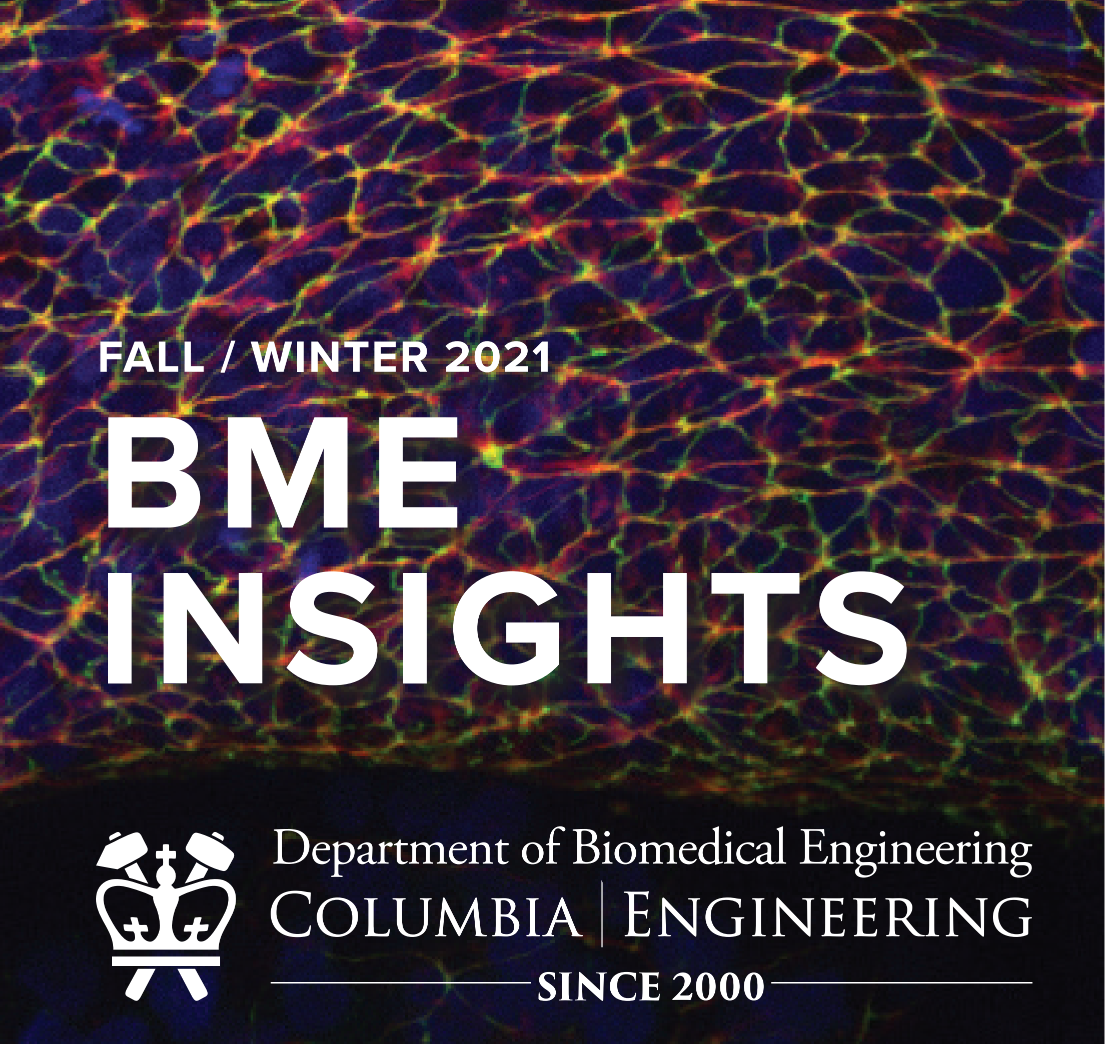

FALL / WINTER 2021

BME INSIGHTS

Department of Biomedical Engineering

COLUMBIA | ENGINEERING

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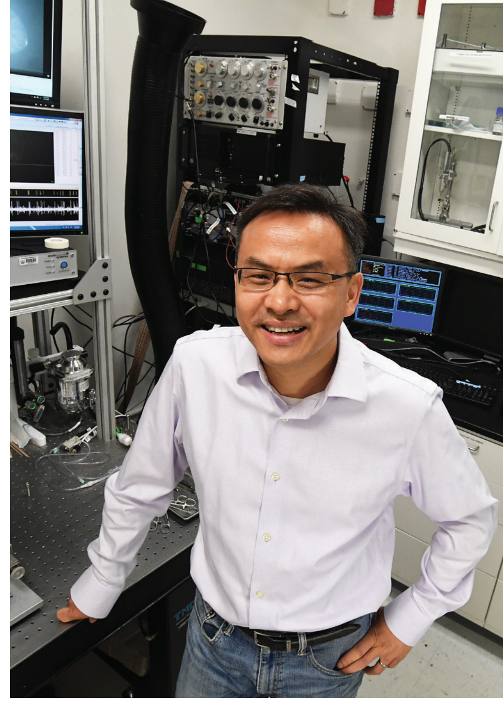
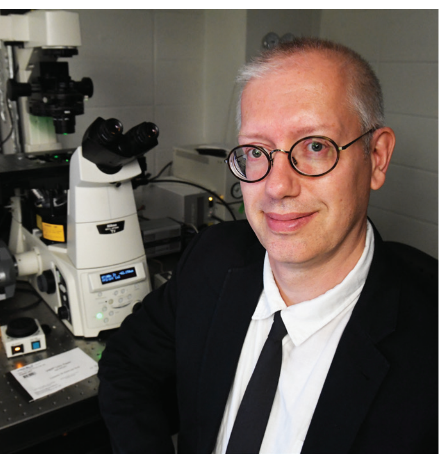
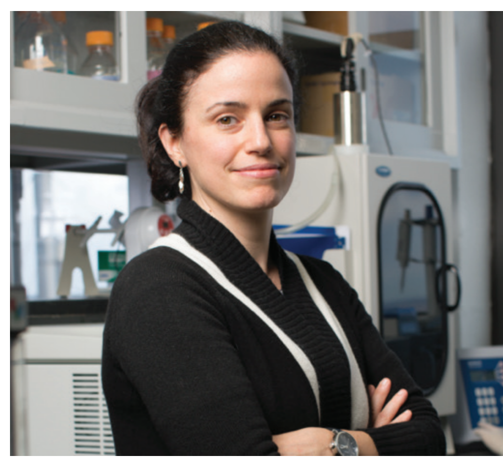
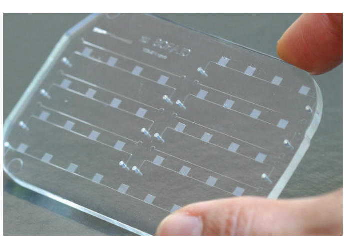
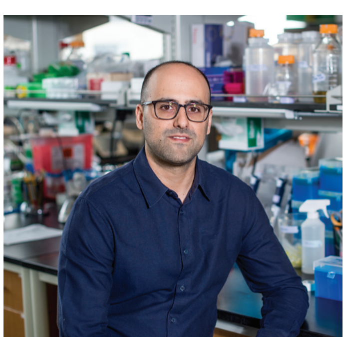










CONTENTS

Photos on front cover from top, clockwise.
1) Prof. Nandan Nerurkar studies the biophysical basis of organ formation; immunostaining image of key mechanical components in cells of the early chick embryo by BME PhD student Olivia Powell. 2) Prof. Qi Wang develops new technologies for restoring and enhancing sensory functions and cognition through brain-machine interfaces (BMI). 3) 2020 photo of students in the Columbia Engineering chapter of the National Society of Black Engineers 4) Henry Hess and his collaborators are working with molecules to figure out how to build artificial muscles that are as good as the real thing. 5) First Alzheimer's Disease Patient Enrolled in Clinical Trial at Columbia University: Elisa Konofagou's research team and the subject in the outpatient room where the procedure took place. 6) Elisa Konofagou designs and develops ultrasound-based technologies for automated estimation of tissue mechanics as well as drug delivery and therapeutics. 7) Gordana Vunjak-Novakovic and her research team have been able to grow bone grafts that will match a patient's original jaw bone for facial reconstruction surgery to repair injuries, disease, or birth defects. 8) Prototype of Sam Sia, Professor of Biomedical Engineering, point-of-care diagnostic chip. 9) Tal Danino's research explores the emerging field of synthetic biology, focusing on engineering bacteria gene circuits to create novel behaviors that have biomedical applications. 10) A group photo of Columbia BME Faculty | *Back cover photo:* Azizi Lab | *Portrait Photography:* Eileen Barroso | *Rising Stars Event Photography:* Diane Bondareff

Columbia BME in Numbers

1:4
Faculty-to-Undergraduate Student ratio

Over **$24M**
in Annual Faculty Research Expenditures 2020-2021

4
Faculty winners of the ASME Van C. Mow Medal

1
Faculty elected to the National Academy of Sciences

3
Faculty elected to the National Academy of Engineering

5
Faculty elected to the National Academy of Medicine

30
Startups launched by students and faculty since 2014

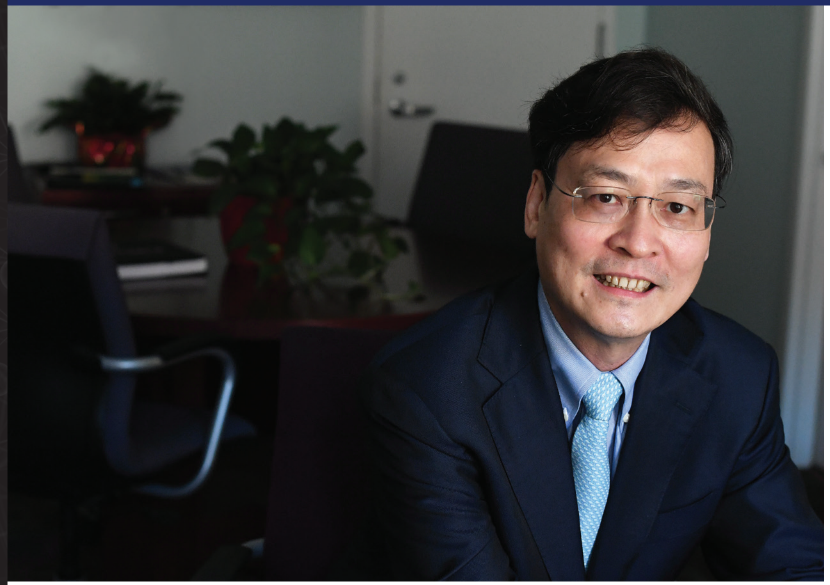
17
AIMBE Fellows in Faculty

10
Faculty Recipients of NSF CAREER Award

3
Faculty are Editor-in-Chief of prestigious industry journals

80%
of BS and MS Students Participate in Research

101 Undergraduates
180 Masters Students
161 PhD Students



A Note From the Chair

Dear Colleagues and Friends of Columbia BME,

I am very pleased to present to you the 2021 Fall/Winter Edition of Columbia University's Biomedical Engineering Insights. 2021 welcomed back our BME students as we resumed in-person education. Though this year has brought several challenges, Columbia BME faculty, staff, and students have been determined to return to "normal" while keeping everyone safe. We resumed our annual department summer retreat and faculty, staff, and students enjoyed seeing each other in-person for the first time in over a year. We have enhanced our research and education missions by building on lessons learned during the pandemic. Our BME distinguished lecture series resumed in hybrid format with both an in-person audience of Columbia students and a virtual audience on both Zoom and YouTube live stream. On December 3rd, the Department celebrated the holidays in person at our annual holiday party, and I was excited to see our faculty, staff, and students come together and celebrate in a safe manner!

Our faculty and students have continued to excel in outstanding cutting-edge research and education, and have received major awards and honors. We were very pleased to learn that Professor Elisa Konofagou was elected to the National Academy of Medicine for her pioneering work in ultrasound technology in biology and medicine, and we just learned that she has been named a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). On a related note, we were proud to learn that BME Department Vice Chair Paul Sajda was elected President of IEEE Engineering in Medicine and Biology Society, effective January 1, 2022. Columbia University and Mikati Foundation Professor of Biomedical Engineering and Medical Sciences Gordana Vunjak-Novakovic received several honors this year, including being elected Fellow of the International Academy of Medical and Biological Engineering as well as receiving the Pierre Galletti Award, the highest honor bestowed by the American Institute for Medical and Biological Engineering. She also received the Popular Prize of the European Patent Office's European Inventor Award. In January of 2021, we welcomed to our department José L. McFaline-Figueroa, assistant professor of biomedical engineering, and José has already received the prestigious NIH National Human Genome Research Institute Genomic Innovator Award.

Despite the challenges and difficulties of the pandemic, faculty and staff have been busy submitting new grants. The number of new grants submitted in FY21 has increased by 51% since FY20. We applaud our faculty for submitting a record four NIH T32 applications and two major Center grants in 2021. The two center grants are in the final stage of competition. Let us keep our fingers crossed for good news.

Our innovative BME design students swept the top three prizes at this year's Columbia Venture Competition, where more than 100 alumni judges from around the world gathered to rank Columbia startups. Our students' winning projects addressed important health-related issues including colorectal cancer, vision/hearing, and vaccination. The Columbia Venture Competition is a partnership between Columbia College, Columbia Engineering, Columbia Entrepreneurship, the School of International and Public Affairs (SIPA), and the Alliance Program that works with French universities, Sciences Po, Sorbonne University, and École Polytechnique.

Following the great success of the inaugural 2020 Rising Stars in Engineering in Health Workshop, which was held virtually in December of 2020, we were excited to invite our friends at Johns Hopkins University's Department of Biomedical Engineering to partner with us to host the workshops moving forward. Together, we co-hosted the 2021 Rising Stars Workshop in person on the Columbia campus in NYC. We celebrated the outstanding achievements

(continued)

of 20 brilliant young stars in engineering and medicine, who were carefully selected from a pool of approximately 200 applicants, and we provided an intensive training environment where each rising star was equipped with valuable tools to help them enter the faculty job market. We also welcomed back several alumni of the Rising Stars Class of 2020 as they shared their success stories in starting their academic careers. We look forward to co-hosting the 2022 Rising Stars Workshop at Johns Hopkins next year.

As we move forward into 2022, we are hopeful that the world will finally emerge from the cloud of COVID-19. Columbia BME is pleased to work with our colleagues in the New York area including the biomedical engineering departments of the City College of New York, New York University, and Stony Brook University, to host the 48th Annual Northeast Bioengineering Conference (NEBEC 2022) and the Northeast Biomedical Engineering Chairs' Summit.

We wish all our colleagues and friends in BME Happy Holidays and a Happy New Year!

X. Edward Guo, Ph.D.
Chair, Department of Biomedical Engineering;
Stanley Dicker Professor of Biomedical Engineering;
Professor of Medical Sciences (in Medicine);
Director, Bone Bioengineering Laboratory

Celebrating Faculty Excellence

Pictured left to right: BME Chair X. Edward Guo, Columbia Engineering Interim Dean Shih-Fu Chang, Prof. Elisa Konofagou, Prof. Kam Leong. Image courtesy of Mindaugas Paunksnis, MPH.

The Department of Biomedical Engineering honored Professors Leong and Konofagou with a champagne toast this fall in celebration of their election to the National Academy of Medicine in 2020 and 2021, respectively. BME Department Chair Ed Guo and Columbia Engineering Interim Dean Shih-Fu Chang both delivered heartfelt congratulatory remarks.

Celebrating Faculty Excellence

Honors, Recognition, and Achievement

Nadeen O. Chahine
Associate Professor of Biomedical Engineering (in Orthopedic Surgery)

- 2022 Orthopaedic Research Society (ORS) Adele L. Boskey, PhD Award

Tal Danino
Associate Professor of Biomedical Engineering

- 2021-2022 Columbia Life Science Accelerator Pilot Grant Winner, Columbia Cancer

Aaron Kyle
Senior Lecturer in Biomedical Engineering Design, Director of Undergraduate Studies, Director and Co-Founder Hk Maker Lab

- 2020 BMS DIversity Lecture Award, Biomedical Engineering Society

Nandan Nerurkar
Assistant Professor of Biomedical Engineering

- Maximizing the Investigator's Research Award (MIRA) for Early Stage Investigators, NIH/NIGMS

Gordana Vunjak-Novakovic
University Professor; The Mikati Foundation Professor of Biomedical Engineering and Medical Sciences; Professor of Dental Medicine; Director of the Laboratory for STEM Cells and Tissue Engineering

- 2021 Lifetime Achievement Award, Tissue Engineering & Regenerative Medicine International Society - Americas (TERMIS-AM)
- Pierre Galletti Award, AIMBE's highest honor, American Institute for Medical and Biological Engineering (AIMBE)
- Fellow, International Academy of Medical and Biological Engineering (IAMBE)
- Popular Prize, European Inventor Award, European Patent Office (EPO)
- 2021-2022 Columbia Life Science Accelerator Pilot Grant Winner, Columbia Cancer

Promotions – Tenure

Nadeen O. Chahine
Associate Professor of Biomedical Engineering (in Orthopedic Surgery)

Endowed Professorships

Paul Sajda
Vice Chair and Vikram S. Pandit Professor of Biomedical Engineering; Professor of Electrical Engineering and Radiology

Election to Professional Societies

Clark T. Hung
Professor of Biomedical Engineering and Orthopaedic Sciences (in Orthopedic Surgery); Director, Master's Studies in Biomedical Engineering

- Fellow, Orthopaedic Research Society (ORS)

Elisa Konofagou
Robert and Margaret Hariri Professor of Biomedical Engineering and Professor of Radiology

- Fellow, Institute of Electrical and Electronics Engineers (IEEE)
- Member, National Academy of Medicine

J. Thomas "Tommy" Vaughan, Jr.
Professor of Biomedical Engineering and Radiology (Physics)

- Fellow, American Institute for Medical and Biological Engineering College of Fellows (AIMBE)

Teaching Awards

Katherine Reuther
Senior Lecturer, Biomedical Engineering

- 2021 Presidential Award for Outstanding Teaching, Columbia University

Scholarly Leadership

Nadeen O. Chahine
Associate Professor of Biomedical Engineering (in Orthopedic Surgery)

- Standing Member on NIH CSR Skeletal Biology and Skeletal Regeneration (SBSR) Study Section

Elizabeth Olson
Professor, Departments of Otolaryngology, Head and Neck Surgery and BME

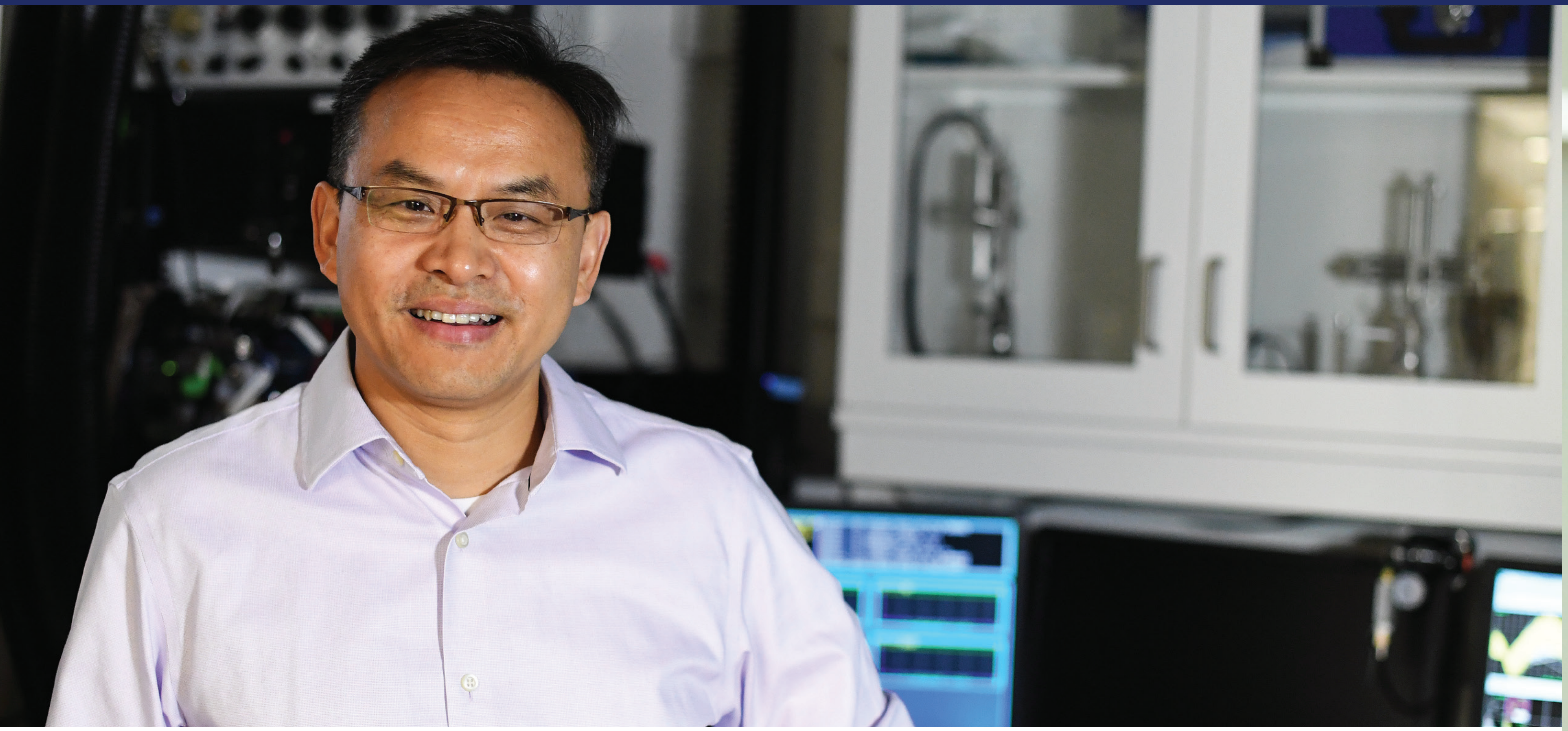
- President-Elect of the Association for Research in Otolaryngology (beginning Feb.2021), Association for Research in Otolaryngology (ARO)

Gordana Vunjak-Novakovic
University Professor; The Mikati Foundation Professor of Biomedical Engineering and Medical Sciences; Professor of Dental Medicine; Director of the Laboratory for STEM Cells and Tissue Engineering

- Committee on Membership, National Academy of Engineering

Paul Sajda
Vice Chair and Vikram S. Pandit Professor of Biomedical Engineering; Professor of Electrical Engineering and Radiology

- President (January 1, 2022 - December 31, 2025), IEEE Engineering in Medicine and Biology Society (EMBS)



Faculty Q&A: Qi Wang

Qi Wang develops new technologies for restoring and enhancing sensory functions and cognition through brain-machine interfaces (BMI). He has been working on cracking neural codes underlying our perception and cognition, and has been developing new strategies for selectively activating neural circuitry.

Q: How would the technology help in enhancing sensory functions and cognition in the next ten years?

Information processing in the brain is intrinsically noisy and naturally fluctuates dramatically throughout a normal day. Just imagine the difference in your grade on an exam that you take when you are drowsy versus when you are alert. The technology we work on aims to regulate the fluctuation of information processing in the brain. We can do this through control of neural activity of a critical brain region called the locus coeruleus, which is important to information processing because it is the only brain region that produces norepinephrine, an essential neurotransmitter, for the forebrain.

We have demonstrated that the direct stimulation of the locus coeruleus significantly improves the information processing of sensory signal and cognition in animal models. We are now testing, at a startup spun off our lab, the extent to which activation of the locus coeruleus, through non-invasive neural interfaces, improves sensory performance in touch, vision and hearing tasks. In the next ten years, we expect our wearable neural devices will help people enhance their sensory and cognition functions in an on-demand fashion.

Q: How did you initially get interested in the neuroscience field?

During my PhD in electrical and computer engineering, I engineered many haptic devices to produce various tactile illusions. I was profoundly intrigued by the fact that our brain can be easily tricked if we know how it processes external sensory information, like a hacker hacking into a computer system if he knows how the system was programed. This stimulated my interestnin understanding how the brain works and how to use brain-machine interfaces to make the information processing in the brain faster and more robust.

Q: How would you describe the process of modelling the interactions between different brain regions during sensory processing and what variables are involved?

Sensory information is processed in the brain by a complex interconnected neuronal network involving millions of neurons, with various types in different brain regions. Limited by the current technology, we are currently unable to record from every neuron in the neuronal network. Using our basic understanding of biophysics of individual types of neurons, computational modelling provides a physiologically realistic way to simulate neuronal responses to sensory signals under different conditions. As such, we are able to simulate the functional roles of each type of neuron in the complex network in processing information, and to predict the functional consequences of pathological changes of one type of neuron in certain diseases. In our modelling, the effects of all major neurotransmitters and the dynamics of various types of membrane channels are taken into account.

Faculty Q&A: Joshua Jacobs

Joshua Jacobs and his laboratory examine the neural basis of human spatial navigation and spatial memory. This work is performed by conducting direct brain recordings from epilepsy patients that have electrodes implanted surgically in deep brain structures. Via these recordings, he and his team identify neural patterns that reveal how the brain represents memory for spatial locations and maps.

Q: How would you sum up the big idea of neutral patterns of human spatial navigation?

A big idea in my research is that during spatial navigation the brain has individual neurons that represent where we are located and where we are trying to go. I am trying to understand this network of navigational brain cells, not only to explain how we navigate, but also to explain other related processes such as memory for spatial locations.

Q: There are a few goals described in the work you are doing. What would be the ultimate outcomes of this research?

The ultimate goal of my research is for us to have a deep understanding of how the brain supports navigation and memory such that we know what has gone wrong when this system does not work correctly. This would allow us to better treat people who have disorders of spatial disorientation or poor memory function.

Q: The research you are doing involves helping people who experience cognitive impairment due to aging or disease. How would you describe the brain stimulation protocols that you are currently working on?

One way in which we are trying to help people with poor memory and navigation is with the use of brain stimulation. We are currently developing and testing new brain stimulation protocols that might help people to better navigate and remember environments. These systems work by using brain stimulation to help the brain to recreate its own innate signals that naturally support memory, thus giving the brain a boost when it needs it.

Prof. Gordana Vunjak-Novakovic Receives AIMBE's Highest Honor

The American Institute for Medical and Biological Engineering (AIMBE) is honored to recognize Columbia University Professor and Mikati Foundation Professor of Biomedical Engineering and Medical Sciences, Gordana Vunjak-Novakovic, with its 2021 Pierre Galletti Award, the Institute's highest accolade.

Including years of contributions to AIMBE and the BME community, Vunjak-Novakovic is recognized for impactful innovations in technologies to generate, understand and utilize functional human tissues, especially in regenerative engineering, studies of development and disease, while inspiring the next generation of practitioners.

This award is presented to an individual in recognition of her contributions to public awareness of medical and biological engineering, and to the advancement of biomedical public policy in science, engineering, and education.

The award was presented at the 2021 AIMBE Annual Meeting.

Fall 2021 Biomedical Engineering Seminar Series

September 24	Juergen Hahn, Ph.D., BME Department Head, RPI
October 1	Rong Fan, Ph.D., Yale University
October 15	James Wells, Ph.D., Cincinnati Children's Hospital
October 22	Aaron Batista, Ph.D., University of Pittsburgh
October 29	Dan Huh, Ph.D., University of Pennsylvania
November 5	Milan Yager, MPA, Executive Director, AIMBE
November 12	Ashley Laughney, Ph.D., Weill Cornell Medicine
November 19	Laurel Carney, Ph.D., University of Rochester
November 19-20	Rising Stars in Engineering in Health Workshop
December 3	Maribel Vazquez, Sc.D., Rutgers University

FACULTY HIGHLIGHTS

Clark Hung Selected to 2021 ORS Class of Fellows

Clark Hung, Professor of Biomedical Engineering and Professor of Orthopaedic Sciences (in Orthopedic Surgery) and Director of the Cellular Engineering Laboratory, has been selected to the 2021 Orthopaedic Research Society (ORS) Class of Fellows. Professor Hung is recognized by ORS for his exemplary service, leadership, achievement, expert knowledge & contributions, representing ORS as a thought leader & expert in the field of musculoskeletal research, and serving as a role model in the ORS community.

"I started attending the ORS annual meeting when I was a doctoral student, and it has been my home professional society ever since," says Hung. "It is rewarding to see former students at the annual meeting who are now active independent investigators, training their own students, and doing amazingly well in the field." Professor Hung has served as an associate editor for Journal of Orthopaedic Research, the flagship ORS journal, for the past 12 years and he credits this role as having "provided [him] the opportunity to keep a finger on the pulse of the field, as well as to have some impact on its direction."

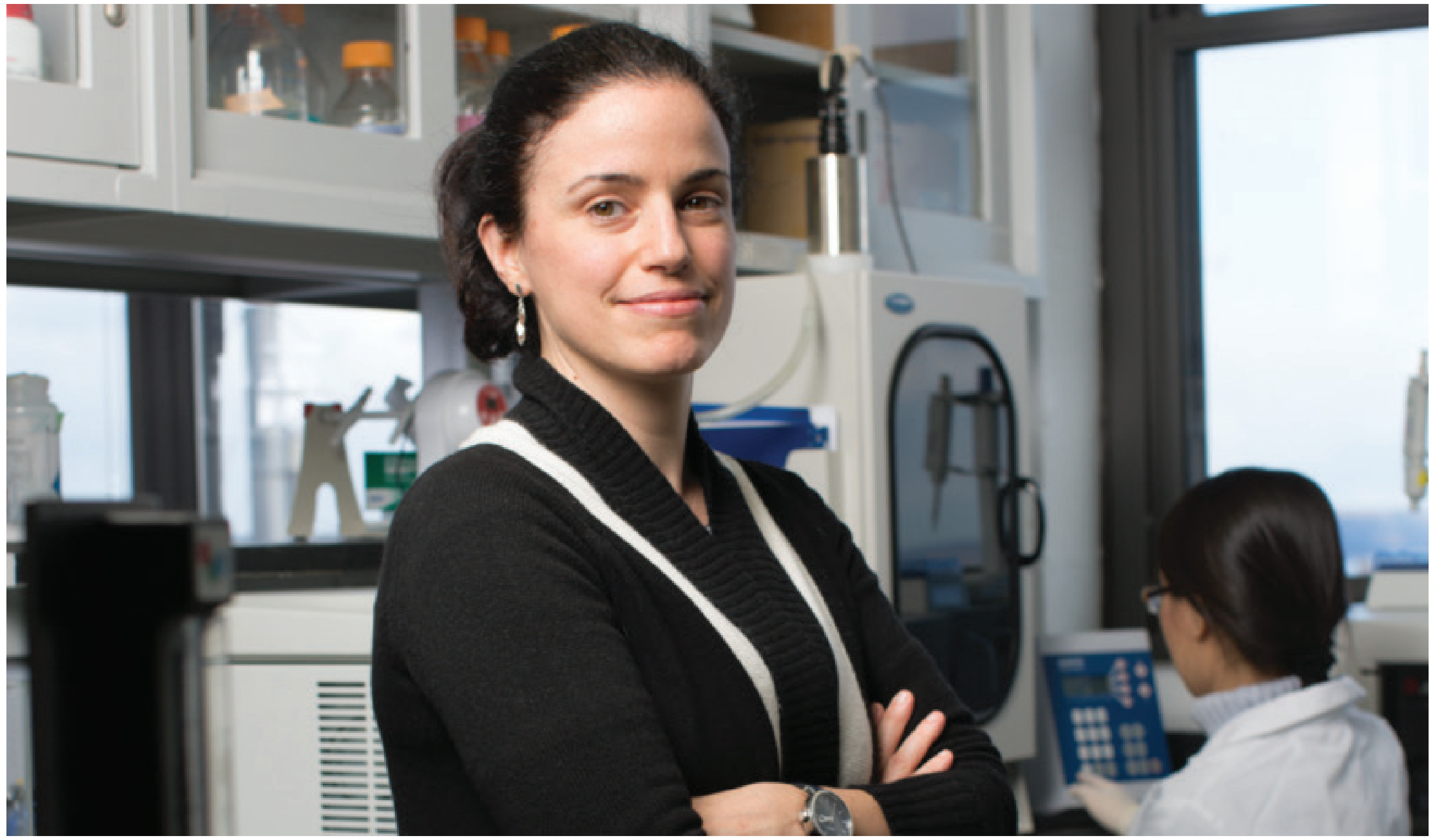
"My involvement with ORS has truly shaped my career," he remarks, "and was a catalyst for many friendships and collaborations."

Spring 2022 Biomedical Engineering Seminar Series

January 21	Tyrone Porter, Ph.D., The University of Texas at Austin
January 28	Rusty Lansford, Ph.D., USC
February 4	Charles Gersbach, Ph.D., Duke University
February 11	Yamuna Krishnan, Ph.D., University of Chicago
February 17	Engineering in Medicine Symposium
February 25	Douglas Weber, Ph.D., Carnegie Mellon University
March 4	Mitra Hartmann, Ph.D., Northwestern University
March 11	Jude Phillip, Ph.D., Johns Hopkins University
March 24-26	48th Annual Northeast Bioengineering Conference (NEBEC)
April 1	Xue Han, Ph.D., Boston University
April 8	Srivalleesha Mallidi, Ph.D., Tufts University
April 15	Bryan Bryson, Ph.D., MIT
April 22	Aaron Streets, Ph.D., UC Berkeley

Elisa Konofagou Elected to the National Academy of Medicine

Biomedical engineer honored for her leadership and innovation in ultrasound imaging and therapeutics in medical practice and treatmentt



Elisa Konofagou, the Robert and Margaret Hariri Professor of Biomedical Engineering and Professor of Radiology at Columbia University, has been elected a member of the National Academy of Medicine (NAM), one of the highest honors in the fields of health and medicine. Election to the Academy recognizes individuals who have demonstrated outstanding professional achievement and commitment to service. The NAM cited Elisa's "leadership and innovation in ultrasound and other advanced imaging modalities and their application in the clinical management of significant health care problems such as cardiovascular diseases, neurodegenerative diseases, and cancer, through licensing to the major imaging companies."

"I am delighted and humbled after receiving this wonderful news! Thank you to the NIH for your support," says Konofagou. "I owe this tremendous honor to all the extremely talented students, postdoctoral fellows and staff that have come through my lab over the years. I also owe this recognition to my colleagues and collaborators, both at Columbia Engineering and Columbia University Irving Medical Center. It has been an absolute privilege and honor to work on important clinical problems that we as engineers could help solve, but also benefit from the clinical perspective on what a patient may need for a more accurate diagnosis, targeted treatment, or better quality of life. I am also indebted to the patients in our studies for their time to allow us to develop and test our technologies."

Konofagou continues, "I feel especially fortunate to have grown as faculty in a Department and School that actively support creativity and innovation with the right infrastructure—whether that means laboratory space contiguous with clinical facilities or connecting engineers with biologists and clinicians—to not only unveil mechanisms, but also to translate clinically relevant approaches. Finally, I owe everything to my family, my husband, Simos, and our two kids, Philippos and Aris, for inspiring me and supporting me every day to push through."

As Director of the Ultrasound and Elasticity Imaging Laboratory, Konofagou's research focuses on the development of novel elasticity imaging techniques and therapeutic ultrasound methods and, more notably, focused ultrasound in the brain for drug delivery and stimulation, myocardial elastography, electromechanical and pulse wave imaging, harmonic motion imaging with several clinical collaborations in the NewYork-Presbyterian/Columbia University Irving Medical Center and elsewhere.

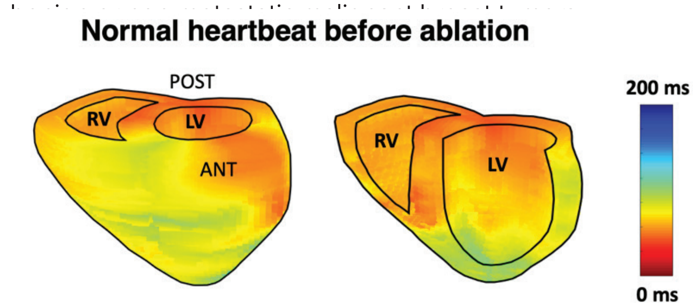
> **"Her work in therapeutic ultrasound is widely acknowledged as breaking new ground in medical practice and treatment. Her pioneering research and translation effort is a true testament to the impact of cross-disciplinary collaboration between engineering and medicine.** —SHIH-FU CHANG, INTERIM DEAN COLUMBIA ENGINEERING

"We are thrilled that Professor Konofagou has received this much deserved recognition from the National Academy of Medicine," said Shih-Fu Chang, interim dean of Columbia Engineering. "Her work in therapeutic ultrasound is widely acknowledged as breaking new ground in medical practice and treatment. Her pioneering research and translation effort is a true testament to the impact of cross-disciplinary collaboration between engineering and medicine. This is a great honor for Elisa, for Columbia Engineering, and for the University as a whole, and we congratulate her wholeheartedly."

For her doctoral work, Konofagou was instrumental in the development of elastography, a technique that images organs and tumors based on their distinct elasticity, for breast cancer diagnosis. The technique has been licensed by ultrasound imaging manufacturers worldwide to better aid in early detection of inconspicuous or suspicious lesions. Her group is currently developing elastography for the early detection of myocardial ischemia and infarction in the heart as well as electromechanical imaging of cardiac arrhythmias.

In the vascular realm, Konofagou's team is developing approaches for prevention of ischemic stroke through elasticity and flow imaging of the carotid arteries for the characterization of atherosclerotic lesions. The technique her group has pioneered, Pulse Wave Imaging, can both map the compliance of the atherosclerotic wall but also the wall-shear stress as a result of the flow changes that together can serve as important biomarkers in vulnerable plaque detection and characterization.

Her group is also building on her earlier work in cancer diagnosis by evaluating chemotherapeutic response or monitoring ultrasound ablative treatment. Konofagou has devised methodologies that detect the change in tumor elasticity prior to tumor volume changes with success in preclinical mouse models of breast and pancreatic cancer. Her group designed and implemented an all-ultrasound clinical system for detection and monitoring of chemotherapy or ultrasound ablative therapy; the latter targeting only the breast tumor itself for efficient annihilation of its growth. Her team has two clinical trials in patients with breast cancer: detecting early response to neoadjuvant chemotherapy and performing safe and efficient ultrasound ablative treatment of



Electromechanical wave imaging (EWI) activation maps are capable of localizing the arrhythmic origin and differentiating irregular beats (figure 2) from consecutive normal sinus rhythm beats (figure 1) on the same patient before ablation.

Konofagou's work has also proven pivotal in the brain, which is an especially hard organ to deliver drugs to, partly because of the blood-brain barrier, a membrane that lines all the blood vessels in the brain and acts as a formidable filter of all circulating compounds including drugs. Her group has shown that temporarily lifting the barrier using ultrasound and microbubbles allows proteins, antibodies, chemotherapeutic drugs, and gene delivery vectors to penetrate all the way to the neurons to restore dopaminergic neurons in Parkinson's patients and reduce tumor burden in glioma tumors in mouse animal models. Her group has also published on drug-free BBB opening for the reduction of tau and amyloid in Alzheimer's through immune cell activation. This work is now being translated to Alzheimer's patients where similar amyloid reduction is reported, and to Parkinson's patients and pediatric tumor patients. Konofagou's team is also pioneering theranostic approaches that combine imaging and therapeutics for noninvasive deep brain stimulation, peripheral nerve modulation, and mapping of normal

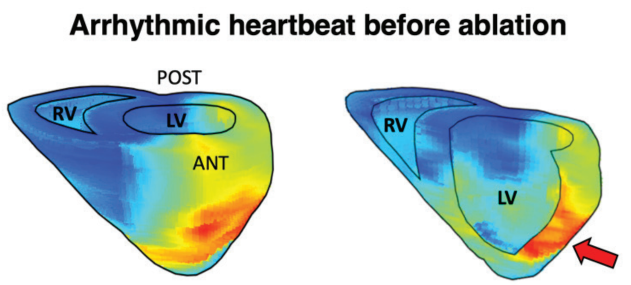
(continued)

human brain circuitry. Preliminary findings have shown that such approaches could one day have an impact in pain management as well as treatment of addiction or psychiatric disorders.

Biomedical Engineering Chair X. Edward Guo, Stanley Dicker Professor of Biomedical Engineering and professor of medical sciences, said, “On behalf of the Department of Biomedical Engineering, we are very pleased to learn this great news and we are extremely happy for Elisa as she receives this well deserved and huge honor.”

“I must admit that I am not at all surprised,” Guo added. “Elisa has maintained high octane research in ultrasound for almost two decades, with more than five concurrent National Institutes of Health R01 Grants over the past 10 years. Her work in ultrasound research is groundbreaking, highly innovative, and transformative, and this is just the beginning of her fantastic career. We expect many more revolutionary discoveries to come from her research.”

“Not only is Elisa a fabulous researcher, but she is also a great teacher and a great leader in our Department,” Guo continued. “She led our graduate committee for many years and currently serves as the chair of our Diversity, Equity, and Inclusion committee. Congratulations, Elisa! We are excited to celebrate your future discoveries and honors.”



Electromechanical wave imaging (EWI) activation maps are capable of localizing the arrhythmic origin and differentiating irregular beats (figure 2) from consecutive normal sinus rhythm beats (figure 1) on the same patient before ablation.

Konofagou is an elected fellow of the American Institute of Biological and Medical Engineering, a member of the Institute of Electrical and Electronics Engineers in Engineering in Medicine and Biology (IEEE-EMBS), IEEE in Ultrasonics, Ferroelectrics and Frequency Control Society, the Acoustical Society of America, and the American Institute of Ultrasound in Medicine. Konofagou has co-authored more than 240 published articles in the aforementioned fields. She is also a technical committee member of the Acoustical Society of America, the International Society of Therapeutic Ultrasound, the IEEE Engineering in Medicine and Biology conference, the IEEE International Ultrasonics Symposium, and the American Association of Physicists in Medicine.

Konofagou serves as associate editor for the journals of IEEE Transactions in Ultrasonics, Ferroelectrics and Frequency Control, Ultrasonic Imaging, and Medical Physics, and is a recipient of numerous prestigious awards, including the National Science Foundation CAREER award, the NIH Edward C. Nagy New Investigator Award, and the IEEE-EMBS Technological Achievement Award as well as additional recognitions by the American Heart Association, the Acoustical Society of America, the American Institute of Ultrasound in Medicine, the American Association of Physicists in Medicine, the Wallace H. Coulter foundation, the Bodossaki foundation, the Society of Photo-optical Instrumentation Engineers, and the Radiological Society of North America.

Konofagou received a BS in chemical physics from Université de Paris 6 in 1992, a MS in biomedical engineering from Imperial College (London) in 1993, and a PhD in biomedical engineering from the University of Houston in 1999.

Konofagou joins Columbia Engineering colleagues Van C. Mow, Stanley Dicker Professor Emeritus of Biomedical Engineering and Professor Emeritus of Orthopaedic Engineering (elected 1998); Gordana Vunjak-Novakovic, University Professor and Mikati Foundation Professor of Biomedical Engineering (elected 2014); and Kam Leong, Samuel Y. Sheng Professor in the departments of biomedical engineering and systems biology (elected 2020), in receiving this highly prized honor.

Established originally as the Institute of Medicine in 1970 by the National Academy of Sciences, the National Academy of Medicine addresses critical issues in health, science, medicine, and related policy and inspires positive actions across sectors. NAM works alongside the National Academy of Sciences and National Academy of Engineering to provide independent, objective analysis and advice to the nation and conduct other activities to solve complex problems and inform public policy decisions.

Featured Faculty: Gordana Vunjak-Novakovic, PhD

Professor Gordana Vunjak-Novakovic Elected IAMBE Fellow

Gordana Vunjak-Novakovic, University Professor, has been elected to be a Fellow of the International Academy of Medical and Biological Engineering (IAMBE), for her “pioneering studies in engineering functional human tissues for regenerative medicine and study of diseases.” This honor is in recognition of Vunjak-Novakovic’s distinguished contributions to and leadership in the field of medical and biological engineering on an international level.

IAMBE comprises fellows who are recognized for their outstanding contributions to the profession of medical and biological engineering. The election to IAMBE represents a highly selective process and there are currently some 200 living IAMBE Fellows.

Vunjak-Novakovic, currently the Mikati Foundation Professor of Biomedical Engineering and Medical Sciences, reacted to the announcement, “I am delighted to join this group of distinguished colleagues that I have long admired.” She directs the Laboratory for Stem Cells and Tissue Engineering, which is focused on engineering human tissues for regenerative medicine, stem cell research, and modeling of disease, drug safety, and efficacy.

Professor Gordana Vunjak-Novakovic Wins European Inventor Award by Popular Acclaim

In an online ceremony on June 21, the European Patent Office (EPO) in Munich, Germany, awarded Professor Gordana Vunjak-Novakovic the Popular Prize of this year’s European Inventor Award. Presented annually, the prestigious honor recognizes outstanding inventors making exceptional contributions around the world. A University Professor and the Mikati Foundation Professor of Biomedical Engineering and Medical Sciences, Vunjak-Novakovic was overwhelmingly selected by popular vote among 15 accomplished candidates. The Serbian-American scientist, who directs the Laboratory For Stem Cells And Tissue Engineering, was cited for opening “new horizons in regenerative medicine by developing a way of growing new tissue ex vivo (outside the body) using the patient's own cells . . . with a ground-breaking approach [that] offers a safer, more precise and less intrusive way of performing facial reconstruction, and holds promise for replacing damaged lung and heart tissue.”

The award underlines how innovation can make an impact almost everywhere, notes EPO President António Campinos: "After an incredibly challenging year, public enthusiasm for Gordana Vunjak-Novakovic’s invention also reflects a firm optimism that human creativity, passion for innovation, and ingenuity will help us move towards a brighter future.”

Prof. J. Thomas "Tommy" Vaughan Jr. Elected AIMBE Fellow

J. Thomas “Tommy” Vaughan, Jr, professor of biomedical engineering and radiology, director of The Columbia Magnetic Resonance Research Center, and principal investigator at Columbia's Zuckerman Institute, was elected to the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows. In awarding the honor, AIMBE cited his groundbreaking developments of magnetic resonance imaging, spectroscopy and fMRI technologies for applications in science and medicine.

A leading pioneer in magnetic resonance (MR) and its broad utility in science and medicine, Vaughan joined Columbia as director of research in 2016 to launch a new university-wide initiative to develop and apply MR methods and technologies to advance biomedical research and clinical diagnostics. With 52 patents to his name, Vaughan designs and builds the MRI systems that produce non-invasive high-resolution images of anatomical, metabolic, and physiological systems and functions. His inventions, which are usually licensed by the biotech and medical industries, are found in most MRI systems.

Vaughan is developing new research tools at Columbia Engineering and applying them to basic research at the Zuckerman Mind, Brain, Behavior Institute and to translational research at the Columbia University Irving Medical Center. Although widely used in some countries, MRI is not available to 70% of the world’s population. One of Vaughan’s many projects is to build a system that can provide access to MRI diagnostics anywhere in the world. He, together with colleagues from the University of Minnesota and other international institutions, has received three National Institutes of Health BRAIN Initiative grants to develop and build such a system.

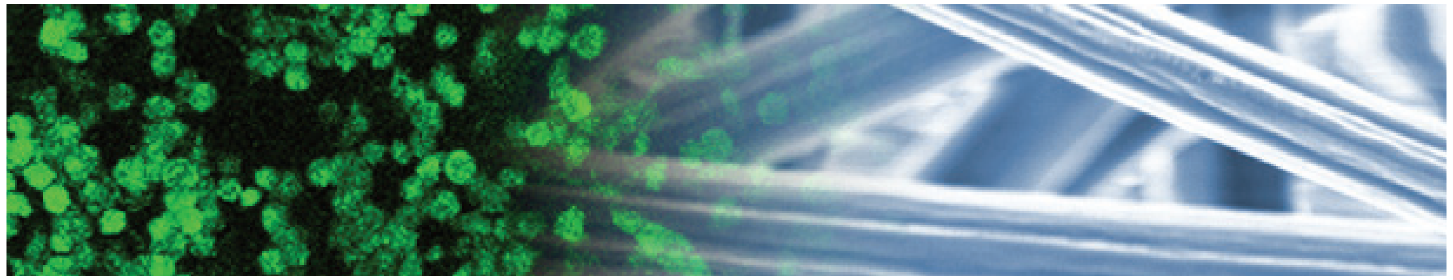
Another project is the development and delivery of a 9.4T human neuroimager to be located in a lab under Vaughan’s direction at the New York State Nathan Kline Institute. To be shared with Columbia and other NYC-area institutions, this will be one of the most powerful MR systems in the world for human neuroscience applications. The 9.4T magnet for this project has already arrived.

Vaughan, who has co-authored more than 140 research papers and a number of book chapters as well as several books, is a fellow of the IEEE and ISMRM societies, serves on the editorial board of NMR in Biomedicine, and is active in NIH and journal peer reviews. He is also the CTO of three small biotech businesses, including Life Service, LLC; MR Safe Devices, LLC; and MR Access, Inc.

He will join 174 colleagues of the AIMBE Fellow Class of 2021 when they are formally inducted at a ceremony on March 26 during AIMBE’s 2021 Annual Event. AIMBE’s College of Fellows is comprised of the top two percent of medical and biological engineers in the country.

"Greening” Biomaterials and Scaffolds Used in Regenerative Medicine

Columbia Engineers develop new “green electrospinning” process that could transform biofabrication, enabling production of nano-biomaterials that is scalable with minimal environmental impact



Live cells (left) fabricate a biologically relevant extracellular matrix on “green” electrospun fibers (right) for tissue regeneration

Green manufacturing is becoming an increasingly critical process across industries, propelled by a growing awareness of the negative environmental and health impacts associated with traditional practices. In the biomaterials industry, electrospinning is a universal fabrication method used around the world to produce nano- to microscale fibrous meshes that closely resemble native tissue architecture. The process, however, has traditionally used solvents that not only are environmentally hazardous but also pose a significant barrier to industrial scale-up, clinical translation, and, ultimately, widespread use.

Researchers at Columbia Engineering report that they have developed a "green electrospinning" process that addresses many of the challenges to scaling up this fabrication method, from managing the environmental risks of volatile solvent storage and disposal at large volumes to meeting health and safety standards during both fabrication and implementation.

The team’s new study, published June 28, 2021, by Biofabrication, details how they have modernized the nanofiber fabrication of widely utilized biological and synthetic polymers (e.g. poly-α-hydroxyesters, collagen), polymer blends, and polymer-ceramic composites. The study also underscores the superiority of green manufacturing. The group’s “green” fibers exhibited exceptional mechanical properties and preserved growth factor bioactivity relative to traditional fiber counterparts, which is essential for drug delivery and tissue engineering applications. Regenerative medicine is a $156 billion global industry, one that is growing exponentially.

The team of researchers, led by Helen H. Lu, Percy K. and Vida L.W. Hudson Professor of Biomedical Engineering, wanted to address the challenge of establishing scalable green manufacturing practices for biomimetic biomaterials and scaffolds used in regenerative medicine.

“We think this is a paradigm shift in biofabrication, and will accelerate the translation of scalable biomaterials and biomimetic scaffolds for tissue engineering and regenerative medicine,”

said Lu, a leader in research on tissue interfaces, particularly the design of biomaterials and therapeutic strategies for recreating the body’s natural synchrony between tissues. “Green electrospinning not only preserves the composition, chemistry, architecture, and biocompatibility of traditionally electrospun fibers, but it also improves their mechanical properties by doubling the ductility of traditional fibers without compromising yield or ultimate tensile strength. Our work provides both a more biocompatible and sustainable solution for scalable nanomaterial fabrication.”

The team, which included several BME doctoral students from Lu’s group, Christopher Mosher PhD’20 and Philip Brudnicki, as well as Theanne Schiros, an expert in eco-conscious textile synthesis who is also a research scientist at Columbia MRSEC and assistant professor at FIT, applied sustainability

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principles to biomaterial production, and developed a green electrospinning process by systematically testing what the FDA considers as biologically benign solvents (Q3C Class 3). They identified acetic acid as a green solvent that exhibits low ecological impact (Sustainable Minds® Life Cycle Assessment) and supports a stable electrospinning jet under routine fabrication conditions. By tuning electrospinning parameters, such as needle-plate distance and flow rate, the researchers were able to ameliorate the fabrication of research and industry-standard biomedical polymers, cutting the detrimental manufacturing impacts of the electrospinning process by three to six times.

Green electrospun materials can be used in a broad range of applications. Lu's team is currently working on further innovating these materials for orthopaedic and dental applications, and expanding this eco-conscious fabrication process for scalable production of regenerative materials.

"Biofabrication has been referred to as the 'fourth industrial revolution' following steam engines, electrical power, and the digital age for automating mass production," noted Mosher, the study's first author. "This work is an important step towards developing sustainable practices in the next generation of biomaterials manufacturing, which has become paramount amidst the global climate crisis."

Prof. Nandan Nerurkar Awarded Five-year Grant from the National Institutes of Health and the National Institute of General Medical Sciences

Professor Nandan Nerurkar has earned a major five-year grant totaling $2 million from the National Institutes of Health (NIH) and the National Institute of General Medical Sciences (NIGMS). The Maximizing Investigators' Research Award (MIRA) will support his research into the biophysical and biochemical intricacies of how early-stage embryos develop from clusters of stem cells into complex and precisely patterned organisms.

A member of the department of Biomedical Engineering, Nerurkar investigates how tissues and organs form in developing embryos via interwoven genetic, molecular, and biophysical cues. Utilizing live in vivo imaging of early-stages in a classical embryology model system, the chicken embryo, his Morphogenesis and Developmental Biomechanics Lab explores how developmental signals specify the forces that influence tissue growth and stem cell differentiation, including in birth defects when such processes go awry. Ultimately, he seeks to uncover design principles of embryonic tissue formation for applications in regenerative medicine and tissue engineering.

The MIRA grant will support Nerurkar's work in building highly quantitative perspectives on the many factors affecting embryonic development, particularly in understanding how stem cells in the embryo become fated to give rise to specific tissues. His lab has recently identified a special class of cells uniquely capable of spawning a remarkably wide range of cell types, which he believes could be transformative across the fields of developmental biology and stem cell reprogramming.

FEATURED NEWS

How egocentric bearing cells behaved

Newfound Human Brain Cell Type Helps Center People in Mental Maps

Experiments in virtual reality shed light on the cellular mechanisms underlying navigation and memory in humans

A previously unknown kind of human brain cell appears to help people center themselves in their personal maps of the world, according to a new study from neuroscientists at Columbia Engineering. This discovery sheds light on the cellular mechanisms underlying navigation and memory in humans, as well as what parts of the brain might get disrupted during the kinds of memory impairments common in neurodegenerative diseases such as Alzheimer's.

There are two strategies with which humans and animals navigate and orient themselves. One involves locating places, distances and directions in "allocentric" or other-centered frames of reference rooted in the external world. The other strategy involves "egocentric" frames of reference that are centered on the self.

Whenever you use a mobile phone app to find driving directions, it will likely employ both these modes of navigation. When you first type in an address, it will normally show you the address on a map from an allocentric perspective, with 'north' at the top and 'south' at the bottom. When you then go to route view, it will switch to an egocentric perspective where 'ahead' is at the top and 'behind' is at the bottom.

Scientists first discovered brain cells linked with allocentric frames of reference in rats in 1971 — "place cells" that may, for example, indicate that one is located in the northeast corner of an area. Other allocentric spatial cell types include head-direction cells that may activate whenever one is navigating south, or border cells that may respond when a boundary is located to the west.

In the past decade, researchers began investigating how rat brains mapped egocentric frames of reference. Two years ago, scientists at Dartmouth College in Hanover, New Hampshire, identified a brain region in rats called the postrhinal cortex in which egocentrically tuned cells are abundant. However, it remained poorly understood what brain cells formed the basis of egocentric spatial maps in humans.

"In humans it is only rarely possible to directly record the activity of single neurons from the brain, due to ethical reasons," said Lukas Kunz, a postdoctoral research scientist at Columbia

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University's Department of Biomedical Engineering and first author of the new study. "There are techniques like fMRI or EEG, which allow us to indirectly measure neural activity from healthy human brains, but this neural activity reflects the sum activity of millions of neurons, which does not allow for direct conclusions about the working principles of single neurons."

> "Memories consist of multiple different elements, such as a specific event, the place where the event happened, and the time when the event happened. We believe that there are different neural systems for the different components of these memories. Egocentric bearing cells are presumably particularly involved in processing the spatial information of the memories."

In the new study, neuroscientists from the United States and Germany investigated 15 epilepsy patients at the University of Freiburg's Medical Center in Germany. These volunteers were implanted with electrodes to help doctors monitor their disorder. The researchers asked the volunteers to perform computer tasks that explored their ability to navigate through virtual environments and to remember where many different objects were located there. At the same time, the scientists recorded the activity of more than 1,400 single neurons in multiple brain regions across all the participants. The scientists identified more than 160 neurons that behaved like egocentric spatial cell types, activating when specific parts of the virtual environment were ahead, behind, to the left, or to the right of the patients, or when points in space were close to or far away from the patients.

"We are now the first to report egocentric spatial cell types in humans," Kunz said. The scientists published their study, "A neural code for egocentric spatial maps in the human medial temporal lobe," in the journal Neuron on July 14, 2021.

These "egocentric bearing cells" likely encode spatial information on a mental map centered on each person. "This is presumably important for everyday life, when humans try to orient themselves in their environments and when they navigate along routes," said Joshua Jacobs, associate professor of biomedical engineering at Columbia Engineering and senior author of the study. These egocentric bearing cells were particularly ample in the parahippocampal cortex, a region located deep within the brain that prior work suggested is the human equivalent of the rodent postrhinal cortex. Egocentric bearing cells comprised about 25% of all neurons in the parahippocampal cortex. "Previous studies had shown that patients with damage to this brain region are disoriented, presumably because their egocentric bearing cells were affected," Kunz said.

The researchers also found these egocentric bearing cells showed increases in activity when the patients used their memory to successfully recall the locations of objects they had found in the virtual environments. "This suggests these cells are not only relevant for navigation, but also play a role in correctly remembering past experiences," Kunz said.

"Memories consist of multiple different elements, such as a specific event, the place where the event happened, and the time when the event happened," Kunz said. "We believe that there are different neural systems for the different components of these memories. Egocentric bearing cells are presumably particularly involved in processing the spatial information of the memories." These findings may illuminate what might go wrong in people with memory deficits, including patients with neurodegenerative diseases such as Alzheimer's. "Their egocentric bearing cells may not function correctly, or may have been destroyed for some reason, such as a stroke, a brain tumor, or dementia," Jacobs said. These new findings do not answer how one might deal with such memory impairments. "There is still a lot of research to do before memory impairments can be treated successfully," Kunz cautioned.

In the future, the researchers want to see why exactly any given egocentric bearing cell is tuned to whatever point in space it is focused on. Currently, Kunz and his colleagues assume that multiple different spatial cues, such as objects, spatial boundaries and landmarks, combine to influence the position of these reference points. The scientists can examine the influence these cues have on the location of these reference points by removing these cues from environments during experiments.

"Another important question is how egocentric bearing cells interact with allocentric spatial cell types," Kunz said. "We currently hypothesize that egocentric bearing cells provide essential input to allocentric spatial cell types. By understanding this, future studies could explain how the tuning of allocentric spatial cell types is influenced by the functioning of egocentric bearing cells."

First Alzheimer's Disease Patient Enrolled in Clinical Trial at Columbia University

The research team and the subject in the outpatient room where the procedure took place. The ultrasound transducer was attached to a robotic arm and was guided by the neuronavigation system via an infrared camera.

Elisa Konofagou, PhD, the Robert and Margaret Hariri Professor of Biomedical Engineering and Radiology at Columbia University, and her research team recently treated the first patient in their clinical trial to open the blood-brain barrier (BBB) in patients with Alzheimer's disease.

The team, based out of Dr. Konofagou's Ultrasound Elasticity Imaging Laboratory (UEIL), is using a novel, neuronavigation-guided focused ultrasound system that they designed and tested. The clinical trial will now enroll up to six eligible patients to assess the safety and feasibility of focused ultrasound–induced BBB opening with a single-element transducer under neuronavigational guidance. Using MRI and positron emission tomography, the investigators will also test whether the focused ultrasound procedure decreases the amyloid protein levels in the treated brain areas. Finally, the team plans to evaluate any potential treatment effects on the patients' cognitive function. Dr. Konofagou said, "I feel very proud of my incredible team for making a 16-year-old dream come true yesterday…A big thank you to the team for their perseverance and hard work as well as to the several UEIL alumni whose dedication and important discoveries have been the key to this accomplishment…".

"Over the past 15 years," Konofagou continued, "we have been working on a technique that opens the blood-brain barrier, which is one of the main hurdles in brain drug delivery. We have shown that we can get drugs in safely that can treat Alzheimer's and Parkinson's as well as brain tumors in mice. On November 2, 2020, after 3 years of fighting the FDA followed by the pandemic, we were able to translate our technique to the clinic, having started our clinical trial in treating Alzheimer's patients. The barrier was opened safely in a patient with Alzheimer's and preliminary findings indicate a potential reduction in amyloid, one of the proteins that accumulates in the brains of Alzheimer's patients." Antonios Pouliopoulos, UEIL associate research scientist and one of the team's leaders of the study, added that, "the ultrasound system used in this trial was designed and pre-clinically tested by our team. It is a simple, portable, flexible, cost-effective system and can achieve millimeter-precise opening of the blood-brain barrier in a fully non-

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invasive and painless manner. It also allows for real-time monitoring of the treatment. The whole procedure can be completed in approximately 30 minutes and the patient is discharged the same day. It is worth mentioning that this is a purely academic effort here at Columbia, without the support of a company. We believe that our approach can revolutionize the way brain diseases are treated and this trial is a pivotal step for the wider adoption of therapeutic ultrasound throughout the world."

The study is co-led by Dr. Konofagou and Lawrence Honig, MD, PhD, a neurologist at the Taub Institute of Alzheimer's Disease and Aging at Columbia. The Focused Ultrasound Foundation is providing funding for this study.

New research from Columbia Engineering could help make sure microbial therapies target disease sites, not the rest of the body

Genetically engineered bacteria might one day find use in therapeutic applications, growing within the human body to sense and respond to problems such as inflammation, infections, or cancer. Now scientists at Columbia Engineering are designing ways to help confine these cells at diseased tissues or regions where they can do the most good, and not travel elsewhere where they may do harm.

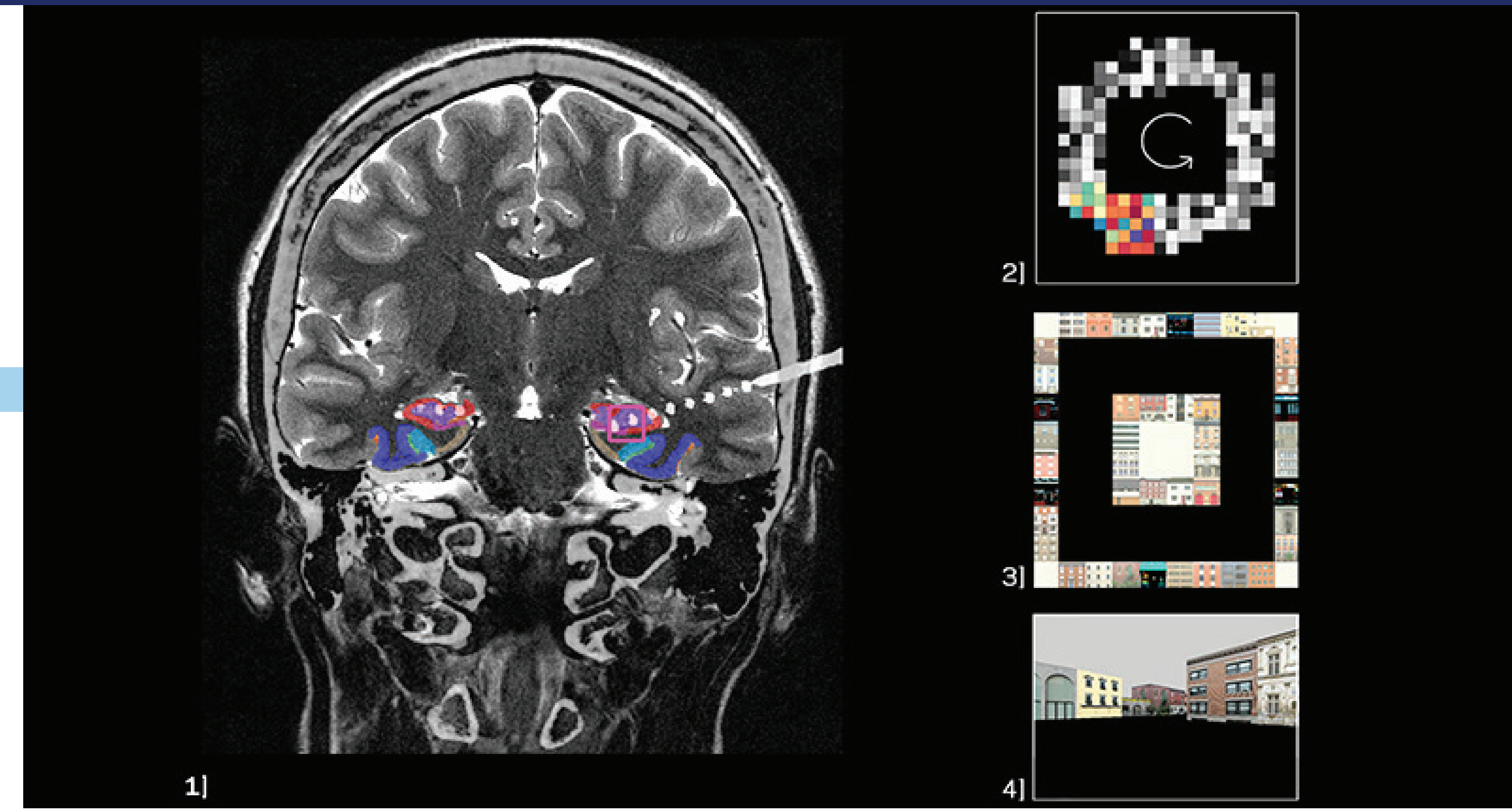
A new study detailing this work, titled "Enhancing the tropism of bacteria via genetically programmed biosensors," appeared July 29 in the journal Nature Biomedical Engineering. The study was co-led by Tiffany Chien and Tetsuhiro Harimoto, PhD candidates in the lab of Tal Danino, associate professor of biomedical engineering at Columbia Engineering.

A major challenge in using engineered microbes for medicine is safety, "because they may grow in unintended body sites, causing toxicity," Chien said. To address this problem, the researchers genetically engineered bacteria that can sense cues in their environment connected with cancer and selectively grow only in those sites. One such hallmark was low oxygen, as the rampant cell growth, abnormal blood vessels and altered metabolism seen with tumors often reduces oxygen levels. Another was the molecule lactate, which cancer cells often produce in high amounts. If the bacteria strayed to areas without these cues, essential genes of theirs shut down, preventing them from growing in these sites.

However, some parts of the body may share certain traits with tumors—for instance, the large intestine also has low oxygen levels. To help prevent therapeutic bacteria from growing in healthy areas that are similar to diseased ones in some

respects, the scientists created a "genetic circuit" so the bacteria would only grow in sites with, say, both low oxygen and high lactate levels. "We demonstrated that this approach improved tumor specificity of the bacteria when administered to tumor-bearing mice," Harimoto said.

The study also showed containment of the probiotic bacteria in the gastrointestinal tract of mice using engineered pH or oxygen dependent biosensors. "It is great to see collaboration between students in the biomedical engineering department, addressing an important problem towards clinical translation of bacterial cancer therapy," Danino said.



Phase precession in the human hippocampus. 1. Coronal T2 MRI scan merged with post-implantation CT scan showing location of electrodes (white circles) in the human hippocampus (red). 2. Heat map of spatial phase precession for one human hippocampal neuron. Each pixel represents a location in space in the virtual environment. Colors indicate the theta phase action-potentials occurred at as the subject moved through a particular location; precession is represented by the gradient of colors across space. 3. Overhead view of the virtual environment, showing the six navigation location goals. 4. First-person view of the virtual environment.

For the Brain, Timing Is Everything

Columbia Engineering/UCLA team is first to demonstrate that phase precession plays a significant role in the human brain, and links not only sequential positions, as seen in animals, but also abstract progression towards specific goals

For decades the dominant approach to understanding the brain has been to measure how many times individual neurons activate during particular behaviors. In contrast to this "rate code," a more recent hypothesis proposes that neurons signal information by changing the precise timing when they activate. One such timing code, called phase precession, is commonly observed in rodents as they navigate through spaces and is thought to form the basis for how the brain represents memories for sequences. Surprisingly, phase precession has never been seen in humans, and thus its usefulness in explaining brain function and creating brain-machine interfaces has been quite limited.

In a study published in *Cell*, Joshua Jacobs, associate professor of biomedical engineering at Columbia Engineering, in collaboration with Dr. Itzhak Fried, a professor of neurosurgery at the David Geffen School of Medicine at UCLA, demonstrate the existence of this neural code in the human brain for the first time, and show that phase precession not only links sequential positions, as in animals, but also abstract progression towards specific goals.

"We were convinced that phase precession held a lot of promise as a widespread neural code that could be used for learning and cognition," says Salman E. Qasim, lead author of the study who received his PhD from Columbia Engineering in 2021. "There's no reason the human brain wouldn't take advantage of this mechanism to encode any kind of sequence, spatial or otherwise."

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The researchers analyzed direct brain recordings from neurosurgical patients who performed a virtual-reality spatial navigation task in which they had to find and return to six specific buildings. By identifying an internal clock in the form of low-frequency (2-10 Hz) brain oscillations, the team was able to measure how the relative timing of neuronal action potentials correlated with sequential spatial locations, just as in rodents. And what they found especially exciting was that this temporal code extended beyond only representing spatial location to represent the episodic progress subjects had made towards certain goal locations.

The team was able to measure the activity of single neurons by taking advantage of a rare opportunity: the ability to invasively record from the brains of 13 neurosurgical patients at UCLA. Because these bedridden patients had drug-resistant epilepsy, they already had recording electrodes implanted in their brains for their clinical treatment. They used laptops and handheld controllers to move through virtual environments to complete a spatial navigation task designed by the research team.

As the researchers analyzed the neural data from the patients, they noticed how often neurons seemed to fire in concert with slow brain waves. The team was then able to identify phase precession in the hippocampus as subjects moved through different locations, similar to prior observations in rodents.

"This study demonstrates the unique insights at the level of single brain cells that we may gain in special clinical settings of brain surgery for patients with epilepsy and other disorders," said the study's co-author Fried, director of the epilepsy surgery program at UCLA Health. "Here, a simple task performed by patients unveils a fundamental brain code for human negotiation of their environment."

Knowing now that this temporal code was present for spatial locations in humans, Qasim next looked for evidence that phase precession tracked more complex cognitive sequences, such as the more abstract progress a person had made towards specific goals (i.e. buildings). To do so, the team had to devise a way to measure the temporal relationship between sparse, inconsistent brain-waves and neural spiking without any reference to spatial position. Once they accomplished this, they were surprised to find evidence for phase precession in the frontal cortex, where it has never been observed before, as subjects sought specific goals.

"It is hard to study the neural representations of complex cognitive functions, like goal-seeking, in many animal models. By demonstrating that phase precession in humans might represent particular goal states, this study supports the idea that temporal codes like phase precession could be critical to understanding human cognition," says Sameer Sheth, a leading neurosurgeon and neuroscientist at the Baylor College of Medicine who is not affiliated with the study.

Qasim and Jacobs hope that establishing a precedent for phase precession in humans will guide research into temporal coding as an important aspect of human cognition. By demonstrating the existence of phase precession in multiple brain regions, with respect to multiple aspects of a task, the Columbia Engineering team hopes to open new avenues to decoding brain activity that rely on temporal coding, in addition to rate coding. Furthermore, scientists have theorized that phase precession might be important for memory, as sequence learning is important to ordering events in our memory. In line with this, rodent researchers have primarily observed phase precession in brain circuits disrupted by Alzheimer's disease. As such, the discovery of phase precession may enable researchers to further probe neuronal biomarkers of memory.

Jacobs adds, "We hope to further explore whether phase precession is a universal code throughout the human brain, and for different kinds of behaviors. Then we can begin to better understand how this neuronal coding mechanism can be used for brain-machine interfaces, and manipulated by therapeutic brain stimulation."

Systems Biologist José L. McFaline-Figueroa Awarded $2,3M NHGRI Genomic Innovator Award

José L. McFaline-Figueroa, assistant professor of biomedical engineering, has won a $2.3M five-year Genomic Innovator Award from the National Human Genome Research Institute, National Institutes of Health. The funding will help support his development of single-cell genomic tools to define the roles that genes play in the way cells respond to disease-relevant exposures, specifically how individual genes and specific cell types contribute to the response of cells to environmental and endogenous exposures associated with neurological diseases such as Alzheimer's disease and brain tumors. McFaline-Figueroa, the principal investigator of The Chemical Genomics Laboratory at SEAS, is focused on customizing these tools and leveraging new models to define how diseased cells of the brain respond to internal cues and their environment.

Prof. Henry Hess Receives Prestigious HSFP Program Award 2021 Research Grant

The Human Frontier Science Program (HFSP) is an international program of research support implemented by the International Human Frontier Science Program Organization (HFSPO) based in Strasbourg, France. It aims to promote intercontinental collaboration and training in cutting-edge, interdisciplinary research focused on the life sciences. The project, Structural damage to axons resulting from repetitive mechanical motion, which is led by Prof. Henry Hess (Columbia University, USA), Akira Kakugo (Hokkaido University, Japan), Vittoria Raffa (Università di Pisa, Italy) and Orit Shefi (Bar-Ilan University, Israel), was one of 21 Program Grants selected by the HFSPO Board of Trustees. The HSFP Awards 2021, announced on April 6, 2021, are research grants that provide three years of financial support to international teams involving at least two countries. Twenty-eight projects were selected this year out of 709 applications, with seven Early Career Grants and 21 Program Grants.

University Researchers Team Up to Develop Technology Innovations for NYC in the face of COVID

Thanks to a generous Columbia Engineering alumni donor, 10 faculty teams have each won an $85,000 award to develop technology innovations for urban living in the face of COVID-19. Each team includes a SEAS faculty member working with collaborators across the University to generate solutions that will not only engineer a speedy recovery for New York, but also will transform the city's infrastructure and systems, define urban redevelopment, and minimize future disruptions—whether from the next pandemic, superstorms and sea-level rise, energy shortages, or other severe events or disasters.

"The COVID-19 crisis has dramatically altered the flow of everyday living—from work, education, and transportation to food, entertainment, and health and services—challenging us to rethink many aspects around the design, infrastructure, and functionality of our cities," said Columbia Engineering Dean Mary Boyce. "Urban centers like New York, including our Columbia campus, require a wide range of innovations as we reemerge into a new "normal" and a resilient future. The greatness of New York City coupled with innovative minds across Columbia is a winning team and we are deeply appreciative of our donor's generosity in helping us to ignite this passion."

The funding for this initiative—Urban Living Tech Innovations—will support creative cross-disciplinary research projects that develop and deploy advanced technologies. These include artificial intelligence, machine learning, computational systems, algorithms, predictive modeling, design thinking, simulations, robotics, materials, chemicals, sensors, and devices to speed New York's recovery, establish a new normal, and advance public health and medicine through new technologies and scalable models.

List of the 10 winning research teams

Real-Time Crowd Management to Prepare Subway Stations for Future Pandemics

Sharon Di, Assistant Professor, Civil Engineering & Engineering Mechanics (SEAS)
Fred Jiang, Associate Professor, Electrical Engineering and Computer Engineering (SEAS)
Jeffrey Shaman, Professor, Environmental Health Sciences (SPH)

The goal of this proposal is to equip public transit communities for greater preparedness and resilience to future pandemics with a crowd management system leveraging sensing, data science, and digital twin. The research question is: how should crowds be managed in real-time during the pandemic to mitigate risk and ease the public fear of taking mass transit? This question will be addressed by bridging engineering and scientific models at the intersection of indoor pedestrian mobility, epidemiology, and travel behavior. Rather than investing in transit infrastructure and services in a short timeframe (which is especially challenging when transit agencies are struggling with staffing shortage and financial crisis), reshaping public transport mobility could be a more viable way.

Optimizing Emergency Response during a Pandemic in Urban Environments

Andrew Smyth, Professor, Civil Engineering & Engineering Mechanics (SEAS)
Henry Lam, Professor, Industrial Engineering and Operations Research (SEAS)
Jay Sethuraman, Professor, Industrial Engineering and Operations Research (SEAS)
Kat Thomson, Assistant Commissioner, Heads the FDNY Data Analytics Team (FDNY)

This proposal seeks to develop implementable policies which can alleviate the load imbalance on hospitals while still maintaining optimized outcomes for individual patients. Such a system will require actual or indirectly estimated hospital real-time "census" data heretofore unused in the EMS world. The hospital capacity data can then be integrated in an optimization setting to balance the travel time and hospital wait time considerations. It is important to note that this consideration is not just made for each individual patient, because a longer EMS trip away from a cluster region will also mean the EMS units are less optimally positioned for the next call from that cluster region.

Preparing for the Next Pandemic and Super-Storm

Daniel Bienstocks, the Liu Family Professor, Industrial Engineering and Operations Research and APAM (SEAS)
George Deodatis, the Santiago and Roberta Calatrava Family Professor, Civil Engineering and Engineering Mechanics (SEAS)
Kyle Mandli, Associate Professor, Applied Physics and Applied Mathematics (SEAS)
Jonathan Sury, Project Director, National Center for Disaster Preparedness (NCDP) / (EI)

A main objective of the work will be the development of a "risk dashboard," a software tool to inform decision-makers and the public concerning risks (e.g. high concentration of people at a subway station), threats (e.g. a hospital experiencing congestion) and ongoing difficulties (e.g. a major roadway to a hospital impeded), as well as projecting future risks (etc) by means of analytics.

Low-Cost Continuous Multi-Person Fever Detection for a Safer COVID-19 and Post-COVID-19 World

Xiaofan (Fred) Jiang, Associate Professor, Electrical Engineering (SEAS)
Andrew Rundle, Associate Professor, Epidemiology (SPH)
Teresa Spada, Director of Practice Operations (ColumbiaDoctors Midtown)

The vision of this project is to equip buildings and mass transits around the world with the capability to continuously screen occupants for fever, thus improving the safety and resilience of our cities against future pandemics. One of the key objectives of this project is to create a technology that can monitor many occupants simultaneous without disrupting their normal activities, which is essential in helping to restore some amount of normality to our vibrant cities. Another goal is to keep the cost to be within a few hundred dollars, so that it is affordable for everyone. Collectively, these "smarter" buildings and transit systems become parts of epidemic early warning systems, enabling cities to quickly respond to future novel viruses, as well as flu seasons.

Designing Safe Elevator Systems amidst a Pandemic

Adam Elmachtoub, Assistant Professor, Industrial Engineering & Operations Research (SEAS)
Cliff Stein, Professor, Industrial Engineering & Operations Research, and Computer Science (SEAS)
Charles Branas, Professor & Chair, Epidemiology (SPH)
Neal Parikh, Director, Artificial Intelligence (Mayor's Office of the CTO)
Department of Citywide Administrative Services (DCAS)
In this proposal, we shall consider two major forms of interventions based on (i) changing passenger behaviors and (ii) elevator AI. In many elevator systems, changing the algorithms and technology of how the elevators navigate through the building is challenging due to outdated technology and would require long-term planning and expensive modifications. Thus, focusing on how passengers use and board elevators is often the only option for an intervention. Currently, many elevator systems take a hands-off approach to managing the flow of people to elevators, resulting in something that resembles first-come first-served.

Low-cost monitor for verification of UV Sterilization systems

Ioannis Kymissis, Professor, Electrical Engineering (SEAS)
Elizabeth Hillman, Professor, Biomedical Engineering (SEAS); Department of Radiology (CUIMC)

Ultraviolet (UV) sterilization is a method that can neutralize a range of pathogens including SARS-CoV-2. However, UV light can also be dangerous to humans, causing cataracts and skin cancer through direct exposure, as well as environmental hazards such as generation of toxic ozone gas. Although UV sterilization systems are broadly categorized in terms of their wavelength band (e.g. A, B or C), the effectiveness of UV sterilization, and the risk of UV to humans, depends critically on the precise wavelength of UV used, and the intensity and duration of UV exposure. The wide array of existing and emerging UV sterilization systems currently being deployed to decontaminate public spaces are likely to have widely varying illumination properties, and are prone to shifts in UV emissions as lamps degrade over time. This project is focused on developing a system to track and wirelessly report UV wavelength and exposure in a space and to precisely quantify both the effectiveness of UV sterilization for removal of pathogens and their acute and cumulative risk of exposure to humans. The project will further develop a low-cost monitor and accompanying mobile app that will report on the spectrally resolved dose that the unit has received, allowing users to be confident that the sterilization of a space has been conducted properly.

Testing the Efficacy of Far-UVC Light to Safely Inactivate Airborne and Surface Viruses in Real-Life Demonstration Projects

David J. Brenner, Professor of Radiation Biophysics, Center for Radiological Research, Department of Radiation Oncology (CUIMC)
Gordana Vunjak-Novakovic, Professor of Biomedical Engineering and Medical Sciences (SEAS)
Manuela Buonanno, Associate Research Scientist, Center for Radiological Research and the Radiological Research Accelerator Facility (CUIMC)
David Welch, Associate Research Scientist, Center for Radiological Research (CUIMC)

Overhead far-UVC light (222 nm) has emerged as a potentially safe and efficient approach for continuously reducing the level of active virus, including coronavirus, in the air and on surfaces in occupied indoor spaces. Prior to large-scale implementation, several real-life demonstration projects are being undertaken. A knowledge gap within these demonstration projects is a methodology for assessing reductions in the infectious viral load in the room – in short, does it work? This work aims to fill that gap by designing and validating an experimental approach for measuring active viral load - as opposed to total (active + inactive) viral load - in the air and on surfaces, and then using the approach in the demonstration projects, with vs. without far-UVC.

(continued)

Development and Field-Testing a Mobile App for Tracking Home-Based COVID-19 Rapid Test Results

Samuel Sia, Professor, Biomedical Engineering (SEAS)
Shih-Fu Chang, the Richard Dicker Professor of Electrical Engineering, and Computer Science (SEAS)
Jessica Justman, Associate Professor of Medicine in Epidemiology (CUIMC) and Senior Technical Director, ICAP (SPH)
Wafaa El-Sadr, University Professor of Epidemiology and Medicine, Founder and Director of ICAP (CUIMC/SPH)

We propose to develop and field-test on at least 20 users in an underserved community (e.g. patients at Harlem Hospital): 1) a mobile app that will aid users (both providers and consumers) to perform and interpret rapid COVID-19 tests, and 2) a cloud-hosted platform that will track the results in real time, matched to geolocation and co-morbidities, to increase the value of the data for epidemiology and public policy. We will build on our previous experience where we field-tested a mobile app for tracking HIV and sexually transmitted disease rapid tests among high-risk groups in an NIH R01-funded project. We will work with partners (starting at Harlem Hospital) across New York City. We now know there are significant and ongoing variations from neighborhood to neighborhood, depending on race and income, with the hardest hit areas including East New York in Brooklyn, Far Rockaway, Flushing and Elmhurst in Queens, and Baychester and Co-op City in the Bronx. Continued collection of granular data in these communities will be crucial, to monitor the infection rate as well as to better understand co-morbidities and other correlates (e.g. density of housing) to disentangle the drivers of these inequalities.

Direct bioelectronic detection of SARS-CoV-2 from saliva using single-molecule field-effect transistor (smFET) arrays

Kenneth Shepard, the Lau Family Professor, Electrical Engineering, and Professor, Biomedical Engineering (SEAS)
Henry Colecraft, the John C. Dalton Professor, Physiology and Cellular Biophysics, and Professor, Pharmacology (CUIMC)

Direct testing for the virus, which also reduces requirements for multiple reagents, is a necessary step to improving diagnostic testing. While two such antigen test have been approved for detection of SARS-CoV-2 based on immunoassays to the S protein, specificity is poor because of reliance on a single (or in a some cases two) detection antibodies, and no quantitation of viral load is possible. Sample preparation is still required for these assays. We will address this gap by using an in development rapid POC platform for direct, real-time, multiplexed, quantitative bioelectronic detection of biomolecules that employs an all-electronic detection device that functions at the single-molecule level. These single-molecule field-effect transistors (smFETs) are arrayed on a complementary metal-oxide-semiconductor (CMOS) integrated circuit chip mounted on a USB-stick-form-factor device.

Education Through Crisis and Disruption: Inquiry Based STEM Learning Via Enhanced Text Message

Paulo Blikstein, Associate Professor (TC)
Lydia Chilton, Assistant Professor, Computer Science (SEAS)

An essential component of STEM education is participation in authentic inquiry-learning activities. Providing students with (a) access to these activities and (b) adequate support while engaged in these activities has proven challenging in the new reality of remote learning. Our goal is to systematically examine and develop a solution to this problem using a low-cost, mobile phone-based approach to at-home, inquiry-driven science learning called the "STEM Messaging System" (SMS+). SMS+ will support real-time, interactive, message-based STEM activities for which the only computational resource required is the family's mobile phone. Continued collection of granular data in these communities will be crucial, to monitor the infection rate as well as to better understand co-morbidities and other correlates (e.g. density of housing) to disentangle the drivers of these inequalities.

Real-World Impact

How Columbia's biomedical engineering department established itself as a hot spot for innovation and entrepreneurship

In Columbia's Department of Biomedical Engineering (BME), the appetite for innovation is as high as the barriers to collaboration are low. "People are totally accustomed to working together across different fields, and we spend a lot of time outside our comfort zones," said Gordana Vunjak-Novakovic, University Professor and Mikati Foundation Professor of Biomedical Engineering and Medicine. When she joined the BME faculty in 2005, the then five-year-old department already had a reputation for camaraderie over competition, and boasted the kinds of clinical partnerships—including ties to the Columbia University Irving Medical Center—that facilitate translational research. Today, as the department marks its 20th anniversary, Vunjak-Novakovic believes that this convergence of disciplines and strong university-wide support for entrepreneurship are the secrets to its success in moving discoveries from the lab to the clinic.

"We're doing good things for patients and humanity because we're working together. You can't do this kind of work just anywhere," she said. Entrepreneurship has deep roots at BME. Some of the first faculty to join the department arrived with a deep understanding of the rewards associated with translating research developments into the commercial realm. They include Paul Sajda, professor of biomedical engineering and electrical engineering and radiology, who had startup experience when he joined Columbia after a stint in industry, and Ken Shepard, Lau Family Professor of Electrical Engineering and professor of biomedical engineering, who founded his first technology company in 2001. Over the past decade, as both Columbia and New York City experienced profound transformations in the establishment and development of a technology startup sector, record numbers of BME faculty, students, and alumni have joined their ranks. "Our students and faculty have spun off 17 companies in the past 5 years alone," said X. Edward Guo, Stanley Dicker Professor of Biomedical Engineering and BME department chair. "The goal for most of us is to do great science, but we also want to have real-world impact. The university and our faculty have created an extraordinary framework for students to accomplish both." In addition to support from the Columbia Technology Ventures office, which brokers licensing agreements and assists with intellectual property protections, BME faculty and students draw on a unique network of entrepreneurial resources. The undergraduate and graduate curricula emphasize the power of biomedical engineering to address unmet health needs with potentially global impact, incorporating training and mentorship in medical technology innovation and entrepreneurship. Graduate students are quickly immersed in a rich startup ecosystem, both at Columbia and within the city at large.

"A week doesn't go by without a student coming to me asking for input about a startup idea or a question on how to transition a technology to a product concept," said Sajda. Concepts that gain traction may qualify to enter Columbia BioMed X, a biomedical engineering technology accelerator that has awarded $4.5 million to 50 research teams over the past eight years—18 of whom have subsequently licensed their technologies to industry or startups. BME faculty aren't only empowering student entrepreneurs; some cast a wider net, supporting the city's burgeoning biotech sector as a whole. When Sam Sia, professor of biomedical engineering and a serial entrepreneur, started Junco Labs in 2013, he faced the daunting task of finding affordable wet lab space in Manhattan. The experience inspired him to partner with the New York City Economic Development Corporation and found Harlem Biospace, an incubator for health and biotech startups.

Harlem Biospace has been a crucial launching point for dozens of companies, including two founded by Vunjak-Novakovic: EpiBone, which just began human clinical trials of a technology to grow precision bone grafts from patients' cells, and TARA Biosystems, a company commercializing "heart-on-a-chip" platforms for cardiac drug discovery. The field of biomedical engineering is still relatively young, and BME students and faculty are excited to be part of the evolving discipline. "As a society, we're seeing the next level of potential for technology impacting medicine and our department is situated right at that nexus," said Sia. "At this moment in time, the opportunities are really quite unprecedented."

Columbia Engineering and Amazon Launch Undergraduate Program to Increase Diversity and Inclusiveness in Tech Fields

With the creation of the Columbia-Amazon Summer Undergraduate Research Experience (SURE) with a focus on undergraduate students from backgrounds historically underrepresented in STEM, Columbia and Amazon are extending their collaboration

2020 photo of students in the Columbia Engineering chapter of the National Society of Black Engineers.

Columbia Engineering and Amazon announced their initiative to create the Columbia-Amazon Summer Undergraduate Research Experience (SURE) program aimed at increasing diversity and inclusiveness in technology fields. The eight-week summer research and professional development program is designed for 30 undergraduate students from backgrounds historically underrepresented in all fields in STEM. Amazon has committed $324,000, with matching support from the School, for SURE, which was scheduled for Summer 2021.

"We are very pleased to join together with Amazon on launching such an important educational program. Expanding diversity and inclusion in science and engineering is critical to our mission of educating the leaders and innovators of the future, and also pioneering engineering innovations to meet societal challenges," said Columbia University Provost Mary C. Boyce, former dean of Columbia Engineering.

"The Columbia-Amazon Summer Undergraduate Research Experience will extend our vision, Engineering for Humanity, to a wider and more broadly diverse group of undergraduate students and is emblematic of the importance of university-industry partnerships in developing talent and delivering much-needed solutions to society's grand challenges," said Shih-Fu Chang, senior executive vice dean of Columbia Engineering and inaugural director of Columbia Center of Artificial Intelligence Technology in collaboration with Amazon.

"Amazon is thrilled to collaborate with Columbia on this important initiative to connect STEM undergraduate students from historically underrepresented backgrounds with top faculty in academia and scientists, engineers, product managers, and designers in industry," said Prem Natarajan, Alexa AI vice president of Alexa AI Natural Understanding. "The unique learning opportunities created by this initiative will accelerate the professional development of the students and contribute to creating a more diverse national talent pool." SURE students will engage in cutting-edge research on campus at Columbia, and explore foundational research in areas of artificial intelligence, material science, and computational science and engineering, and research in confronting challenges in medicine, climate, sustainability, business, and other areas. They will also meet with leading experts and practitioners from Amazon to learn about real-world scientific and technical challenges, from understanding customer needs to designing, implementing, testing, and launching products. The blending of academic and industrial perspectives will provide a unique end-to-end learning experience to the participating students.

In addition, the students will be integrated into other summer programs on Columbia's campus, including the Summer@SEAS program, where they will take part in workshops on presentation skills, learn how to build personal mentor networks, and join discussions on ethics and scientific integrity.

Each SURE student will receive a weekly stipend, help with travel expenses, and on-campus residency during the duration of the program, including room and board (pending COVID-19 restrictions). Participants will have an academic advisor (a faculty member or PI), a research mentor (a SEAS graduate student or postdoctoral fellow), and an industry mentor (scientist or engineer from Amazon). They will be offered visits to company sites and social engagements both with their peers as well as the extended research community at Columbia Engineering.

Participants will also receive support on preparing applications for graduate schools and fellowships. This will include application fee waivers, scheduled office hours (virtual or in-person) with potential faculty mentors and student peers, invitations to seminars and research symposia at Columbia Engineering, and other benefits. In addition, they will be given opportunities to be considered for an industry internship in the future.

SURE will culminate in a symposium with presentations from the students about their research and professional development activities during the program.

FEATURED NEWS

Columbia Engineering Ranked #1 for Online Graduate Engineering Programs by the U.S. News & World Report Four Years in a Row

For the fourth consecutive year, Columbia Engineering is ranked #1 online graduate engineering program by the 2021 edition of the U.S. News & World Report. The ranking methodology centers on faculty excellence, student engagement, evaluation by peers, student services, and technology. Additionally, Columbia Engineering's online computer science program was ranked #1 Online Master's in Information Technology Program.

"Our commitment to excellence in online education, fostered by the tireless efforts of our dedicated faculty members and staff, allows us to maintain the exceptional quality of our programs while cultivating a supportive environment for our students," said Mary C. Boyce, dean of Columbia Engineering. Since its launch in 1986, Columbia Video Network (CVN), Columbia Engineering's online education arm, has provided engineers, scientists, executives, and technical professionals worldwide an opportunity to advance their knowledge in engineering and applied science disciplines, and gain industry-relevant skills from world-renowned Columbia Engineering faculty.

"CVN serves a dual mission at the School of Engineering, providing unparalleled services to our online students and advancing educational innovation and hybrid learning in our on-campus programs," said Soulaymane Kachani, vice provost for Teaching, Learning, and Innovation of Columbia University, and senior vice dean of Columbia Engineering CVN offers part-time online Masters, D.E.S., certificate, and non-degree programs in the fields of:

Applied Mathematics	Data Science
Applied Physics	Earth & Environmental Engineering
Biomedical Engineering	Electrical Engineering
Chemical Engineering	Industrial Engineering
Civil Engineering	Materials Science
Computer Science	Mechanical Engineering

"At Columbia Video Network, we prioritize our students, many of whom are full-time engineering professionals," said Marina Zamalin, executive director of CVN. "To accommodate students during this pandemic, we have waived the GRE General Test requirement for Summer and Fall 2021 applications. For added flexibility, admitted MS students have up to one year to begin their coursework."

In addition to graduate programs, CVN offers executive education courses and boot camps, as well as a portfolio of Massive Open Online Courses (MOOCs) on Coursera and edX platforms.

Elham Azizi
Assistant Professor, Biomedical Engineering; Herbert and Florence Irving Assistant Professor, Cancer Data Research (in the Herbert and Florence Irving Institute for Cancer Dynamics and in the Herbert Irving Comprehensive Cancer Center)
Machine learning in single cell analysis and cancer.

Tal Danino
Associate Professor, Biomedical Engineering; Director, Synthetic Biological Systems Laboratory
Synthetic biology. Engineering gene circuits in microbes.

X. Edward Guo, Chair
Chair, Department of Biomedical Engineering; Stanley Dicker Professor of Biomedical Engineering; Professor of Medical Sciences (in Medicine); Director, Bone Bioengineering Laboratory | Image-based microstructural and finite element analyses of skeletons.

Henry Hess, Chair of Graduate Studies
Professor, Biomedical Engineering; Director, Laboratory for Nanobiotechnology & Synthetic Biology
Molecular scale engineering. Nanosystems of biomolecular motors.

Elizabeth M. C. Hillman
Professor, Biomedical Engineering & Radiology (Physics) and Herbert and Florence Irving Professor at the Zuckerman Institute; Director, Laboratory for Functional Optical Imaging | Optical imaging of brain function.

Clark T. Hung, Director of Master's Studies
Professor of Biomedical Engineering & Orthopaedic Sciences (in Orthopedic Surgery); Director, Cellular Engineering Laboratory
Cellular and tissue engineering of musculoskeletal cells.

Joshua Jacobs
Associate Professor, Biomedical Engineering; Director, Memory and Navigation Laboratory
Electrophysiology of navigation and memory. Brain stimulation.

Christoph Juchem
Associate Professor, Biomedical Engineering; Director, Magnetic Resonance Scientific Engineering for Clinical Excellence Laboratory (MR SCIENCE Lab) | Brain chemistry/metabolism. Magnetic resonance imaging.

Lance Kam, Chair of Undergraduate Studies
Professor, Biomedical Engineering; Professor, Medical Sciences (in Medicine); Director, Microscale Biocomplexity Laboratory | Micro- and nano-scale fabrication of biological systems.

Elisa E. Konofagou, Chair of Diversity, Equity & Inclusion *Robert and Margaret Hariri Professor, Biomedical Engineering & Radiology (Physics); Director, Ultrasound Elasticity Imaging Laboratory* | Elasticity imaging. Therapeutic ultrasound. Soft tissue mechanics.

Aaron Matthew Kyle, Director of Undergraduate Studies
Senior Lecturer, Biomedical Engineering Design; Director, Hk Maker Lab
Engineering education and laboratory development.

Andrew F. Laine
Percy K. and Vida L. W. Hudson Professor, Biomedical Engineering & Radiology (Physics); Director, Heffner Biomedical Imaging Lab
Quantative image analysis. Imaging informatics

Kam W. Leong
Samuel Y. Sheng Professor, Biomedical Engineering (Systems Biology); Director, Nanotherapeutics and Stem Cell Engineering Laboratory | Regenerative medicine through direct cellular reprogramming.

Helen H. Lu, Vice Dean of Faculty Affairs and Advancement
Percy K. and Vida L.W. Hudson Professor, Biomedical Engineering; Director, Biomaterials & Interface Tissue Engineering Laboratory | Interface tissue engineering.

José L. McFaline-Figueroa
Assistant Professor, Biomedical Engineering; Director, The Chemical Genomics Laboratory
Single-cell genomics, multiplex molecular screens, genome engineering, cancer biology.

Barclay Morrison, Vice Dean for Undergraduate Programs
Professor, Biomedical Engineering; Director, Neurotrauma and Repair Laboratory
Mechanical injury of the central nervous system.

Van C. Mow
Stanley Dicker Professor Emeritus, Biomedical Engineering
Soft tissue biomechanics. Cell-matrix interactions.

Nandan Nerurkar
Assistant Professor, Biomedical Engineering; Director, Morphogenesis & Development Biomechanics Laboratory | Mechanobiology of embryonic development and organ formation. Birth defects of the central nervous and gastrointestinal systems.

Qi Wang
Associate Professor, Biomedical Engineering; Director, Raymond and Beverly Sackler Laboratory for Neural Engineering and Control
Brain-machine interfaces.

Paul Sajda, Vice Chair *and Vikram S. Pandit Professor of Biomedical Engineering; Professor of Electrical Engineering and Radiology; Director, Laboratory for Intelligent Imaging & Neural Computing* | Neuroimaging. Computational neural modeling. Machine learning.

Samuel K. Sia
Professor, Biomedical Engineering; Director, Microfluidics For Point-Of-Care Diagnostics And Therapeutics Laboratory | Point-of-care diagnostics. 3D tissue engineering. Implantable devices.

J. Thomas "Tommy" Vaughan, Jr.
Professor, Biomedical Engineering, Zuckerman Institute; Director, Columbia University Magnetic Resonance Research Initiative | Magnetic resonance imaging (MRI) spectroscopy (MRS).

Gordana Vunjak-Novakovic
University Professor and Mikati Foundation Professor, Biomedical Engineering & Medical Sciences; Director, Laboratory for Stem Cells and Tissue Engineering
Tissue engineering. Stem cells. Regenerative medicine.

Outstanding BME Students Honored - 2021

In April 2021, Columbia Engineering students, deans, faculty, staff, parents, friends, and alumni gathered virtually for Class Day to celebrate the accomplishments of outstanding students. Among the honorees at both celebrations were five undergraduate and three graduate students in Biomedical Engineering. Also among the BME honorees were ten undergraduate senior designers who placed 1st and 2nd at Columbia BME's virtual Senior Design Day, as well as four MS student designers who placed first in the MS Biomedical Design & Innovation Awards.

GRADUATE STUDENT CLASS DAY AWARDS

- **Lauren Friend** Outstanding Achievement Award in Biomedical Engineering Master's Studies / Graduate Student Marshal
- **Shreya Narasimhan** Doctoral Graduate Student Life Leadership Award
- **Salman Ehtesham Qasim** Yuen-huo Hung and Chao-chin Huang Award in Biomedical Engineering ("The Grandparents' Award")

UNDERGRADUATE STUDENT CLASS DAY AWARDS

- **Nicolas Acosta** Claire S. and Robert E. Reiss Prize
- **Özgenur Çelik (BS exp. '22)** King's Crown Leadership & Excellence Award: Community Building
- **Archana Murali** Campbell Award
- **Ziad Saade** Richard Skalak Memorial Prize
- **Anisha Tyagi** Senior Marshal / King's Crown Leadership & Excellence Award: Civic Responsibility

MS BIOMEDICAL DESIGN & INNOVATION AWARDS

- **Team Amani Mama** - An early screening device for pre-eclampsia: Best Overall Design Award. *Design Team Members: Shirley Xinyi Liu, Ashley Qian-Hui Lee, Mara Katinka Kaspers, and Vernicka Gene Mercado de Sagun*

SENIOR DESIGN AWARDS

- **Team EyePhone** 1st Place, BME 2021 Senior Design Award. *Design Team Members: Allegra Campanini-Bonomi, Katherine Liu, Lauren Sekiguchi, Anisha Tyagi, Helen Ugulava.*
  EyePhone is a mobile phone app that works in coordination with a Google Cardboard to create a virtual reality field for at-home visual field testing
- **Team Perfecto Injector** Runner Up, BME 2021 Senior Design Award. *Design Team Members: Divya Gandla, Cyrus Jonathan Ghaderi, Julia Hutsko, Alexander Kaminsky, Guntaash Sahani.*
  Perfecto Injector detects differential pressure changes that occur as a needle is injected through the sclera and into the SCS, alerting the ophthalmologist when SCS access is achieved.

BME Sweeps Top 3 Prizes in Columbia Venture Competition

As the spring semester reached its conclusion, more than 100 alumni judges from around the world gathered to rank Columbia startups during the 2021 Columbia Venture Competition, held virtually for the second consecutive year. We are grateful to the Columbia alumni judges for lending their time, talent, and expertise to narrow down the field and select the winners.

Every year, Columbia gives out millions of dollars to startups across campus through its various programs, and the Columbia Venture Competition is a major part of that funding. The Columbia Venture Competition is a partnership between Columbia College, Columbia Engineering, Columbia Entrepreneurship, the School of International and Public Affairs (SIPA), and the Alliance Program that works with French universities Sciences Po, Sorbonne University, and École Polytechnique.

This year, the two challenges set forth in the venture competition were the Urban Works India Challenge and the Technology Challenge. Students and alumni from Columbia's Department of Biomedical Engineering participated on several teams in the Technology Challenge, including the top three winning teams.

Meet the 2021 Technology Challenge Winners

Entries in the Technology Challenge must include business models based on a solid foundation of applied, solution-focused, technological innovation. Submissions for this track focus on product development, innovative design, and "builder" technologies. This year's winning projects addressed important health-related issues including colorectal cancer, vision/hearing, and vaccination.

1st Place – $25,000
Colonai uses AI driven imaging to detect and decrease the risk of colorectal cancer.

Team Members: Jacob Nye (Biomedical Engineering, BS '18; MS '19); Bina Bansinath (GSAS '19)

2nd Place – $15,000
Sharper Sense is developing a non-invasive nerve stimulation patch that enhances vision and hearing by reducing sensory noise.

Team Members: Charles Rodenkirch (Biomedical Engineering, MS '16; PhD '19); Professor Qi Wang (Biomedical Engineering)

3rd Place – $10,000
Cold Chain-ge aims to improve vaccine accessibility through the use of orally dissolving films.

Team Members: Madeline Meier (Biomedical Engineering, BS '21); Anuva Banwasi SEAS '24; Laura Torre SEAS '24; Amy Wang SEAS '24

BME Senior Design Team Wins NIBIB DEBUT 2021 Challenge

Congratulations are in order for Columbia BME Senior Design Team, EyePhone, for winning 3rd Place at the **NIH 2021 Design by Biomedical Undergraduate Teams (DEBUT) Challenge**

Team Members: Allegra Campanini-Bonomi, Katherine Liu, Lauren Sekiguchi, Anisha Tyagi, Helen Ugulava. Faculty Advisors: Dr. Aaron Kyle, Dr. Stephen Tsang

NIBIB selected three winning teams for designs that excel according to four criteria: the significance of the problem being addressed; the impact on clinical care; the innovation of the design; and the ideation process or existence of a working prototype. The third prize of $10,000 went to a team from Columbia University for their mobile phone app to monitor the progress of glaucoma.

The design team was formed during the 2020-2021 Columbia BME Senior Design class. With consultation by faculty advisors, Dr. Aaron Kyle and Dr. Stephen Tsang, the team devised an app that works in coordination with a cardboard VR headset to create a virtual reality field for at-home visual field testing. The device uses existing visual field-testing algorithms to assess a person's vision outside of a doctor's office, promoting more regular and accessible monitoring of glaucoma progression.

Pictured from top left: Cody Slater, Parth Gami, Howard James Nicholson III, Mathini Vaikunthan, Christia Victoriano, Neeraj Sakhrani, Sophia Windemuth, Lauren Chiriboga, Yinuo Jin, Yu-Yu (Linda) Chen, Margaretha Morsink, Delfina Rodriguez Briozzo, Bryan Aldana, and Sarah Cheeran

SharperSense selected for Comcast NBCUniversal SportsTech Accelerator

Comcast NBCUniversal announced it has picked 10 sports tech and esports startups for the first annual Comcast NBCUniversal SportsTech Accelerator.

Comcast NBCUniversal is investing $50,000 in each startup and training them for 12 weeks, in partnership with Boomtown Accelerators. Two of the winners are esports companies. It chose the winners from over 1,000 applicants in 70 countries. The companies will work with Comcast NBCUniversal and the SportsTech partner consortium, which includes NBC Sports, Sky Sports, Golf, NASCAR, U.S. Ski and Snowboard, USA Cycling, USA Swimming, and Comcast Ventures.

Charles Rodenkirch, president of Sharper Sense and Columbia alumni, named one of the 10 companies named for the accelerator. The startup spun out of Columbia University, where Rodenkirch got his doctorate, to develop neuromodulation. It's developing a noninvasive stimulation patch that enhances the brain's ability to accurately process sensory information received from the eyes, ears, and skin, Rodenkirch said.

For everyone from athletes to those with learning disabilities, impaired sensory processing decreases sensory acuity and reduces the ability to understand spoken words and written words, but it also interferes with performance at work, during recreation, and in sports, he said.

"There are clinical causes of impaired sensory processing, like sensory processing disorders … that long-term we can treat," Rodenkirch said. "But even healthy individuals will have temporarily impaired senses from things like inattention or fatigue. So when you think about athletes at the end of a long race, [it's about] making sure that they're not having these types of misperceptions. I'm sure everyone's familiar with standing in front of a cupboard looking for some sort of ingredient for all your cooking and then noticing that it's been in front of your face for the whole last minute. So this is kind of a moment where you're having this type of impaired sensory processing. For athletes, these types of moments are really strongly linked with errors. Things like, 'I didn't see that defender out there,' or the 'steering wheel didn't feel right.' We really think we can help improve both safety and performance."

> **" We really think of ourselves as this new generation of neuromodulation technology that's built out of true science."**

Rodenkirch said he was aware of pseudoscience hucksters out there who have been selling devices that reportedly help you with your physical and mental acuity. But he said his company will have research to back it up.

The company has completed its preclinical research, which has produced a proof of concept showing that the company's tech could reduce error rates on sensory testing tasks and games. Next, Sharper Sense will spin up clinical studies for a patch that could send electrical signals into an athlete's body to improve things like awareness and reaction time. The tech might be useful for gamers and esports players as well.

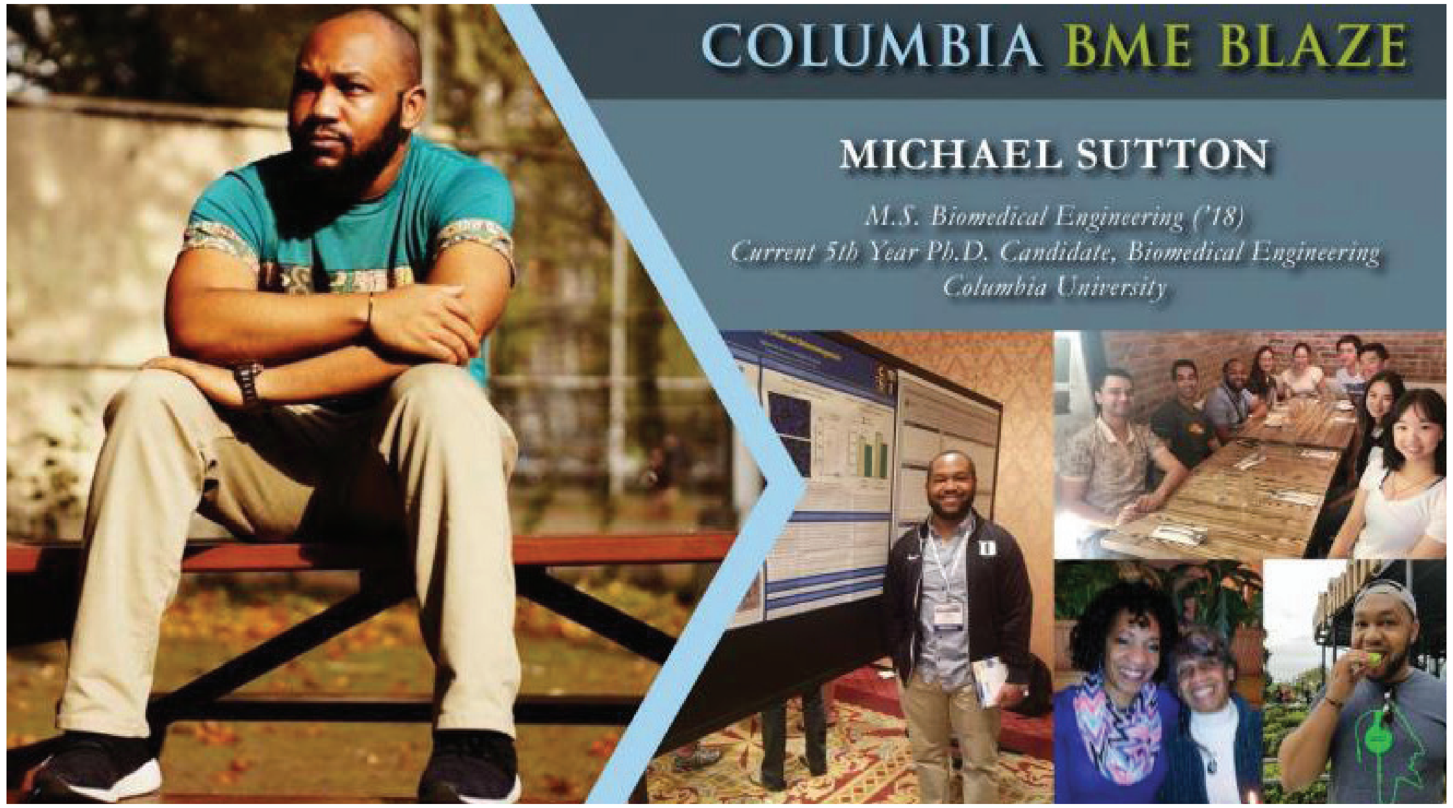
COLUMBIA BME BLAZE

Monthly Blog Highlights Exceptional Columbia BME Students and Alumni

In our monthly spotlight blog, get to know the alumni and students of Columbia's Department of Biomedical Engineering. Read what our BME folks are up to, from our labs' latest research, to our students' plans for the future, to our teams' innovations, start-ups and other career successes.

To read their amazing stories, follow us on social media for the latest interview or visit bme.columbia.edu and search for "BME Blaze."

February 2021 - BME Blaze: Michael Sutton



Michael Sutton

Education

M.S. '18, Biomedical Engineering
Current 5th Year Ph.D. Candidate, Biomedical Engineering

Noteworthy Achievements
NIH Trainee, NSF Fellow, JKCF Scholar, SMDP MedTech Scholar

Where are you from?
Aliquippa, PA

What is your current position?
5th year Ph.D. student

Tell us about your research journey.
I started at Columbia in Fall 2016 in the Cell and Molecular Biomechanics Lab (CMBL) under Dr. Christopher Jacobs. Our lab studied how to use the body's natural bone remodeling process to develop more effective therapeutics for osteoporosis. The CMBL was among the first to identify the osteocyte primary cilium, a solitary antenna-like organelle, as a mechanosensitive signaling nexus that contributes to bone adaptation. My project focused on understanding the degree to which the primary cilium of macrophages regulated osteoclast differentiation and function. Dr. Jacobs passed away in July of 2018 after a long battle with cancer. Rather than navigate the larger half of my Ph.D. without the help of the expert in the field I was studying, I opted to transfer labs, joining the Microscale Biocomplexity Laboratory (MBL) and am now being advised by Dr. Lance Kam. The MBL focuses on using engineered surfaces and biomaterials to study T-cell mechanobiology. In particular, our lab previously demonstrated that the activation of T cells is affected by the mechanical response of their surroundings. My project hopes to elucidate the mechanism by which components of the cytoskeleton translocate during T-cell activation, an understanding that will hopefully lead to new immunotherapeutic targets.

How did you become interested in STEM research and, more specifically, in biomedical engineering?
I was always drawn towards math and science as a kid. When I was finishing high school, I decided I would be pre-med and thought majoring in biomedical engineering would allow me to gain exposure to the technological side of the medical field. But, while I was in college, I decided that the physician's life would not be for me. I also realized that biomedical engineering was a pretty cool discipline in and of itself. An old professor once told me, "When our society faces a health problem, it's biomedical engineers who often create the solution; doctors usually just prescribe it."

Tell us about your family. Who has/have been your strongest influence(s) in life?

I grew up feeling like an only child in a single-parent household. I say "feeling," because my dad was technically around but didn't play an active role in raising me, and my only brother was so much older than me that we didn't really start bonding until I was an adult. I'm the first person in my immediate family to graduate from college and will be the first in my extended family (that I'm aware of) to earn a Ph.D. My mother and grandmother have been the strongest influences in my life. I didn't have many positive male figures growing up, so the women in my family were who I looked up to. My mother in particular has always been my biggest supporter and voice of reason, and my grandmother has acted as my spiritual guide. There's no way I would be where I am today without the two of them.

What does Black History Month mean to you?

To me, Black History Month means that Black lives matter. They hold importance and value. They have been, and continue to be, vital to global progress in every sector, despite the degree to which their lives are often devalued and easily forgotten. This month is a period of time set aside for the world to be reminded of the impact that Black people have made towards the advancement of society, which people of all races benefit from to this day. My favorite historical Black figure is Dr. Charles R. Drew, an American surgeon who did research at Columbia's Presbyterian Hospital and pioneered techniques for blood plasma storage and preservation leading up to World War II. For his work, he was appointed director of the first American Red Cross Blood Bank in 1941. However, just a year later, he resigned from his position, because the U.S. armed forces ruled that blood donated from African Americans had to be stored separately from that of Whites. Dr. Drew is a constant reminder that my little world of scientific research does not get to exist outside of the issues of American society. With every new drug delivery system or therapeutic, it is imperative to consider access and availability thereof for all people, particularly communities most often underserved. We must be citizens as well as scientists and engineers.

What accomplishment(s) are you most proud of, and what do you hope to accomplish in the future?

There are many things of which I am proud and by which I am humbled. I am a 26-year-old Black man who will soon have a Ph.D. in Biomedical Engineering from Columbia University. I have made positive contributions to my educational institutions in the form of student advocacy, most recently in the Columbia University Senate and the Engineering Graduate Student Council. I tutor underserved students in NYC and have personally seen their standardized test scores improve and them matriculate to four-year colleges and universities. In the future, I hope to help reshape the way academia operates such that I am not one in a million, and a child's future is not derailed simply because of their zip code. I want to help underrepresented minorities who pursue STEM to feel supported enough to stick with their major after freshman year and even pursue advanced degrees. I want to help fix a health system that still sees higher mortality rates and reduced access to care for Black people than White people. I want to have established myself as a respected leader and intellectual such that I have the privilege of being my true self, free of preconceived judgment, whenever I walk through a door.

What advice would you give to others who wish to pursue a degree and/or career in BME?

1. Create a support system. That could be maintaining contact with family, making new friends, seeking out social groups, and anything in between. The road is challenging with the best of help, and near impossible to traverse alone.
2. Explore career paths early. Just because you're studying BME does not mean that's the only career you're qualified for, and just because you get a Ph.D. doesn't mean your only job option is being a professor. You have options. The sooner you discover which possibilities you might most enjoy, the sooner you can shape your own academic journey and emphasize the things that make you happy.

COLUMBIA BME BLAZE

June 2021 - BME Blaze: Kevin Burt

Kevin Burt

Education
BS in Civil Engineering – Montana State University - 2017
MS in Biomedical Engineering – Columbia University - 2019
PhD Candidate in Biomedical Engineering - Columbia University

Where are you from?
Butte, Montana (Yee-haw)

What drew you to the field of Biomedical Engineering?
During my senior year of undergrad, I took a cellular biology course for fun–huge nerd energy–and realized cell biology and the human body was a tiny bit more interesting to me than structural engineering. From then on, I set my sights on the top Biomedical Engineering graduate programs in the country and decided to try to switch things up a little.

What is your current role?
I am currently a graduate student researcher within the Chahine Lab. Under both the Biomedical Engineering and Orthopedic Surgery departments, the Chahine Lab and my research focus on the biological and mechanical drivers of intervertebral disc degeneration.

Why did you choose Columbia BME?
Being new to the field of BME, I was less familiar with the different aspects of research, so I chose Columbia BME primarily due to its location. I knew that I wanted to get as far out of my comfort zone as possible, and moving across the country from a town of 30,000 people to NYC seemed like it would do the job. I did visit the campus and the city one time prior to committing and immediately knew it was the right choice.

What are some of your favorite projects/memories from the program so far?
My favorite project would probably be starting two genetic mouse models within my lab. This was a new venture for myself and my lab as a whole, so a LOT of trial and error in the beginning. In vivo genetic manipulation comes with seemingly endless possibilities and avenues of exploration. With this, I can confidently say that no two days in the lab look exactly the same for me, which I love.

Shifting from the lab to the BME program in general, my favorite memories would have to be the socials, specifically the BME boat cruises. I served on the

Graduate Organization of Biomedical Engineers (GoBME) as the social chair, and I now like to say I part-timed as a party planner while at Columbia.

What are your proudest moments at Columbia so far?

My proudest academic moment at Columbia thus far would probably be recently passing my thesis proposal. The proposal was definitely a turning point in my academic career where I began to finally start to feel like the expert in my research. I still have a long way to go, but getting to showcase my previous years of work was very validating.

Additionally, another one of my proudest moments would be taking on the role as President of Columbia Engineering's qSTEM (queer in STEM) graduate student organization. From being afraid to even talk about being gay as an undergrad in a STEM field, to now speaking at new student orientations and working directly with engineering faculty about LGBTQ+ issues, it feels very 'full circle'.

What does Pride Month mean to you?

As the name suggests, Pride Month is a reminder that I need to be proud of who I am, how I identify, and how I got to this point in my life. Seeing people from every walk of life celebrating Pride, and seeing queer stories being highlighted and broadcasted on such a wide scale is something growing up I did not get to experience, but I am extremely grateful exists now.

What advice would you give to your younger self?

If given the chance, I would tell my younger self that it all works out. You will stop being ashamed of who you are, you will come out and the world won't end, and you will eventually be confident expressing yourself to your family, your friends, and in your career. Ignore the people who hate you for being queer and focus your energy on those who love you for it.

What are you excited about?

I am excited about my future! I am excited to become a PI/professor and to be the representation I didn't have, and I am excited and hopeful that the world is going to continue to become gayer and more inclusive.

Images (clockwise from top left):
1. *A break from feeding cells to take advantage of golden hour lighting ;)*
2. *Getting a photo for Instagram, post thesis proposal*
3. *Completing an intervertebral disc injury surgical study*
4. *First week at Columbia!*
5. *Group photo from BME reception*

2nd Annual Rising Stars in Engineering in Health Workshop

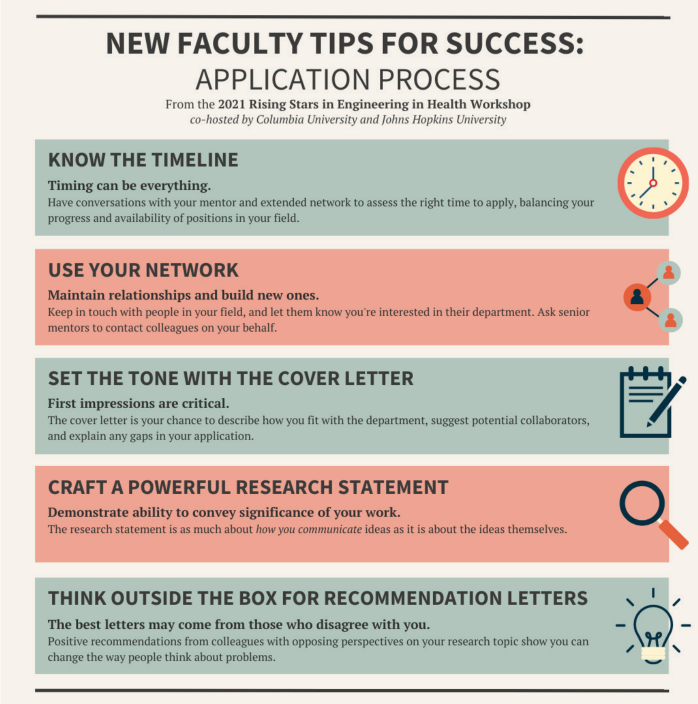
Once a year, the best and brightest young researchers working at the intersection of engineering and biomedicine gather to attend the Rising Stars in Engineering in Health Workshop. Those selected for the Rising Stars cohort are typically one to two years away from applying for a faculty position, hoping to gain valuable insight on the journey of a prospective new faculty researcher through the two-day interactive workshop. This year, the workshop was a joint venture between Columbia Engineering, Columbia Medicine, and Johns Hopkins Biomedical Engineering. Each institution pursues excellence in engineering in health and has prioritized doing so in an environment that embraces diversity, equity, and inclusion. This workshop represents the collaboration between Columbia and Johns Hopkins as they work side-by-side to innovate at the intersection of engineering and health science and educate the next generation of scientists.

"As two of the leading BME departments in the nation," says Michael Miller, Chair of the Department of Biomedical Engineering at Johns Hopkins University, "it is Johns Hopkins' and Columbia University's responsibility and privilege to help the next generation of promising young scientists develop their careers."

X. Edward Guo, BME Department Chair at Columbia University, adds, "We were very pleased to work with wonderful colleagues at Johns Hopkins BME to host this outstanding Workshop. Congratulations to our extraordinary Rising Stars! We hope that all engineering and medical schools jump at the opportunity to hire these outstanding young stars in Engineering in Health."

The 2021 workshop was held in a hybrid format on November 19 and 20. An atmosphere of excitement and inspiration surrounded all in attendance, participants and organizers alike. Compared to the 2020 virtual workshop, the in-person event allowed better opportunities for cultivating relationships, personalized mentoring and feedback, and networking among colleagues. The workshop kicked off with some icebreakers and a lightning talk workshop, where participants got the chance to receive feedback and fine-tune 5 minute presentations of their research. Later, each participant presented their lightning talk for everyone; the breadth of research covered was impressive, including topics ranging from improving implant outcomes, to new imaging technologies, to studying tissue loss during spaceflight. With one remarkable talk after another, the participants were able to share their own exciting discoveries and learn about those of their peers.

After the lightning talks came three panel sessions on the topic of applying for faculty positions. All sessions were packed full of valuable information for prospective researchers. The first session was a junior faculty panel offering of insights into the job application process from Cory Abate-Shen, PhD of Columbia, José McFaline-Figueroa, PhD of Columbia, Casey Overby Taylor, PhD of Johns Hopkins, and Jeremias Sulam, PhD of Johns Hopkins, moderated by Elham Azizi, PhD of Columbia. They broke down the expected timeline and components of applications, gave advice about knowing when to apply, and spoke of their own experiences with the process. The top tips from this panel session are summarized in the infographic below.



The second session was a virtual talk by Polina Golland, PhD, a Henry Ellis Warren (1894) professor of Electrical Engineering and Computer Science (EECS) at Massachusetts Institute of Technology. In a uniquely engaging and dynamic way, Dr. Golland shared her bag of tricks regarding the application process and interviews, collected over the years from watching candidates succeed (and not succeed). She dispensed many useful and often surprising pieces of wisdom, guiding attendees to new ways of thinking about the application, interviews, and steps to becoming faculty at an institution. The top tips about the interview process are summarized in the infographic below. The third session consisted of a senior faculty panel with

Elizabeth M.C. Hillman, PhD of Columbia, Warren Grayson, PhD of Johns Hopkins, Feilim Mac Gabhann, PhD of Johns Hopkins, and Kenneth P. Olive, PhD of Columbia, moderated by Edward Guo, PhD of Columbia and Michael Miller, PhD of Johns Hopkins. These accomplished faculty shared strategies for success as a faculty member, especially in the early years of the journey. Hearing from the collective experience of leading researchers in their fields was inspiring, and participants received priceless advice for surviving in academia. The top tips about starting a new research laboratory are summarized in the infographic below.

After the day 1 sessions concluded, attendees enjoyed a dinner reception at The Faculty House where the 2021 Rising Stars were presented with crystal awards and certificates. After an action-packed first day, day 2 of the Rising Stars workshop continued the momentum with a career building workshop and one-on-one mock interviews. The program concluded with a panel of 2020 Rising Stars alumni who shared their recent experience in the job application process, followed by a cocktail reception al fresco. In just two days, the 2021 Rising Stars cohort gathered invaluable information and gained essential skills to prepare them for the coming years in a career that is as challenging as it is rewarding. The world persists in its struggle against an ongoing pandemic, and health crises continuously develop and evolve; despite it all, Rising Stars of past, present, and future rise to the challenge. As representatives of the next generation of researchers, our Rising Stars give us reason to look forward with optimism and trust that the future of engineering in health is in good hands.

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Photography: Diane Bondareff

Columbia Biomedical Engineering Accelerator (BiomedX) Program

POSITIONING PROMISING BIOMEDICAL TECHNOLOGIES TO ADDRESS UNDERSERVED HEALTHCARE NEEDS

The Columbia Biomedical Engineering Technology Accelerator (formerly the Columbia-Coulter Translational Research Partnership) aims to catalyze the advancement of biomedical technologies by providing funding, education, resources and mentorship to teams of clinicians, engineers and scientists working to develop solutions to clinical unmet needs, with the ultimate goal of bringing innovative research out of the lab to benefit society.

Project support is expected to serve as a bridge to commercial investment, with awards granted to perform specific tasks needed to validate a commercial hypothesis (vs. a scientific hypothesis). Regardless, award recipients are encouraged to submit their funded research outcomes for publication in academic journals.

Funding for the program has been generously provided by the Dept of Biomedical Engineering at the Fu Foundation School of Engineering and Applied Science, the Depts of Surgery, Orthopedic Surgery and Radiology at Columbia University Medical Center, and Columbia Technology Ventures, the technology transfer office of Columbia University.

In addition, BiomedX is sponsored by Columbia's School of Engineering, Yiannis and Jamie Monovoukas, the Department of Medicine, the College of Dental Medicine, the Division of Cardiology, the Irving Institute for Clinical and Translational Research, and the Vagelos College of Physicians and Surgeons.

FUNDING

Funding is available to support selected projects and in-kind additional resources (marketing, regulatory, reimbursement, and legal)

MENTORSHIP

Selected teams are connected with experts in regulatory strategy, intellectual property counsel, reimbursement, marketing identifying and product development.

PROJECT MANAGEMENT

Funded project teams work with a commercialization team as active partners, and meet regularly with Program Management to review technical and business milestones.

Department of Biomedical Engineering

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