DNA is expressed and translated into a protein, we now have a much clearer picture of all the different types of coding sequences in DNA and the proteins that are produced by the body," Haynes explains. "Allowing us to take a healthy cell and compare it to a diseased cell, and then say 'This is what is right in the healthy cell and these are the things that are wrong in the unhealthy cell.' Then we could introduce the right things into the diseased area to try to fix it."

Rege's research team is investigating other aspects of such regenerative medicine. One project involves experimentation with efficiently delivering therapeutic molecules into cells that could target areas of disease. Techniques like that could also be part of new processes to perform body tissue repair, helping to seal internal organs after surgical incisions — in conjunction with the use of laser light to activate sealing — and even healing organ tissues damaged by injury or disease.

The ASU Molecular, Cellular and Tissue Bioengineering Symposium drew support from the National Science Foundation, the National Institutes of Health, the American Heart Association and the Arizona Biomedical Research Commission.

The ABRC, a part of the Arizona Department of Health Services, sees significant benefits for the state in helping "to create a shared sense of community" among engineers, scientists, industries and health care institutions interested in making medical advances, says Jennifer Botsford, the commission's program manager. ✤

Douglas J. Weber, PhD

When Douglas Weber was a bioengineering doctoral student at the School of Biological and Health Systems Engineering in the 1990s, the team he worked with was doing some of the first research exploring the brain-computer interfaces for controlling robotic limbs. Today, Weber is continuing along the trajectory as an associate professor and director of the Rehab Neural Engineering Lab (RNEL) at the University of Pittsburgh, and that goal of treating humans with neural technology is within reach.

Weber established RNEL to explore how technology could aid rehabilitation from stroke. The work has since expanded to include spinal cord injuries and amputation. A network of labs grew up around RNEL, comprising a collaborative, interdisciplinary research community working on implantable and wearable technologies.

In 2017 Weber completed a four-year term at the Defense Advanced Research Projects Agency (DARPA), where he was a founding member of the biological technologies office. He created and managed a portfolio of neurotechnology research programs supporting the White House BRAIN initiative, launched by President Obama in 2013. ⚙

Kari Ashmont, PhD

Kari Ashmont has a scenic view of sorts from her post as health program specialist at the National Institutes of Health. Her work at the National Institute of Neurological Disorders and Stroke (NINDS) exposes her to research from the top investigators in the field.

Ashmont received a doctorate in biomedical engineering in 2015, then spent the next year as a postdoctoral researcher in the neuroscience research department at Barrow Neurological Institute in Phoenix Children's Hospital. That experience positioned her to secure the NINDS job in January 2017.

Ashmont performs a number of project management duties involving translational neural device studies at the NINDS and is active in the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative, and the Stimulating Peripheral Activity to Relieve Conditions (SPARC) Program. Many studies she is involved with are now conducting FDA regulated first-in-human trials. ⚙

Kip Ludwig, PhD

Kip Ludwig says he wasn't thinking about graduate school when he went to work in Alyssa Panitch's lab as part of his senior design project at the Ira A. Fulton Schools of Engineering. Panitch was working on heparin binding domains and convinced Ludwig that he should consider going into the field. He went on to attend the doctoral program at the University of Michigan and then launched a career in biomedical engineering innovation.

His first stop was a company that developed an implantable neuromodulation device to stimulate the carotid baroreceptors in the treatment of hypertension and heart failure.

Ludwig's contribution was a next-generation product, a minimally invasive electrode, that has been approved for sale in Europe. Next, he became the program director for neural engineering at the National Institute for Neurological Disorders and Stroke at the National Institutes of Health. Then Ludwig was the associate director of the Mayo Neural Engineering Laboratories, where he led the Bioelectronic Medicines Laboratory. He currently is an associate professor at the University of Wisconsin-Madison. ⚙

2016-2017 student awards

Lexi **Bounds**
Accepted to Harvard Stem Cell Institute Internship Program. She is one of the 35 accepted from over 650 applicants

Courtney **DuBois**
SBHSE Celebration of Excellence 2017 Outstanding Undergraduate Research Assistant

Swathy Sampath **Kumar**
SBHSE Celebration of Excellence 2017 Outstanding Teaching Award

Alison **Llave**
SBHSE Celebration of Excellence 2017 Outstanding Seniors

Aldin **Malkoc**
Metrohm USA's 2017 Young Chemist Award Winner

Allison **Marley**
SBHSE Celebration of Excellence 2017 Outstanding Seniors

Danh **Truong**
Won competitive International Foundation for Ethical Research Fellowship
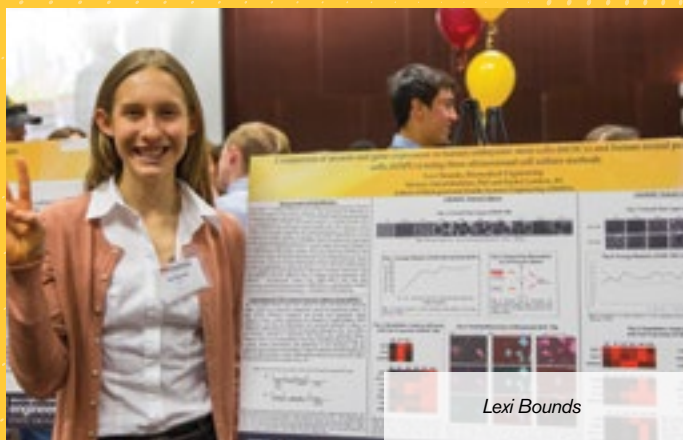
Maria José **Quezada**
Recipient of the 2017 American Society for Engineering Education Pacific Southwest Student Award

SBHSE Celebration of Excellence 2017 Katie Conrad Memorial Award

Maria Jose Quezada (left) and Arianna Moreno (right)

Lexi Bounds

Michael Caplan, Associate Professor (left) Courtney DuBois (right)

Team awards

Brandon **Bartels**, Arianna **Moreno**, Haley **Sivertson** and Maria José **Quezada**
StepPlus Group — Awarded the Second Place Prize in the Student Concept Pitch at the Bioaccel Solutions **Challenge 2016.**

iGEM 2016
The team project, with Dr. Karmella Haynes, earned several awards for the first time in ASU's history in iGEM, and won the highest number of awards since 2011 when ASU first participated in iGEM, including Gold Medal, Best New Basic Part, Best Part Collection and Biosafety Commendation. In addition, finalist for "Best in Track: Foundational Advance" and "Best Integrated Human Practices."

NSF graduate Research Fellowships

Recipients of National Science Foundation Graduate Research Fellowships are seen by the federal agency as potential leaders in research, teaching and innovation in engineering and science. Career success for these students is viewed as critical to the United States maintaining its leading role in technological advancement and its strength in national security. The NSF also counts on the students' future contributions to boost the vitality of the country's economy.

The Graduate Research Fellows are awarded a three-year annual stipend of $34,000 and a $12,000 cost-of-education allowance for tuition and fees to pursue graduate degrees. They also have opportunities for internships, professional development and participation in international research projects, and the freedom to do their own research at any accredited U.S. institution of graduate education of their choice.

Three graduate students in ASU's Ira A. Fulton Schools of Engineering, including Alyssa Henning are among the 2016 recipients of the highly sought after NSF Fellowships.

Alyssa Henning earned a bachelor's degree in biological engineering with a minor in biomedical engineering from Cornell University and a master's degree in agricultural and biological engineering from Penn State University.

She chose to come to ASU to pursue a doctoral degree in biological design in the Fulton Schools in large part because of the opportunity to work with faculty members whose expertise is in the emerging field of synthetic biology.

At Cornell she got involved in the top collegiate synthetic biology challenge — the International Genetically Engineered Machine Competition, known as iGEM — which led her to meet synthetic biologist and Fulton Schools Assistant Professor Karmella Haynes.

That prompted Henning to look into engineering graduate programs at ASU and to see "a biological engineering program that is flexible in allowing you to tailor your own studies, and a research approach that is really collaborative."

She also saw evidence of the university making investments in building high-quality lab facilities.

"All of that was very appealing," she says. "And they give you a chance to come up with really cool, imaginative research projects," rather than stick to a traditional track.

Henning is now doing rotations for her doctoral studies research in Haynes' lab.
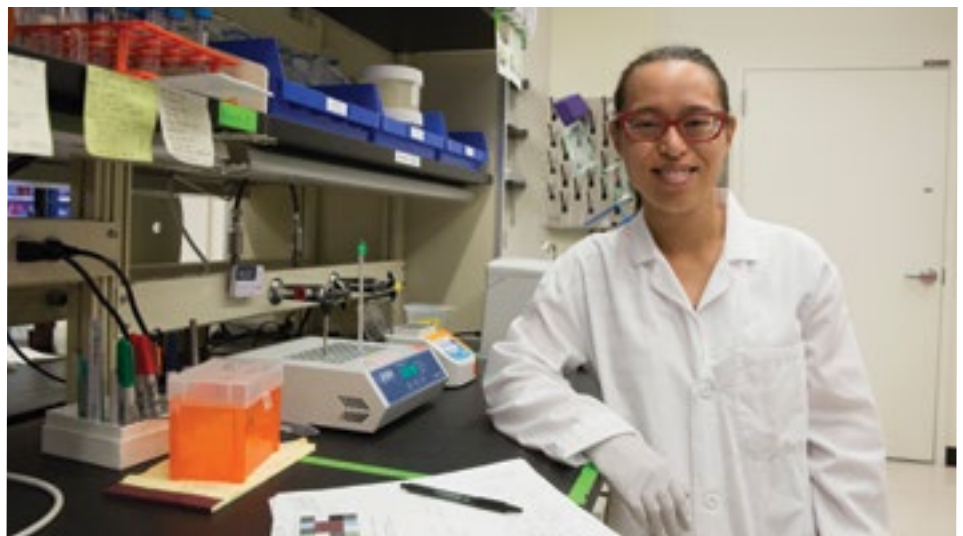
Along with the technological and engineering aspects of synthetic biology, Henning is also interested in exploring the ethical and policy issues involved in the field.

She's considering challenging herself to do a doctoral dissertation that will combine a focus on technical aspects of synthetic biology along with an examination of policy and practices in the field.

Outside of academics and research, she hopes to contribute to the local cultural scene by continuing to promote taiko drumming.

"Taiko" is the Japanese word for "drum." The use of large drums originated in Japan centuries ago as a form entertainment or celebration at various festivals that continue to this day. The custom has since expanded into an ensemble performance art involving many drummers and many types of drums.

Henning first joined the Genki Spark taiko group while doing a one-year internship in Boston after graduating from Cornell, and then started the Penn State Taiko group while earning her master's degree there — and even successfully lobbied for some funding for the troupe from the university.

Only a few months after arriving at ASU, she co-founded Sun Devil Taiko with Barrett, the Honors College students Tanyon Berry and Bradley Kemp. Their ensemble debuted this fall semester at a Barrett Showcase event as part of the college's recent Family Weekend and performed as part of the entertainment at ASU's Homecoming Parade and Block Party.

Henning says she's is particularly drawn to taiko because performances exude "so much positive energy, and there's also a lot of yelling." ✿

Impressive at iGEM

Soon after arriving at the 2016 International Genetically Engineered Machine Giant Jamboree to showcase the project they had worked on for several months, the undergraduate students representing ASU's iGEM team got a shocking surprise.

Their two graduate student advisors had been mistaken for team members, so the three undergraduates were placed in the graduate level of the iGEM competition instead of the undergraduate level division.

They would be up against more experienced rivals, many of them veterans of iGEM contests.

The 2016 iGEM Giant Jamboree is a three-day competition and the largest and most prominent test of students' skills in synthetic biology. The iGEM event helps to fuel the advancement of synthetic biology with fresh ideas contributed by the undergraduate scientists-in-training. Students from some of the world's most prestigious colleges and universities were among the approximately 5,600 students on about 300 teams from 42 countries.

Brady Dennison is a biomedical engineering major in ASU's Ira A. Fulton Schools of Engineering and a microbiology major in the School of Molecular Sciences.

Wu and Xu are students in ASU's Barrett, The Honors College. Wu is a computer science major and Xu is chemical engineering major in the Fulton Schools. Xu is also studying molecular biosciences in the School of Life Sciences.

They went into the competition armed with the results of the team's project: Diverse Homoserine Lactone Systems for Cellular Communication. The ASU team's research was based on a genetic system that enables bacteria to communicate with one another using small molecules known as N-Acyl homoserine lactones, or AHLs.

The molecules act as signals that travel from one bacterium to the next, activate genes in the bacteria and thereby alter cell behaviors within groups of bacteria. This signaling is called quorum sensing, a term describing how bacteria coordinate the genes that influence their behavior depending upon the density of their population.

The team produced six new BioBricks derived from quorum sensing systems of different species of bacteria. These BioBricks can potentially be used to build complex artificial gene circuits in which each unique signal activates different steps in the circuit. The project's outcome definitely opened the door to some ideas for a way to more precisely control communications among bacteria, says the team's student mentor, Cassandra Barrett, who is pursuing a doctoral degree in biological design in the Fulton Schools.

The ASU squad won more awards than any of the four previous teams that have represented ASU at the iGEM event. ✪

Aldin Malkoc wins young chemist award

Biomedical engineering graduate student Aldin Malkoc was awarded the 2017 Young Chemist Award by Metrohm USA at the Pittcon Conference and Expo in Chicago in March 2017 and received a $10,000 award.

Malkoc is working on cooperative DNA-based molecular elements for electrochemical biosensors. His research is looking to improve on the specificity and sensitivity of DNA detection, specifically, differentiation between single nucleotide differences using electrochemical impedance spectroscopy. Malkcoc has worked to develop a new biosensor that integrates a novel DNA detection mechanism called the Tentacle Probe with electrochemical impedance spectroscopy. This combined EIS-TP system has the potential to be multiplexed for quick medical diagnostic tests. With the potential to be transformative by providing a platform technology for both DNA and protein detection with high sensitivity this system offers extremely low rates of false positives.

Malkoc got an early start in the Fulton Schools as he participated in a summer school scholars program in the School of Biological and Health Systems Engineering before becoming a freshman at ASU. As part of the program, he met Assistant Professor Jeffrey La Belle who went on to become one of Malkoc's mentors.

Malkoc worked with La Belle and Associate Professor Michael Caplan on developing low-cost biosensors that could bring highly efficient medical diagnostics to low-income communities as an undergraduate student and this experience made him want to stay in the biomedical engineering program.

Malkoc states that the devices he would like to develop are ones that would allow physicians to assist their patients more efficiently and affordably. He says that specifically he hopes patients in low-income communities would benefit from low cost, highly accurate diagnostic devices made available to them in convenient and accessible locations. ✪

Engineering Smiles project manager Sara Mantlik (right) poses for a photo with fellow mechanical engineering student Nick Kemme (left), Both Engineering Smiles and IMAHelps received Making a World of Difference awards from the Tempe Sister Cities. Photographer: Pete Zrioka/ASU

Engineering Smiles

Engineering Smiles, a student-run project that started in Engineering Projects in Community Service, has spent the last three years working to design, build and deliver a mobile dental clinic which will bring dental care to developing nations.

They were recognized for their commitment to their cause with a Making a World of Difference Award from the Tempe Sister Cities in October 2016.

The award honors individuals who have made a substantial difference in people's lives around the globe through their humanitarian efforts.

The team includes mechanical engineering students Sara Mantlik, Andrea Kemmerrer and Nick Kemme, biomedical engineering students Jackie Janssen and Fionnuala McPeake, and architectural studies alumna Christine Bui.

Engineering Smiles has partnered and supported medical and dental missions to Central and South America by transforming a trailer into a mobile dental clinic. Not only will the clinic expand dental mission capabilities, but it will reside at Universidad Católica de Nicaragua, where it will be used as a training aide for dentistry students. ✪

Danh Truong wins IFER fellowship

Danh Truong, a doctoral student studying biomedical engineering, recently received the prestigious IFER (International Foundation for Ethical Research) graduate fellowship for alternatives to the use of animals in science.

Truong conducts research in Assistant Professor Mehdi Nikkhah's lab to develop a physiologically relevant 3D breast tumor model on a micro-engineered chip. The platform is comprised of breast cancer cells as well as surrounding stromal cells in 3D to reproduce a biologically relevant testing environment. They have used this chip to investigate breast cancer invasion under influences of biomolecules (for example, growth factors and chemokines) and anti-cancer drugs.

The work has been showcased in several national and international conferences, including BMES and ASME. Truong recently won the first place award at the ASU Molecular, Cellular and Tissue Bioengineering Symposium for his work and presentation. Most importantly, the research was published in the journal, Scientific Reports, of Nature's Publishing Group. Overall, Truong's work has potential to replace the use of animals in cancer drug testing. They hope that this model will provide better answers in cancer research than current technologies.

The awarded fellowship will help him further his studies by providing a stipend as well as funding for research supplies. He is currently studying the influences of different cells (i.e. fibroblasts, endothelial and immune) on cancer growth and invasion within his model. ✪

Velia Francis (left), Anthony Zlaket (center) and Nick Vale (right) are designing orthopedic dynamic splints that both prevent and fix hand deformities. The team will represent ASU at the United States National Grand Challenges Summit in Washington, D.C. Photographer: Pete Zrioka/ASU

Orthopedic startup goes to international competition

A team of three biomedical engineering students in the Ira A. Fulton Schools of Engineering was selected by the National Academy of Engineers as one of 12 finalists to compete at the United States National Grand Challenges Summit in Washington, D.C. in March 2017.

First selected by Arizona State University for the competition, the team was then

selected by the National Academy of Engineers as one of the top 30 entrants from across the country, making them a finalist. The Grand Challenges Summit occurs once every two years in the United States, the United Kingdom and China. Teams from all three countries will compete in the finals.

The team's startup is called Rethro. Their focus is on designing orthopedic dynamic splints that both prevent and fix hand deformities. There are millions of people in the United States who are affected by hand-deforming diseases that not only experience pain and reduced hand functionality, but are often embarrassed by their hand's aesthetics and do not feel comfortable to go in public. Additionally, the product can be used preventively for people with conditions such as arthritis.

Rethro is a dynamic splint that helps straighten the fingers and prevents at-risk individuals who do not have hand deformities from developing them. The idea is similar in concept to straightening teeth with dental braces, as Rethro slowly moves a patient's fingers back to a straight, neutral position with regular wear at night while the patient is asleep.

Anthony Zlaket is the materials science and software expert of the team, Nick Vale is the mechanics and design lead, and Velia Francis is responsible for the control hardware and quality testing of the device.

The group was initially targeting people with arthritis, but after consulting multiple biomedical engineers and physicians, they concluded their device can be used for many types of flexion-related hand deformities. The team says they will definitely keep working on the project with their goal to be able to manufacture their product to potential customers. ✿

Above: Left to right, biomedical engineering students Mohammad Mousa, John Tobey and Barrett Anderies pose for a photo with Professor Marco Santello, director of the School of Biological and Health Systems Engineering and Dr. Rami Aoun, of the Mayo Clinic's Department of Neurological Surgery at the SBHSE capstone project showcase in April 2017. Photo courtesy of Barrett Anderies

Biomedical engineers in NIH's debut challenge

A team of biomedical engineering students looking to make surgeries safer recently landed second place in the Design by Biomedical Undergraduate Teams challenge for their innovative 3D brain mapping tool, called NeuroMap.

The challenge, which "recognizes undergraduate excellence in biomedical design and innovation," is a joint effort between the National Institutes of Health's National Institute of Biomedical Imaging and Bioengineering and VentureWell, a nonprofit that helps faculty and student innovators turn their ideas into successful, socially conscious businesses.

The student team, comprised of biomedical engineering graduates Barrett Anderies, Mohammad Mousa and John Tobey, were awarded $15,000 for their design of their 3D mapping tool, which began as the team's capstone project. NeuroMap digitizes brain mapping, allowing surgeons to test whether brain tissue controls a critical area while applying digital tags to the surface of the brain. The digital tags would then provide warning cues if surgical tools approach tagged areas, allowing surgeons to operate without referencing a brain map.

Though the trio were undergraduates when they completed the project, all three have graduated with their bachelor's degrees in biomedical engineering. Anderies, who dual-majored in mathematics and biomedical engineering, recently completed a summer internship at the Mayo Clinic, and Mousa is enrolled at the University of Arizona's College of Medicine to attain his medical degree. In addition to his master's work, Tobey also works as a student researcher in biomedical engineering Associate Professor Vikram

Kodibagkar's ProBE Lab. Upon finishing his master's degree in spring 2018, he plans to enroll in ASU's biomedical engineering doctorate program under Kodibagkar's guidance. Anderies was offered a full-time position at Mayo and plans to continue developing NeuroMap.

The competition's submissions were judged on the significance of the problem being addressed; impact on potential users and clinical care; innovative design and the functionality of the prototype. ✪

giving

Join us in our 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.

Donations support senior projects, student and faculty research, and improve the educational tools and opportunities we offer our students.

To make a donation of any amount, please call Mark DiStasi at 480-727-4609, or mail your gift to Ira A. Fulton Schools of Engineering, ATTN: Mark DiStasi, P.O. Box 879309, Tempe, Arizona, 85287-9309.

Please make checks payable to the "ASU Foundation" with "SBHSE" noted in the memo line.

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