FALL 2019 | BIOMEDICAL ENGINEERING

MAKING A DIFFERENCE IN THE WORLD

A multidisciplinary student organization takes on global health issues.

FULL STORY, p. 10

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Biomedical Engineering Alliance

Cleveland Clinic

EXPLORE

Biomedical Engineering
at Case Western Reserve University

bme.case.edu

CWRU, Department of Biomedical Engineering

@CWRUBME

@CWRUBME

Case Western Reserve University

A Leader in Patents

RANKED 17
IN PATENTS AWARDED

Up from 43 last year

Among the "Top 100 Worldwide Universities Granted U.S. Utility Patents in 2018"

95 utility patents
granted in 2018

Rankings compiled by the National Academy of Inventors (NAI) and Intellectual Property Owners Association (IPO).

FROM THE CHAIRS

Robert F. Kirsch
Allen H. and Constance T. Ford Professor
Chair of Biomedical Engineering
Case Western Reserve University

Geoffrey Vince
The Virginia Lois Kennedy Endowed Chair in Biomedical Engineering and Applied Therapeutics
Lerner Research Institute
Cleveland Clinic

The fall semester has begun, and we are thrilled to welcome back our continuing students and meet a fantastic new group of students! Case Western Reserve University has a typically large and highly-qualified group of freshmen with aspirations for a BS degree in biomedical engineering, and we welcomed a record 33 new Ph.D. students during the annual White Coat Ceremony. The graduates of our programs represent a major way that we impact the world, and we work very hard to prepare them for a dynamic and rapidly changing world. Along these lines, our undergraduate program just received ABET accreditation with flying colors for a maximum of six years!

In May, the Biomedical Engineering Department hosted the BME Council of Chairs Education Summit in Cleveland, the first time in 10 years that the BME academic community came together to discuss curricula and curricular innovation. You can read more about it on page 22.

The alliance between Biomedical Engineering Departments at Case Western Reserve University and Cleveland Clinic continues to grow and evolve. Descriptions of our joint efforts are described throughout this newsletter. Overall, the joint BME Department encompasses more than 800 individuals: 56 nationally prominent BME alliance faculty, 66 associated faculty, 7 research faculty, 22 research associates, 13 technical staff, 14 departmental and research administrators, approximately 450 undergraduate students and 200 graduate students. And, Case Western Reserve University's BME primary faculty is undergoing a major expansion. We recently hired Assistant Professor Andrew Shoffstall who studies neural biomaterials. In addition, we are actively searching for three additional faculty in magnetic resonance imaging, two faculty in neural engineering, one faculty in cancer research and two teaching faculty!

Our Case-Coulter Translational Research Partnership continues to expand its success in moving laboratory discoveries into products that impact health care. Over its 12-year existence, the program has facilitated 23 startup companies, 30 licenses, $200 million in follow-on funding to companies and faculty, and 34 new technologies being tested or deployed in people. On Oct. 21, the Case-Coulter program will host the national Coulter Investment Forum in collaboration with the Cleveland Clinic Medical Innovation Summit, which will highlight Coulter technologies from around the country.

Please read on to get an update on our faculty, students and alumni. Three of our faculty – Bolu Ajiboye, Jeffrey Capadona and Michael Jenkins – were promoted based on their stellar contributions, and Dominique Durand was named a Distinguished University Professor. Among the work highlighted in this issue are inclusion of three professors' research projects in the documentary "I am Human" that was presented at the Tribeca Film Festival (page 23), Dustin Tyler's work on restoring touch sensation following amputation (page 14) and Andrew Rollins' lead in the Global Health Design Collaboration, which extends the reach of our BME program to the rest of the world (page 10). Our alumni are leaders in academia and industry. This newsletter remembers the critical contributions of James Reswick, one of the founding fathers of the biomedical engineering discipline and the Case Western Reserve University BME program (page 25).

So, there is a lot going on! We hope that you enjoy our newsletter updates and would love to hear from you. Have a great fall!

FACULTY HIGHLIGHTS

Bolu Ajiboye

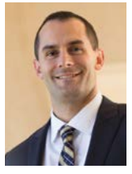
Bolu Ajiboye has been promotoed to associate professor of biomedical engineering with tenure at Case Western Reserve University.

Ajiboye works with the development and control of brain-computer-interface (BCI) technologies for restoring function to individuals who have experienced severely debilitating injuries to the nervous system, such as spinal cord injury and stroke.

Jay Alberts

Jay Alberts, Lerner Research Institute Department of Biomedical Engineering, was awarded a $3 million grant from the National Institute of Neurological Disorders and Stroke to conduct a multi-site clinical trial to determine if long-term, high-intensity aerobic exercise can slow the progression of Parkinson's disease (PD). Cleveland Clinic and the University of Utah will use exercise performance data to determine if there is an optimal exercise dose necessary to slow disease progression, which can provide clinicians with more specific recommendations and allow patients to play a more active role in their treatment.

Additionally, Alberts and his team have developed the Cleveland Clinic Concussion Application (C3 app) for the iPad. Cleveland Clinic providers can use the app to help assess injured youth athletes for the need for emergency department management of concussion.



Jeffrey Capadona

Jeffrey Capadona has been promoted to professor of biomedical engineering at Case Western Reserve University. Capadona is a research health scientist at the Louis Stokes VA Medical Center. His lab is studying various aspects of microelectrode performance and pursuing both materials-based and therapeutic-mediated methods to mitigate the inflammatory-mediated microelectrode failure mechanisms.

This year, Capadona received three grants. The first is a $2.5 million R01 from NIH's National Institute of Neurological Disorders and Stroke for a project characterizing and mitigating the role of oxidative damage in microelectrode failure. The second grant is a $1.1 million Rehabilitation Research and Development (RR&D) Merit Review from the Department of Veteran's Affairs for work on a hybrid drug-eluting microfluidic neural probe for chronic drug diffusion. The third grant for $590,184 is a RR&D Research Career Scientist Award that honors top-performing VA investigators.

Dominique Durand

Dominique Durand has been awarded the title of Distinguished University Professor at Case Western Reserve University — a permanent, honorific title that acknowledges contributions of full-time, tenured faculty with exceptional records of research, scholarship, teaching and service. Durand has been with the university for 35 years with interests in neural engineering.

Ahmet Erdemir

Ahmet Erdemir, Lerner Research Institute Department of Biomedical Engineering, received a $3.5 million grant from the National Institute of Biomedical Imaging and Bioengineering to develop a software suite that will allow the annotation of virtual anatomy, a three-dimensional, interactive rendering of the human anatomy. This comprehensive software package, called AEVA (Annotation and Exchange of Virtual Anatomy), will enable doctors and researchers to better describe the relationships and interactions between organs and to label symptoms that will help in the diagnosis of illness. This will help to augment the virtual representations of the anatomy that are increasingly relied upon in computational modeling and simulation.

Michael Jenkins

Micheal Jenkins has been promoted to associate professor of biomedical engineering with tenure at Case Western Reserve University.

Jenkins researches how to use infrared light to neuromodulate the vagus nerve to treat several diseases, including rheumatoid arthritis, epilepsy, hypertension, obesity, heart failure and coma.

Xiaojuan Li

Xiaojuan Li, Lerner Research Institute Department of Biomedical Engineering and director of the Cleveland Clinic Program for Advanced Medical Imaging and Kurt Spindler, Cleveland Clinic Orthopaedic & Rheumatology Institute, received a $3.1 million grant from the National Institute of Arthritis and Musculoskeletal and Skin Diseases to help identify long-term risk factors for osteoarthritis after an anterior cruciate ligament (ACL) tear and reconstruction. This multicenter study will utilize an advanced type of magnetic resonance imaging (MRI) known as quantitative MRI, or qMRI, to illustrate long-term structural damage and degeneration of the cartilage after the ACL reconstruction. This will help identify the risk factors for post-traumatic osteoarthritis.

Anant Madabhushi

Anant Madabhushi, director of the Center for Computational Imaging and Personalized Diagnostics and the F. Alex Nason Professor II of biomedical engineering, is one of the authors of the eBook, "Deep Learning in Medical Image Analysis and Multimodal Learning for Clinical Decision Support." It has been downloaded more than 137,000 times, putting it in the top 25% of most downloaded books under the Springer family of artificial intelligence publications in 2018. In addition, Madabhushi was named to The Pathologist's Power List of 100 inspirational and influential professionals in pathology for his pioneering work on computer-aided diagnosis, pattern recognition and image analysis tools.

Ela Plow

Ela Plow, Lerner Research Institute Department of Biomedical Engineering, received a $3.1 million grant from the National Institute of Child Health and Human Development to test an innovative therapy to restore arm and hand function in patients who have suffered upper limb paralysis after a stroke. This therapy combines a new method of brain stimulation that targets the intact, or uninjured, hemisphere with a technique that may enhance the effects of a novel rehabilitation therapy called Contralaterally Controlled Functional Electrical Stimulation (CCFES), which does not require patients to retain hand or wrist movement. The CCFES therapy was developed by Plow's colleague, Jayme Knutson, Department of Physical Medicine & Rehabilitation, MetroHealth System, and Case Western Reserve University School of Medicine.

Horst von Recum

Horst von Recum, associate professor of biomedical engineering, became the president for the Society for Biomaterials in 2019.

The Society for Biomaterials chapter at Case Western Reserve University looks to serve the biomaterials community by enhancing the learning and career development of its members by providing opportunities to engage in scientific research as well as network with industries.

Anirban Sen Gupta

Anirban Sen Gupta, professor of biomedical engineering at Case Western Reserve University, is a PI on a multi-PI team with Prithu Sundd, Melanie Scott and Matthew Neal at the University of Pittsburgh that has been awarded a $4 million R01 grant from the NIH NHLBI in March 2019 to study mechanisms of platelet exosome-mediated acute chest syndrome in sickle cell disease.

Additionally, Haima Therapeutics, a company co-founded by Sen Gupta and Christa Pawlowski, has been awarded an NIH Phase I SBIR grant for $250,000 in May 2019 to evaluate synthetic platelet dosing in treating thrombocytopenia.

Furthermore, Sen Gupta is the co-investigator on a VA Merit Award grant of $650,000 funded to Evi Stavrou as PI to study targeted inhibition of neutrophil signaling as a treatment for deep vein thrombosis. Sen Gupta and his research team were also awarded the Case School of Engineering Innovation Award in 2019. Sen Gupta has been appointed chair of the Education and Professional Development Committee of the Society for Biomaterials.

Welcome New Faculty

Andrew Shoffstall
Assistant Professor

The Department of Biomedical Engineering at Case Western Reserve University welcomes Andrew Shoffstall as an assistant professor. Research by Shoffstall, *'A Mosquito Inspired Strategy to Implant Microprobes into the Brain,'* received 2,127 article views in 2018, placing it as one of the top 100 read neuroscience papers for Scientific Reports in 2018.

Andrew Janowczyk
Assistant Research Professor

The Department of Biomedical Engineering at Case Western Reserve University welcomes Andrew Janowczyk as an assistant research professor in Anant Madabhushi's Center for Computational Imaging and Personal Diagnostics. Janowczyk has developed a program to ensure the quality of digital images being used for diagnostic and research purposes. Janowczyk and Madabhushi unveiled their new quality-control tool in the most recent edition of the Journal of Clinical Oncology Clinical Informatics and are being supported by a three-year, $1.2 million grant from the National Cancer Institute.

Rakesh Shiradkar
Assistant Research Professor

The Department of Biomedical Engineering at Case Western Reserve University welcomes Rakesh Shiradkar as an assistant research professor in Anant Madabhushi's Center for Computational Imaging and Personal Diagnostics. Shiradkar focuses on building novel computational tools and machine learning models for characterization, diagnosis and prognosis of cancer on imaging.

Research Snapshot

Advancing Epilepsy Treatment

Researchers at Case Western Reserve prevent seizures in 90% of non-human subjects with low-frequency stimulation of axons in brain.

Researchers at Case Western Reserve University have successfully prevented epileptic seizures in animal models by preemptively directing a low-frequency stimulus to the nerve fibers in the brain.

That technique differs substantially from current human therapies recently approved by the U.S. Food and Drug Administration, in which doctors now employ a much higher frequency directly into brain tissue and sometimes only after a seizure has started.

Dominique Durand

Those methods, while an alternative to previous treatments in which brain tissue is surgically removed, still only reduce seizures by about 50% and in just about half of the patients treated, said researcher Dominique Durand, the Elmer Lincoln Lindseth Professor of Biomedical Engineering at Case Western Reserve and director of its Neural Engineering Center.

Nicholas Couturier

But Durand and PhD student Nick Couturier have demonstrated a success rate of more than 90% in animal testing — and by a method that works before a seizure even occurs.

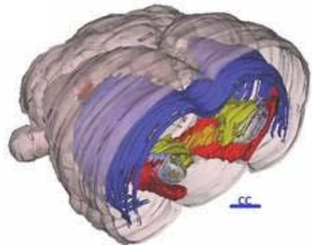
"So the state-of-the-art right now is not so great, in my opinion," Durand said. "There have been some success stories, yes, but our lab has developed a new way of thinking about this that no one else is really looking at."

A New Approach

Durand and Couturier's work differs from the norm in two critical ways: They direct a lower frequency stimulus into the brain and they target what are known as white matter tracts (axons), not gray matter (the brain tissue).

But this new way of preventing a seizure — a sudden, uncontrolled electrical disturbance in the brain — by actually exciting axons may seem counterintuitive, Durand said.

"We stimulate a fiber track, the corpus callosum, at a frequency of about 10 to 20 hertz," he said. "You would think that this method would stimulate everything else and make it worse, but that is not what happens. Instead, it can prevent a seizure from even happening."



The corpus callosum (shown in purple) is a nerve fiber tract that innervates most of the cortex on both sides.

This phenomenon — low-frequency stimulation of the axons producing long-lasting inhibition of neural firing — had first been observed by Stanford University neurologist Sheela Toprani a few years ago when she was a student in Durand's lab.

Although likely years from human trials and certainly from mainstream use, the advance is still exciting, Couturier said.

"The hope is that this can someday bring some benefit to people," he said. "We got the ball rolling, at least, and our research is the first of its kind, so we believe we're on to something good."

Prize-winning Paper

Couturier is first author on a paper from last fall describing this new work in the journal Epilepsia and was awarded its Basic Science Prize for "significant advances to knowledge and understanding" of the fundamental understanding of the pervasive neurological disorder.

He presented his research at the 33rd International Epilepsy Congress in Bangkok, Thailand, in late June.

Epilepsy affects about 1% of the world's population or about 65 million people. One-third of them live with uncontrollable seizures because no available treatment works for them, according to The Epilepsy Foundation.

STUDENT SPOTLIGHT

Jacob Antunes
Advisor: Satish Viswanath

Jacob Antunes, a graduate research assistant in the Center for Computational Imaging and Personalized Diagnostics, received the Medical Image Computing and Computer Assisted Intervention (MICCAI) 2019 Graduate Student Travel Award for his paper "STructural Rectal Atlas Deformation (StRAD) features for characterizing intra- and peri-wall chemoradiation response on MRI."

Kaustav Bera
Advisor: Anant Madabhushi

Kaustav Bera, a research associate in the Center for Computational Imaging and Personalized Diagnostics, received the Early Career Travel Award from the International Association for the Study of Lung Cancer (IASLC).

Yijiang Chen
Advisor: Anant Madabhushi

Yijiang Chen, a graduate research assistant with the Center for Computational Imaging and Personalized Diagnostics, received the American Society of Nephrology (ASN) Pre-Doctoral Fellowship Award worth $10,000 annually for up to two years. In addition, Chen received a travel award to attend the ASN Annual Meeting and Kidney STARS program.

Shyam Chowdhry
Advisor: Miklos Gratzl

Shyam Chowdhry received the Bernstein Award from the Department of Biomedical Engineering for excellence in the classroom and contributions to campus life and the community outside the university. He helped develop a biomedical instrumentation laboratory course and served as the lead teaching assistant. Chowdhry earned his B.S. in biomedical and electrical engineering in the spring.

Albert Feeny
Advisor: Anant Madabhushi

Albert Feeny, a research assistant and medical student at the Cleveland Clinic Lerner Research Institute, was awarded a 2019 Student Scholarship in Cardiovascular Disease from the Scientific Councils of the American Heart Association.

Rebecca Haley
Advisor: Sam Senyo

Rebecca Haley won the Student Award for Outstanding Research in the Masters Category for the Awards and Recognition of Advancements in the Field of Biomaterials. Haley began work on her Ph.D. at the University of Pennsylvania this fall.

Ujjal Sekhon
Advisor: Anirban Sen Gupta

Ujjal Sekhon, a graduate researcher and Ph.D. candidate, was invited to present a podium talk and a research poster at the Gordon Research Conference on Cell Biology of Megakaryocytes and Platelets in Galveston, Texas, in February 2019. His talk was entitled, "Nanomaterial Based Modular Integration of Pro-Coagulant Mechanisms on a Liposomal Template for Targeted Augmentation of Hemostasis."

Rajat Shivaracharan
Advisor: Dominique Durand

Rajat Shivaracharan won the 2019 BME Ph.D. award with his thesis entitled, "Self-Propagating, Non-Synaptic Hippocampal Waves Recruit Neurons by Electric Field Coupling."

Stephanie Yang
Advisor: Anirban Sen Gupta

Stephanie Yang, an undergraduate researcher, has been awarded the CWRU SOURCE (Support of Undergraduate Research & Creative Endeavors) 2019 scholarship for summer research. Yang focuses on engineering a thrombus-targeted vascular nanomedicine system that allows for controlled release of fibrinolytic drug triggered by thrombus-relevant enzyme activity.

Three Students Earn NSF Fellowships

The National Science Foundation named a graduate student and two alumni from Case Western Reserve University to the Graduate Research Fellowship Program for 2019.

Cara Smith
Cara Smith, who graduated with a degree in biomedical engineering from Case Western Reserve in 2018, is now a Ph.D. student at Northwestern University. Smith is a member of the Stupp Laboratory at Northwestern, which develops self-assembling organic materials for functions related to energy and medicine.

Marina Yu
Marina Yu, who graduated with a degree in biomedical engineering from Case Western Reserve in 2019, began a Ph.D. program at Rice University this fall. While at Case Western Reserve University, she worked on reducing inflammation as a result of microelectrode implantation in the lab of Jeffrey Capadona, professor of biomedical engineering.

Kathleen Young
Kathleen Young, a Ph.D. student in Case Western Reserve's Biomedical Engineering Department, is a member of the research team in biomedical engineering Professor Horst von Recum's laboratory. She focuses on developing drug-eluting polymer coating that will provide sustained drug delivery via drug refilling doses to prevent and treat restenosis without removal of a coronary stent implant.

Undergraduate Students Honored by Ohio Cooperative Education Association

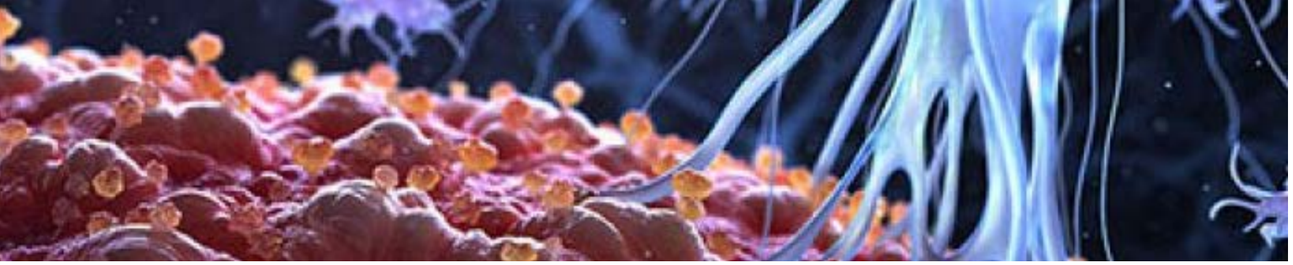
Two Case Western Reserve University undergraduate students in the Department of Biomedical Engineering were honored by the Ohio Cooperative Education Association (OCEA).

Emily Szabo won the association's Cool Co-op Award for her co-op experience at Zimmer Biomet in Warsaw, Ind.

Emily Ingalls received a $1,000 scholarship from OCEA, along with mechanical engineering major Ashley Schuett. Ingalls co-oped at Johnson & Johnson, and Schuett co-oped at Invacare.

Left: Ashley Schuette (pictured left) and Emily Szabo with their awards at the OCEA conference.

Right: Emily Ingalls.



Members of CCIPD Receive Several Honors

Researchers and students working in the university's Center for Computational Imaging and Personalized Diagnostics (CCIPD) have received several recent honors.

Prateek Prasanna and Mohammadhadi Khorrami

Prateek Prasanna, a research associate at the center, and Mohammadhadi Khorrami, a graduate student working in the center, received a $1,000 2019 Conquer Cancer Foundation of ASCO Merit Award for their abstract, "Intra and perinodular CT delta radiomic features associated with early response can predict overall survival (OS) in immunotherapy-treated non-small cell lung cancer (NSCLC): A multi-site multi-agent study."

The merit award program was established in 1995 to recognize high-quality abstracts submitted by fellows and residents. The award included a stipend to attend ASCO in Chicago, May 31–June 4.

Anant Madabhushi, F. Alex Nason Professor II of Biomedical Engineering, is the senior author on the abstract.

Pranjal Vaidya

Pranjal Vaidya, a graduate research assistant with the center, received the Linda K. Arena Endowed Scholarship Award. She received a $6,500 award for her work titled "Pre-treatment Radiomic Features Can Differentiate Hyperprogression from Other Response Patterns Following Immune Checkpoint Inhibitors in Advanced Non-Small Cell Lung Cancer (NSCLC)."

Each year, the Linda K. Arena Endowed Scholarship Award provides funding to obtain advanced training in lung cancer prevention and treatment.

Madabhushi advises Vaidya.

Catherine Jayapandian

Catherine Jayapandian, a research associate with the center, received the Kidney Precision Medicine Travel Award for her abstract titled "Deep Learning based Detection of Normal and Abnormal Glomeruli and Tubules on whole slide images from NEPTUNE digital renal biopsies."

Jayapandian's $1,200 award was for the Kidney Precision Medicine Project consortium face-to-face meeting, which was held in Bethesda, Md., April 30–May 1.

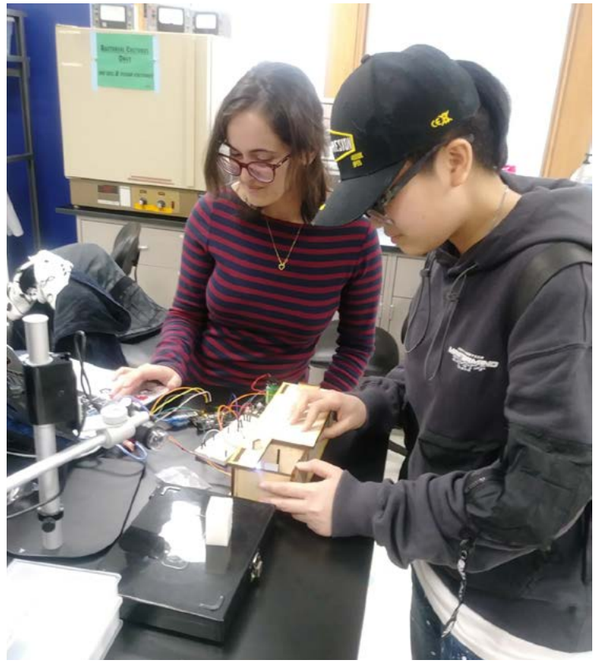
Madabhushi advises Jayapandian.

Student Earns BME Faculty Award

Michael Douglass earned the Department of Biomedical Engineering's Faculty Award last spring. Douglass, who graduated in 2019 with a dual degree in biomedical engineering and engineering physics, was selected for his exceptional work in the classroom and research laboratory, as a teaching assistant and in his co-op program. Douglass completed a co-op and senior year project at Folio Photonics, an optical data storage technology company in Solon, Ohio. While there, he selected and tested materials for co-extrusion of multilayer optical films, characterized film defects, developed techniques to reduce defects, measured and analyzed rheology of new polymer and dye compounds and performed lifetime testing of optical films. Douglass also helped develop the Department of Biomedical Engineering's new biomedical instrumentation laboratory course and served as a teaching assistant. This fall, Douglass began his graduate studies in biomedical engineering at Case Western Reserve University.

Above: The illuminating compartment of a simple spectrophotometer that students assemble and test in the instrumentation core laboratory.

Right: Patricia Alfaro, left, and Holly Wen assemble the instrument and connect it to digital control and data acquisition.



MAKING A DIFFERENCE IN THE WORLD

A multidisciplinary student organization takes on global health issues.

A team of students and professors from Case Western Reserve University and Makerere University in Uganda gather around a syringe and needle disposal system prototype they created as part of the Global Health Design Collaboration.

As part of the Global Health Design Collaboration (GHDC) at Case Western Reserve University, Libby Schubert has teamed with other biomedical engineering students to create a waste disposal system for syringes and needles used by remote medical clinics in Uganda. The enthusiastic undergraduates generate ideas in Cleveland, but the goal of the student organization is to ensure their innovations are usable more than 7,300 miles away in eastern Africa. That's why annual spring break trips to Uganda are so important.

"Meeting the clinicians and healthcare workers was extremely valuable for me," says Schubert, who traveled to Uganda with seven other students from Case Western Reserve University last March. "I got to observe a vaccination outreach and truly see how the nurses work, which gave me an understanding of how important it is that the solutions we implement can be streamlined into their processes."

That's music to the ears of GHDC co-advisors, Andrew Rollins, professor of biomedical engineering, and Janet McGrath, professor and chair of anthropology at Case Western Reserve University. The mission of GHDC is to use the principles of anthropology and engineering design to contextualize and solve unmet clinical needs in the developing world.

"In the realm of global health, decades of technology have been invented in one setting and adapted for use in another. And there have been many failures," says McGrath. "Sometimes the issues are technical, and sometimes they are related to the broader context of the user environment. So you need to have the expertise of both anthropologists and engineers."

A Team Approach to Tackling Issues

The Global Health Design Collaboration was formed in 2016 as an offshoot of the student organization Case Western Reserve University MedWish. "Several students and I decided to pilot a design project, which is different than the work done by MedWish, whose primary aim is to test and repair medical equipment donated abroad," says Rollins. A handful of students worked on a vaccine cooling solution during the spring semester. "The project generated a lot of interest, so the students decided there should be a separate club," says Rollins.

GHDC, which now has about 40 student members from across disciplines, decided to focus its efforts on Uganda because of a 30-plus year relationship that Case Western Reserve University has with Makerere University in Kampala called the Uganda-CWRU Research Collaboration. Students from both universities work on projects for GHDC.

"The collaboration has helped bring together different perspectives and experiences," says Robert T. Ssekitoleko, a lecturer and head of the biomedical engineering program at Makerere University. "CWRU students can access a number of technologies and processes for making [those technologies], whereas the Makerere students better understand the context and give insight into culturally-sensitive issues. This combination is very important for developing context-appropriate technologies."

That dual perspective, along with input from anthropology students, led GHDC students to change direction on the syringe and needle disposal project. In 2018, a group of students on the spring break trip to Uganda – part of Case Western Reserve University's "Global Health Design in Uganda" course – tested a needle clipper system in the rural Luwero District about 50 miles from the capital city of Kampala. The system trimmed off needles from syringes so the two parts could be treated and disposed of separately.

"The feedback we got from the users was that the needle clipper wasn't something they were looking for, so we shifted direction to a method of incineration," says Schubert. The new system GHDC is devising, called Simple Bake, entails putting intact syringes and needles into a metal pan with a replaceable concrete lid, then placing the pan in a burn pit. "The idea is that the plastic melts around the needles and encases them so they are no longer a sharps hazard," says Schubert.

A vaccine carrier designed by the Global Health Design Collaboration.

Healthcare workers in the Luwero District in Uganda test out backpacks designed by the Global Health Design Collaboration that allow them to more easily carry supplies, such as vaccinations and vitamins, to remote villages.

Part of a Larger Mission

The waste disposal system is just one of several projects undertaken by GHDC. Another group of students is designing backpacks for healthcare workers to more easily carry supplies, such as vaccinations, infant scales, mosquito nets and vitamins, to remote rural areas. Other projects include design of an efficient carrier system to transport vaccines to villages and development of a reusable pediatric pulse oximeter to detect hypoxemia, which is a symptom of pneumonia, a leading cause of mortality for children under five in Uganda.

In February 2018, the Global Health Design Collaboration became part of the newly-created Center for Engineering Action. "The purpose of the center is to foster, integrate and manage numerous international design projects with our student groups," says Lynn Rollins, program director for the Center for Engineering Action.

In addition to GHDC, other student organizations fall under the center's umbrella. These include the university's Engineers Without Borders chapter, which is working on a water distribution project in the Dominican Republic, and the Humanitarian Design Corps, which is developing a sustainable water system in Costa Rica and a solar lighting installation in Malawi.

Lynn Rollins says involvement in GHDC and other student organizations in the Center for Engineering Action is meaningful because it more closely resembles how work is done in the "real world" rather than as part of a traditional college class. "Students are part of interdisciplinary teams, working with community partners and addressing real problems," she says. "These experiences are impactful for young people and often define what they will do later in life."

Students Can Make a Difference

That's the case for Amanda Noonan, one of GHDC's founders, past president of the organization and a 2017 graduate of the Case School of Engineering. "The club appealed to me because I wanted to make a difference in medical technology and saw there were so many simple engineering solutions needed in Uganda and other developing countries," says Noonan, an electrical engineering major. "I realized that engineering focused on simple, sustainable solutions is far more beneficial for the whole global healthcare and ecosystem."

While a member of GHDC, Noonan worked primarily on the pediatric pulse oximeter project. Her team researched issues related to oxygen saturation in Uganda, brainstormed several design ideas for a reusable pulse oximeter and began creating a prototype of the selected design. The group landed a $9,000 grant from the Saint-Gobain Corporation Foundation to further the project, which has since resulted in several prototypes.

Noonan says participation in GHDC helped her grow as a leader and learn how to engage people in projects. These skills come in handy at Battelle, where she works as an electrical engineer in research and development in the company's medical and commercial devices division. "I do a lot of different types of work activities in the R&D space, including research and project definition work similar to things I did with GHDC," says Noonan.

While the Global Health Design Collaboration strives to design useable products for Ugandan healthcare workers, Andrew Rollins says that backpacks or vaccine carriers aren't the most important outcome. "We are teaching good design practices and good global citizenship to these young people," he says. "We hope they solve some problems and help people with their designs. But the biggest impact is on the students themselves, who we hope will have a better capacity to help save the world."

That outcome – making the world a bit better – would be a dream come true for Schubert, Noonan and the other current and former members of GHDC.

Ugandan Student Joins Case BME Grad Program

The Uganda-CWRU Research Collaboration began in 1986 when the late Frederick C. Robbins, former dean of the Case School of Medicine and Nobel laureate, visited Uganda to assist with the AIDS epidemic. In the intervening years, the partnership has yielded many results, including a relationship between Makerere University and Case Western Reserve University biomedical engineers.

Makerere launched its undergraduate degree program in biomedical engineering in 2011 and has since graduated 115 students. This fall, one of the school's alumni and research assistants, Zoe Ssekyonda, joined the Ph.D. program in Case's Biomedical Engineering Department. Umut Gurkan, the Warren E. Rupp Associate Professor in the Department of Mechanical & Aerospace Engineering with a secondary appointment in biomedical engineering, will serve as her research supervisor.

Both universities hope Ssekyonda is the first of many Makerere students to further their studies at Case Western Reserve University. "The idea is to help build research and training capacity in Uganda by helping more Ugandans get their Ph.D. training in biomedical engineering so they can go back and be faculty members and researchers there," says Andrew Rollins, professor of biomedical engineering at Case Western Reserve University.

For more information on the Global Health Design Collaboration and the Center for Engineering Action, visit:

engineering.case.edu/center-for-engineering-action

THE MAGIC OF TOUCH

Researchers have developed a neural prosthesis system that sparks the sensation of feeling.

The neural prosthesis developed in Dustin Tyler's lab is no sleight-of-hand trick. It allows research participants to not only have motor control, but also feel objects, too.

Dustin Tyler
Kent H. Smith Professor II of Biomedical Engineering
Case Western Reserve University

At last year's D60 symposium celebrating the Defense Advanced Research Projects Agency's 60th anniversary, attendees got an up-close look at DARPA's breakthrough technologies. For Brandon Prestwood, one of those technologies is both up-close and personal.

Prestwood lost his left arm below the elbow in an industrial accident in 2012. Three years ago, he became a subject in a study conducted by Dustin Tyler, Kent H. Smith Professor II of Biomedical Engineering at Case Western Reserve University. Tyler has developed a neural prosthesis system to provide sensation and human-in-the-loop control for amputees.

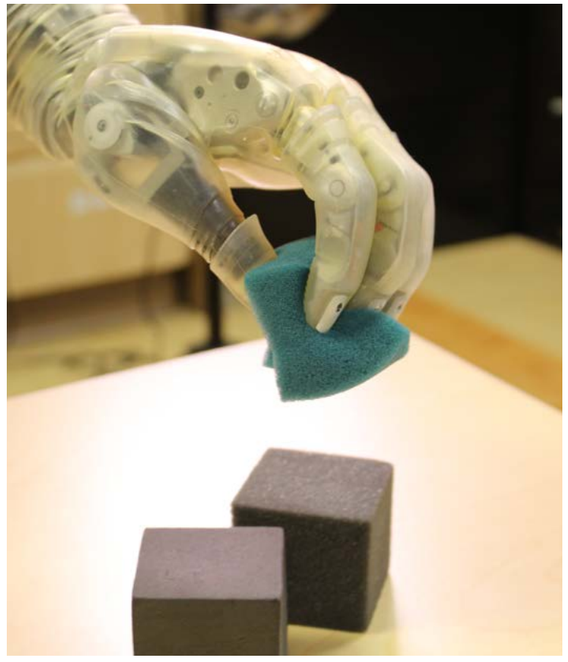
In the crowded D60 exhibit hall, Prestwood slowly extended his neural prosthesis and grasped the hand of his wife Amy. For the first time since the accident, he felt her touch with his left hand. "I felt the connection you are supposed to have," says Prestwood. "It was a life-changing moment."

Early Work in Implanted Devices

Creating life-changing moments – and technologies – has been Tyler's goal since beginning his work in neural engineering as a graduate student at Case Western Reserve University in 1992.

> "I felt the connection you are supposed to have. It was a life-changing moment."
>
> — Brandon Prestwood
> *Research Participant*

Research participants test the sensory prosthetics in the Functional Neural Interface Lab.



"My career has centered around electrode development for connecting to the nervous system, using tools like computational modeling and in vivo biologic studies, to figure out how to build a device to put electrical fields into the nerve to get different activations in the nerve," says Tyler, director of the Functional Neural Interface Lab, associate director of the Cleveland Advanced Platform for Technology (APT) Center and investigator in the Cleveland Functional Electrical Stimulation (FES) Center.

After earning his doctorate degree, Tyler worked several years for NeuroControl Corp., a Cleveland company that commercialized neurostimulation technologies first created in labs at Case Western Reserve University. Calling the experience his "second Ph.D.," Tyler says, "The skills and ideas I picked up in that industrial experience related to actual product design, design control and working with the FDA have been instrumental in enabling and guiding my current work."

After leaving NeuroControl, Tyler's initial research as a principal investigator with the Louis Stokes Cleveland Veterans Affairs Medical Center and in his Functional Neural Interface Lab centered around interfacing with the nervous system for functional purposes, such as treating dysphagia following stroke and restoring motor function to patients with upper and lower spinal cord injury.

Tyler's work on upper extremities with Robert Kirsch, chair of Case Western Reserve University's Biomedical Engineering Department, and on lower extremities with Ronald Triolo, biomedical engineering professor and executive director of the APT Center, led to clinical trials and spurred his interest in moving beyond motor function to sensory stimulation.

Tyler began his sensory stimulation work in individuals with limb loss. "The main thing that's missing for people without a limb, but otherwise able-bodied, is feeling," says Tyler. "Even with great prosthetic motor control, they can't feel anything. Many people abandon myoelectric prostheses – the current state-of-the-art for upper limb amputees – because it doesn't feel like their hand. It's just a foreign tool to them."

The Addition of a Sensory Interface

With initial funding from the VA Rehabilitation Research and Development Service, Tyler's lab created its first sensory interface, which was implanted in subjects in 2012. Sensors on the prosthesis record the pressure applied between the hand and objects as the hand closes around them. These sensors are connected to an external system that transforms the pressure signals into a neural code that is transported through wires to electrodes that are surgically implanted in the subjects' residual arms. When the neural code reaches the nerves, a connection is made between the prosthetic and the brain, which interprets the signals as a sense of feeling in the subject's own hand.

Prestwood remembers the first time Tyler's team tested the sensory interface in his prosthetic in the lab. They began gradually, increasing the electrical stimulation little by little until Prestwood felt a tingling in the tip of his index finger. "The first time I felt it, I said, 'Damn, it worked!'" recalls Prestwood. "I like to think I'm a tough guy, but I got very emotional thinking about how much this would affect me every time I touched something. It was so liberating!"

Tyler says that early tests confirmed the system could provide sensation on locations all around the hand. "We've been building on that since," he says. "When you stimulate a nerve, a message goes back to the brain and there's all kinds of relay stations and processing that happens before the subject actually perceives what that feels like. It's a very complex challenge."

Researchers in the Functional Neural Interface Lab were the first group with a permanently implanted sensory interface that's still going today. "With that, we could do a lot of different studies to begin to understand what perception is and how subjects feel different things," adds Tyler.

One of the critical changes the group has since made to the sensory system was to move from utilizing a string of square pulses, which had been used for motor function, to modulating the amplitude, pulse width and rate. "There are several different types of sensors in your fingers – rapidly adapting, slowly adapting – and different sensor modalities," says Tyler. "In normal touch, they fire differently. If you stimulate with steady square pulses for everything, they fire at the same rate. And that's not normal."

By modulating the amplitude, pulse width and rate, thereby adding more information into the sensory system, the research team changed the sensory experience for users. Rather than feeling a tingling sensation, similar to when the hand falls asleep, users get a pulsing sensation more akin to normal touch.

Tyler and his colleagues also began delving deeper

into the science of touch to decipher its patterns and dimensionality. It's no longer just a matter of whether subjects feel their hands, but rather how the brain interprets touch and where the data is processed in the body's entire sensory system.

Connections to the World

About five years ago, Tyler's lab received additional funding from DARPA's Hand Proprioception and Touch Interfaces (HAPTIX) Program, which allowed the team to create a more robust system that couples the sensory interface with implanted intermuscular electrodes. The latest system records from 16 muscles and has 64 nerve channels – double the previous system – and uses Bluetooth® wireless technology. "It's completely implanted, connects to a cell phone and users are connected to their hand," says Tyler.

The lab is waiting on approval from the Food and Drug Administration that would allow for implantations in subjects in a randomized clinical trial. Tyler is excited by the possibilities, particularly given the difference the neural prosthetic system has made in the lives of those who first tested the system outside the lab, at home, for five weeks. During the first two weeks, they used the prostheses with motor function alone, then they turned on the sensory stimulation for the third week and finally turned it back off for the last two weeks.

"In all cases, their social interaction, sense of self, wholeness and satisfaction went up significantly during that one week when sensation was on and it went back down when we turned it off again," says Tyler. Through the years working on this project, he's slowly learned just how important sensation is.

"What I didn't fully appreciate when I started – and I do now on many levels – is that the hand is the primary connection to the world," he says. "It's equally as much an emotional organ for us as it is a functional organ."

Prestwood knows that first-hand. He looks forward to having the sensory prosthetic full time so he can fish with his son Jake and hold hands with his niece Katelyn, who he calls "near-and-dear to my heart." Like Tyler, he has bigger dreams, too.

"When I first started in the study, I thought a lot about how it was going to change my life and my interactions," says Prestwood. "Soon after I had my sensation restored and some intuitive motor control, I realized it wasn't about me anymore. It's about everybody that's injured. This technology has to get out to everybody."

"What I didn't fully appreciate when I started – and I do now on many levels – is that the hand is the primary connection to the world. It's equally as much an emotional organ for us as it is a functional organ."

— Dustin Tyler
Kent H. Smith Professor II of Biomedical Engineering

The Melding of Man and Machine

The German philosopher Immanuel Kant posited that all knowledge is gained through experience and impressions of the senses. Through years of work on neural prosthetic systems that restore the sense of touch to amputees, Dustin Tyler has begun to embrace this philosophy and consider its future implications.

"What neural interfacing brings is a connection to the sensory systems," says Tyler, Kent H. Smith Professor II of Biomedical Engineering at Case Western Reserve University. "If we can control all the senses and integrate the timing appropriately, there will be no distinction between reality and the neuro-stimulated reality." Such an idea is admittedly hard to wrap your head around, but consider it a step beyond virtual reality – which primarily taps into sound and sight – to full multisensory synchrony that replicates the world around you.

These metaphysical ideas are the basis behind the Human Fusion Institute being spearheaded by Tyler. He has organized meetings among dozens of multidisciplinary experts interested in furthering the symbiotic relationship between humans and technology. The group is currently building a mission statement and defining the purpose of the Human Fusion Institute, taking into consideration philosophical, ethical, legal and regulatory issues. "Rather than thinking of technology and humans as separate, we think of how we can beneficially fuse them together," says Tyler.

One scenario where a synergetic connection between humans and technology could be advantageous is in disaster cleanup, such as after a nuclear accident when it's biologically dangerous for people to be on the ground. "If I can remove you from that physically, but put all your senses there via a synchronized device – your intelligence, creativity and critical thinking – that's revolutionary," says Tyler.

CASE-COULTER TRANSLATIONAL RESEARCH PARTNERSHIP AWARDS

$1.1 million in funding and support for promising biomedical engineering university technologies

Translational Research Partnership

The Case-Coulter Translational Research Partnership (CCTRP) between Case Western Reserve University and the Wallace H. Coulter Foundation has announced more than $1.1 million in 2019 funding and support for seven biomedical technologies.

The seven Case Western Reserve projects were selected for full program funding, which ranges from $50,000 to $200,000 each. Several additional pilot projects have or will be awarded funding by year's end. All projects are partnerships between a clinician and a biomedical engineer and are focused on solving areas of unmet clinical need.

The 13-year-old program invests more than $1 million annually in direct funding and support services to help research teams from Case Western Reserve advance products from the laboratory to the marketplace, where they can improve patient care.

The funding goes toward preparing projects for commercialization, such as demonstrating technical feasibility, and gauging their market feasibility and industry interest. The program has led to 24 startup companies and several other licenses that have delivered 30 technologies to patients.

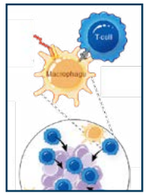
"The Case-Coulter Translational Research Partnership continues to be a cornerstone of our department, filling an essential gap to transition university biomedical technologies from research to products, where they can significantly improve the health of our society," said Robert Kirsch, the Allen H. and Constance T. Ford Professor and chair of the university's Department of Biomedical Engineering.

The Case-Coulter oversight committee reviewed 29 proposals during this cycle. Projects must have the potential to leave the university within 12 to 30 months.

"As a group, the quality of the evaluated tec hnologies continues to improve each year, demonstrating the robustness of the biomedical technology pipeline" said CCTRP Director Stephen Fening. "We had many more proposals that were deserving of inclusion into the program than we were able to accommodate, making the selection process more challenging than ever."

For more information, please visit bme.case.edu/cctrp.

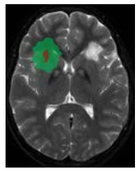
BG34-200: A Potent Immunotherapeutic for Melanoma, Osteosarcoma, Pancreatic Cancer and Other Solid Tumor Cancers



Mei Zhang, Alex Huang

A significant fraction of patients with solid tumor cancers in metastatic and advanced settings do not respond to immunotherapies due to a lack of T-cell-inflamed tumor microenvironment. This botanical-derived non-toxic BG34-200 molecule can be intravenously injected to modulate macrophages and create a tumor microenvironment that is vital for the generation of antitumor T-cell responses.

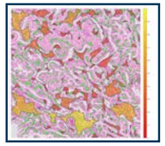
Novel Positron Emission Tomography (PET) Imaging Agent for Tumor Detection and Cancer Treatment



Susann M. Brady-Kalnay, James Basilion

Specific tumor detection is important in cancer imaging to avoid unnecessary biopsies to exclude false-positive findings and to allow treatment — or redirection of treatment — at earlier stages of the disease. Positron Emission Tomography (PET) imaging agents that specifically recognize tumor cells are necessary for improved imaging and subsequent evaluation of therapeutic efficacy independent of their metabolic rates. PTPμ is a novel imageable biomarker that can be used to specifically and more comprehensively detect and monitor aggressive invasive and metastatic tumors.

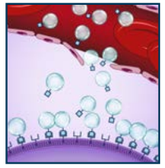
Computerized Response Assessment for Immunotherapy Score (CuRIS): Ovarian and Lung Cancer



Anant Madabhushi, Michael Yang

CuRIS is an artificial intelligence driven digital companion diagnostic tool from routine biopsy images for determining which cancer patients will benefit from immunotherapy.

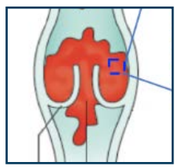
Robust Nanobubble Contrast Agents for Real-time Ultrasound Guided Prostate Cancer Biopsy



Agata Exner, James Basilion

This technology will enable a more efficient and effective prostate cancer diagnosis while building upon the existing biopsy workflow and clinical ultrasound imaging technology. The nanobubble imaging agent will specifically target prostate cancer cells and serve as a beacon guiding the urologist, in real time, to possible tumors. Nanobubble-guided biopsies could identify tumors more accurately and could lead to fewer procedures, thus reducing risk, lowering costs and shortening the time to diagnosis and treatment.

NeutroStat: Neutrophil-Targeted Nanomedicine for Treating Venous Thromboembolism (VTE)



Evi Stavrou, Anirban Sen Gupta

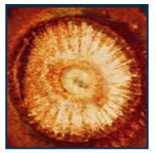
NeutroStat is a nanomedicne technology that targets neutrophil-platelet complexes at the site of growing venous thrombi for site-specific delivery of therapeutic molecules to reduce neutrophil extracellular trap formation. It promises to reduce the upstream mechanisms that drive coagulation and thrombus formation, in a highly targeted fashion, that will significantly improve therapeutic safety and efficacy in the treatment of venous thromboembolism.

Photosorb: Engineered Sunscreen with Single, Multifunctional Active Ingredient

Vijay Krishna, Edward Maytin

Every year more than one million new cases of skin cancer, including melanoma, are diagnosed in the United States. A team from Biomedical Engineering and Dermatology at Cleveland Clinic is developing a novel sunscreen (PhotoSorb) that appears to be safer and more stable than current sunscreens, and also has the potential to actually prevent skin cancers.

Three-Dimensional Ultrasound Imaging for Opthalmology



Faruk Orge, David Wilson,

A high resolution, 3D ultrasound system and software for imaging the eye. As compared to standard 2D ultrasound imaging, 3D enables rapid, intuitive understanding that will lead to improved diagnosis, treatment planning and treatment assessment in ophthalmology. 3D ultrasound enables never-before-possible visualization of ciliary processes, which are important for many eye conditions such as glaucoma.

Leaders Gather at the 2019 BME Council of Chairs Education Summit

Program Chair Eric Perreault, left, Chair of Biomedical Engineering at Northwestern University and CWRU BME alumnus, with Conference Chair Robert Kirsch, Chair of Biomedical Engineering at CWRU.

Case Western Reserve University's Biomedical Engineering Department hosted the BME Council of Chairs Education Summit in Cleveland May 29 – 31, 2019. It was the first time in a decade that the BME academic community gathered together to discuss curricula and curricular innovation. The summit attracted 325 attendees, including BME chairs, curriculum directors, faculty and industry representatives, who participated in forward-looking discussions and made recommendations for the future of biomedical engineering education.

The highlight of the summit was a plenary presentation by Bruce J. Tromberg, Ph.D., who was named director of the National Institute of Biomedical Imaging and Bioengineering (NIBIB) at the National Institutes of Health in January 2019. He shared insight on the mission and activities of NIBIB under his leadership in the Sheila and Eric Samson Pavilion of the newly-opened 11-acre Health Education Campus. A joint venture of Case Western Reserve University and Cleveland Clinic, the Health Education Campus fosters interprofessional education among medical, nursing, dental medicine and physician assistant students.

Bruce Tromberg, NIBIB Director, delivers his plenary presentation.

From left: Case BME Chair Robert Kirsch, NIBIB Director Bruce Tromberg and Cleveland Clinic BME Chair Geoff Vince after Tromberg's presentation.

I AM **HUMAN**

Cleveland Premiere

Thursday, January 30, 2020
The Idea Center at Playhouse Square

Ticket sales open November 2019
www.IAMHUMANfilm.com/Cle

I AM HUMAN, a documentary that made its debut at the 2019 Tribeca Film Festival in New York, examines the realities of neurotechnology, chronicling three research participants with experimental implantable brain treatment.

One of the participants was Bill Kochevar, who, two years ago, was the focal point of published *BrainGate2 research led by Case Western Reserve University, the Cleveland Functional Electrical Stimulation (FES) Center at the Louis Stokes Cleveland VA Medical Center and University Hospitals Cleveland Medical Center (UH).

Kochevar, a U.S. Navy veteran who was paralyzed below his shoulders in a bicycling accident, worked with investigators regularly down the hall from his home at the Cleveland VA Medical Center in the Spinal Cord Injury Long Term Care Unit.

He is believed to have been the first person with quadriplegia in the world to have arm and hand movements restored with the help of two temporarily implanted technologies: A brain-computer interface with recording electrodes under his skull, and a functional electrical stimulation (FES) system* activating his arm and hand, reconnecting his brain to paralyzed muscles.

Bob Kirsch, the Allen H. and Constance T. Ford Professor, chair of Case Western Reserve's Department of Biomedical Engineering and executive director of the FES Center, and Bolu Ajiboye, assistant professor of biomedical engineering, are principal investigators of the ongoing research.

Dustin Tyler, the Kent H. Smith Professor II of Biomedical Engineering, was also interviewed for the film and appears as a subject matter expert commenting on the field of neurotech research.

The documentary, directed and produced by Taryn Southern and Elena Gaby, examines the promises, as well as the challenges, of neurotechnology, according to the production's press materials.

"Advancements in neurotechnology are revolutionizing what it means to be human," according to the festival's description of the film. "Following three subjects who undergo brain interface (research to restore lost function), I AM HUMAN examines the ethical quandaries in brain exploration and cognitive evolution."

Along with Case Western Reserve, the Louis Stokes Cleveland VA Medical Center and the Cleveland FES Center, the film features institutions including Duke University, the University of Washington and The Wyss Center in Geneva, Switzerland.

The other two participants featured in the film are a former Canadian government information technology officer, who undergoes a novel bionic eye implantation to regain sight, and a former artist with degenerative Parkinson's Disease, who considers deep-brain stimulation as a solution to her worsening symptoms.

**CAUTION: Investigational Device. Limited by Federal Law to Investigational Use.*

CHECKING IN WITH ALUMNI

Kenneth R. Lutchen

Kenneth R. Lutchen is Dean of the College of Engineering and professor of biomedical engineering at Boston University. He received his B.S. from the University of Virginia and Ph.D. from Case Western Reserve University. He has published over 135 peer-reviewed journal articles. Lutchen was Chair of Biomedical Engineering at Boston University from 1998-2006, during which time the department ranking improved from 18th to 6th in the nation. Lutchen is past-president of the American Institute of Medical and Biological Engineering (AIMBE).

Since becoming dean of the College of Engineering at Boston University, the college's graduate ranking in US News and World Report has improved from 54th to 34th , the largest improvement of any school in the top 54 over that time. Since 2015, he has overseen the creation and resourcing of several new major research centers, including The Biological Design Center, The Precision Diagnostics Center and the Neurophotonics Center. During his deanship, he has orchestrated the creation of a new Division of Materials Science and Engineering and a new Division of Systems Engineering and Masters programs in Robotics, Cybersecurity and Data Analytics.

Recently, Lutchen oversaw the creation of a new 20,000-square-foot Engineering Product Innovation Center (EPIC) designed to partner with industry to instill interdisciplinary design and product innovation skills throughout engineering education. Lutchen has focused on transforming engineering education to create the Societal Engineer®, an individual who combines their engineering foundation with empowering attributes to address society's challenges regardless of their career paths. He also drove the creation of a unique Technology Inspiration Ambassador program that trains engineering students to inspire K-12 students to pursue engineering. In five years, this program has reached over 20,000 K-12 students in 26 states.

In 2016, Lutchen was named a member of the Advisory Committ ee to the Directorate for Engineering of The National Science Foundation. Lutchen is on the board of directors of the Wyss Institute at Harvard and serves several other academic and corporate advisory boards. In addition, he is on review panels for the NIH and NSF. Lutchen has been the recipient of the AIMBE Pierre Galletti Award, AIMBE's highest honor, and the College of Engineering's Professor of the Year Award and the Biomedical Engineering Professor of the Year Award twice.

To be featured in the next edition of the Biomedical Engineering newsletter, please send your stories to bmedept@case.edu.

REMEMBERING OUR FOUNDING FATHERS

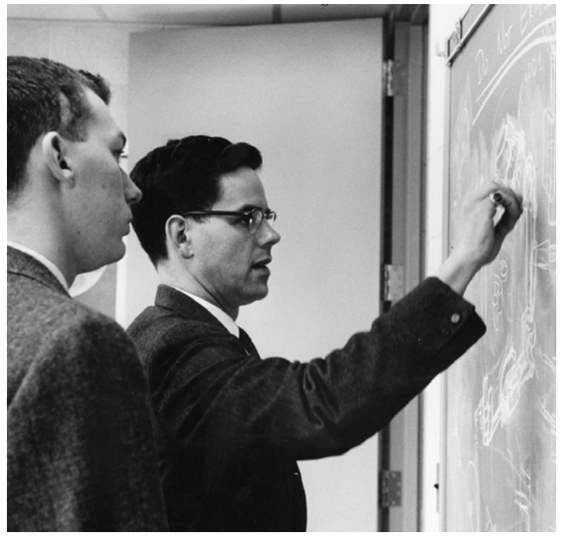
As we continue to celebrate the 50th anniversary of Case Western Reserve University's Biomedical Engineering Department, we remember yet another pivotal faculty member who helped launch the department and build it into a leader in the field. This tribute is shared by J. Thomas Mortimer, professor emeritus of biomedical engineering.

James Bigelow Reswick

James "Jim" Bigelow Reswick (1922-2013) served as the Leonard Case Professor of Engineering and director of the Engineering Design Center at the Case Institute of Technology, and later Case Western Reserve University, between 1959 and 1970. His role as a founding father of the Department of Biomedical Engineering was profound. The department was formed by pulling together two special entities that evolved during the early 1960s – Reswick's medical engineering group and Wen Ko's medical instrumentation group from the Engineering Design Center and Bob Plonsey and David Fleming's bio engineering group from the Systems Engineering Center.

Reswick was recruited to the Case Institute of Technology by Provost John Hrones, who was his mentor at the Massachusetts Institute of Technology while earning his doctor of science (Sc.D.) At Case Western Reserve University, Reswick fostered a "can-do" environment where ideas were nurtured and students were encouraged to experiment and take risks. When they failed, he treated it as a learning experience. In this environment, innovation flourished. One of the students Reswick mentored, Robert Corell, was co-awarded the 2007 Nobel Peace Prize Award for his contribution to assessment reports of the Intergovernmental Panel on Climate Change.

Reswick's middle child was born with severe neurological problems, a factor believed by those close to him to be a motivating drive for his life-long endeavor to devise engineering solutions for people with disabilities. His vision and accomplishments in this area have been recognized through numerous awards, including membership in the National Academy of Engineering, membership in the Institute of Medicine of the National Academy of Sciences, Product Designer Award, Isabel & Leonard Goldenson Award and decoration by the president of Slovenia with the "Yugoslav Flag with Golden Wreath."



Circa 1963, Robert W. Corell, left, co-awardee of the 2007 Nobel Peace Prize Award, and Jim Reswick, his mentor.

An encounter with Lojze Vodovnik from Ljubljana, Slovenia, at a meeting in the mid-1960s had a lasting impact on biomedical engineering at Case Western Reserve University. Reswick invited Vodovnik to join the Engineering Design Center in 1964, where his team had just began testing a pneumatically-powered exoskeletal arm assist device to provide hand/arm movements to subjects with paralyzed upper extremities. Vodovnik contributed the idea of powering a hand/arm assist device by electrically activating the paralyzed muscles, eliminating the need for a bulky exoskeletal structure.

It was in this environment – created by Reswick – that Vodovnik seeded what has become world-wide recognition for Case Western Reserve University's expertise in electrically activating the nervous system. Reswick created the pathway for the Department of Biomedical Engineering to become a pioneer and leader in the field.

CASE WESTERN RESERVE UNIVERSITY EST. 1826
Department of Biomedical Engineering
10900 Euclid Ave.
Cleveland, Ohio 44106-7207

Stay in touch

bme.case.edu

CWRU, Department of Biomedical Engineering @CWRUBME @CWRUBME