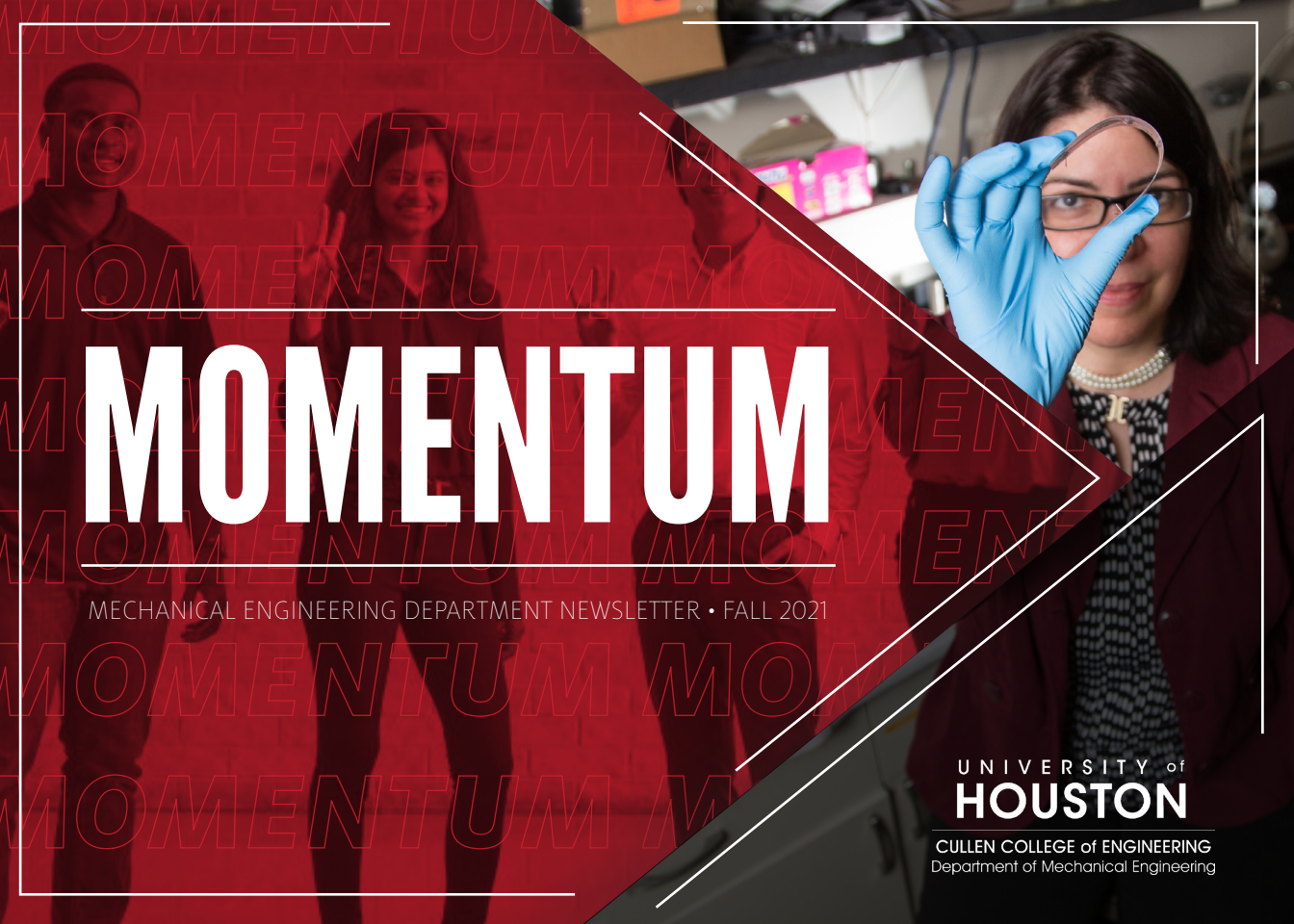


MOMENTUM

MECHANICAL ENGINEERING DEPARTMENT NEWSLETTER • FALL 2021

UNIVERSITY of HOUSTON

CULLEN COLLEGE of ENGINEERING

Department of Mechanical Engineering

Letter from the Chair

Dear Colleagues,

While we continue to closely monitor the effects of COVID-19 in the greater Houston area and beyond, we have now resumed full-in person functionality at the University of Houston campus. Despite the challenges from the last year, the University of Houston has continued to excel, including enrollment levels reaching record numbers and an increase of 40% in research grants. This publication highlights some of the specific achievements of the Cullen College's mechanical engineering department from the last six months. If you would like to know more about any of these projects, or wish to collaborate, I invite you to contact me directly.

Warm Regards,

Pradeep Sharma, Ph.D
M.D. Anderson Professor and Chair
Mechanical Engineering
Cullen College of Engineering
University of Houston

MECE WELCOMES THREE NEW FACULTY

MECE WELCOMES THREE NEW FACULTY FOR FALL 2021

"Tian "Tim" Chen

"Tian "Tim" Chen, assistant professor. Prior to joining UH, Chen was a postdoctoral scientist at the EPFL's Flexible Structures Laboratory & Geometric Computing Laboratory in Switzerland. He received his doctorate in Mechanical Engineering from ETH Zurich in Switzerland.

Daniel Floryan

Daniel Floryan, assistant professor. Floryan was a postdoctoral research associate in the Complex Flows and Fluids Research Group at the University of Wisconsin-Madison. He earned his doctorate from Princeton in 2019.

Bo Zhao

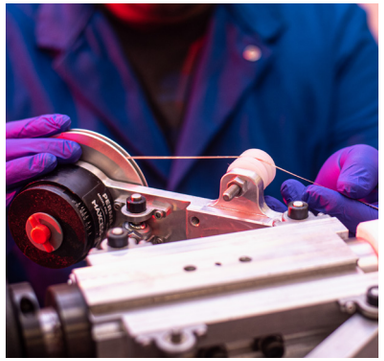
Bo Zhao,assistant professor. Before coming to UH, he worked as a postdoctoral research associate at Stanford University, after earning his doctorate from Georgia Tech in 2016. The Zhao Group is engaged in theoretical and experimental understanding of photonic transport processes for thermal management, energy conversion and information processing.

AMPING UP DELIVERY

OF SUPERCONDUCTING WIRES

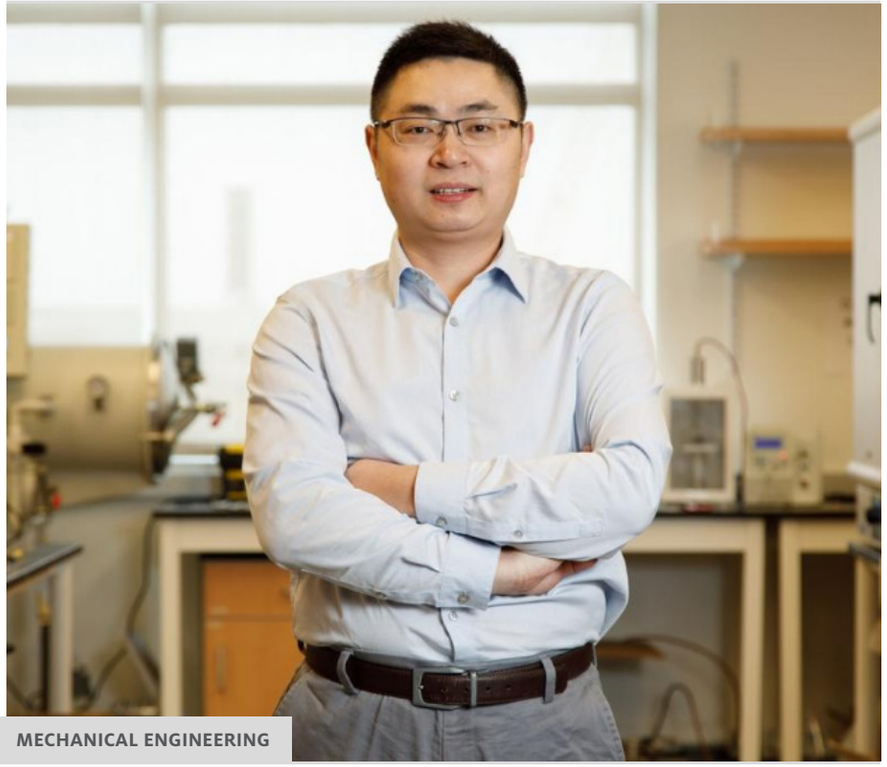
Superconductivity, where electrical resistance vanishes, remains a technology that both powers science and mystifies scientists. It charges MRI scanners, enables new drug discovery through advanced spectroscopy machines, and is used to create the kind of powerful magnets that help smash atoms as scientists work to uncover how the universe is made and how it works.

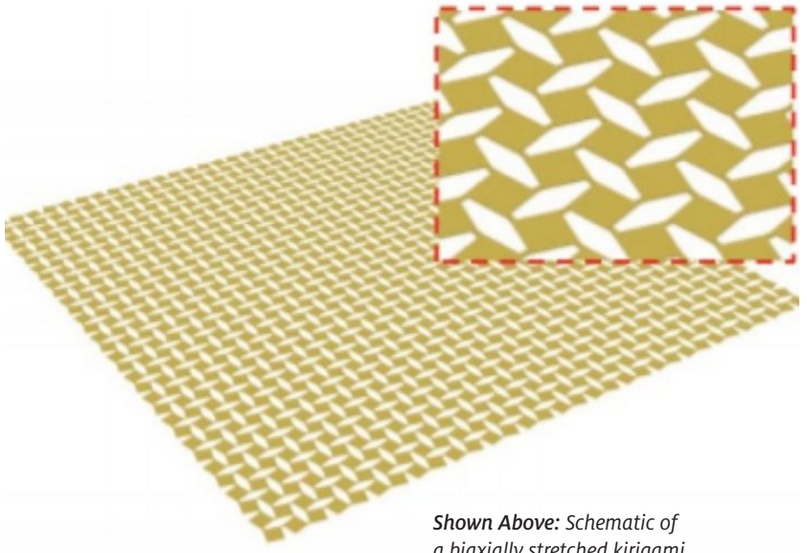
In all of these and more disparate uses, the next-generation machines could have one common connection: the kind of unique wire, or superconducting material, necessary to enable the development of ultra-high field magnets that need hardly any power for sustained operation. It's a wire that nobody else makes other than **Venkat Selvamanickam**, M.D. Anderson Chair Professor of Mechanical Engineering at the University of Houston Cullen College of Engineering and director of the Advanced Manufacturing Institute.



His high-temperature superconducting wires can carry 300 – 600 times the current carrying capacity of copper wires of the same size.

His company AMPeers, short for Advanced Materials Pioneers, in partnership with UH, has received three grants totaling $1.6 million (two from the Department of Energy and one from the U.S. Navy) to accelerate utilization of the technology. These grants are from the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs, which encourage domestic small businesses to engage in federal research with the potential for commercialization.





Shown Above: *Schematic of a biaxially stretched kirigami sheet.*

USING THE ANCIENT ART OF KIRIGAMI TO MAKE
AN EYEBALL-LIKE CAMERA

Cunjiang Yu, Ph.D., Bill D. Cook Associate Professor of Mechanical Engineering at the University of Houston, is reporting the development of a camera with a curvy, adaptable imaging sensor that could improve image quality in endoscopes, night-vision goggles, artificial compound eyes and fish-eye cameras.

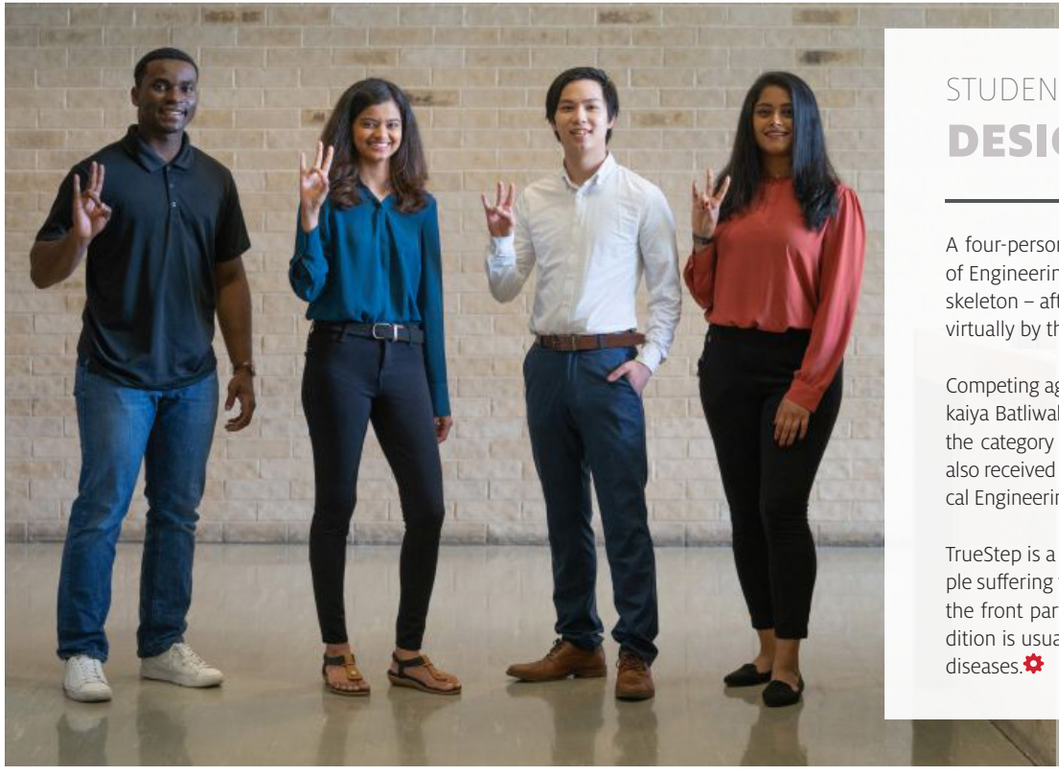
"Existing curvy imagers are either flexible but not compatible with tunable focal surfaces, or stretchable but with low pixel density and pixel fill factors," reports Yu in *Nature Electronics*. "The new imager with kirigami design has a high pixel fill factor, before stretching, of 78% and can retain its optoelectronic performance while being biaxially stretched by 30 percent."

Modern digital camera systems using conventional rigid, flat imaging sensors require complex and bulky lenses to correct optical aberrations. The curvy camera, like a human eyeball, on the other hand, can work with a single lens while correcting aberrations and offering other merits, such as a wide field of view and compact size.

ARDEBILI HONORED BY **FACULTY EXCELLENCE AWARDS**

Haleh Ardebili, Ph.D., Bill D. Cook Professor of Mechanical Engineering, was honored in the University of Houston's 2021 Faculty Excellence Awards. She was one of three professors recognized with the Undergraduate Research Mentor Award. The award recognizes the mentorship efforts of UH faculty at all stages of their careers, and faculty who are making a significant impact in their field by supporting and mentoring undergraduate students in research and scholarship endeavors. Professors must demonstrate at least five years of involvement to receive the award.

The Faculty Excellence Awards are administered by the University of Houston's Office of the Provost. The Teaching Excellence Awards Committee – composed of faculty, students and alumni – reviewed the nominations and made recommendations to Provost Paula Myrick Short, the Senior Vice Chancellor for Academic Affairs.



STUDENT PROJECT TRUESTEP TAKES **1ST AT DESIGN COMPETITION**

A four-person team of students at the University of Houston's Cullen College of Engineering has won a pair of awards for their project – a soft robotics exoskeleton – after presenting at the Excellence in Senior Design competition, held virtually by the University of Texas at Dallas on May 21.

Competing against 12 other universities and colleges, the TrueStep project by Rukaiya Batliwala, Arnold Emeh, Tanvi Parikh and Anthony Pham took first place in the category of Texas Instrument's Best Engineering Design Award. The group also received the Out of the Box Award. Batliwala, Pham and Parikh are Mechanical Engineering students, and Emeh is an Electrical Engineering student.

TrueStep is a soft robotics exoskeleton that provides walking assistance to people suffering from foot drop, a medical condition where an individual cannot lift the front part of their feet due to weakness in dorsiflexion muscles. The condition is usually caused by stroke, spinal cord injuries, or other neuromuscular diseases.

THE POWERHOUSE FUTURE

IS FLEXOELECTRIC

What do the following have in common: a self-powered implanted medical device, a soft human-like robot and how we hear sound? The answer as to why these two disparate technologies and biological phenomena are similar lies in how the materials they are made of can significantly change in size and shape – or deform – like a rubber band, when an electrical signal is sent. Researchers have demonstrated "giant flexoelectricity" in soft elastomers that could improve robot movement range and make self-powered pacemakers a real possibility. In a paper published this month in the *Proceedings of the National Academy of Sciences*, scientists from the University of Houston and the Air Force Research Laboratory explain how to engineer ostensibly ordinary substances like silicone rubber into an electric powerhouse. Kosar Mozaffari, a graduate student at the Cullen College of Engineering, is lead author of the paper.

Next steps include testing this theory in a lab using potential applications. Additionally, efforts to improve on the flexoelectric effect in soft elastomers will be the focus of further study.

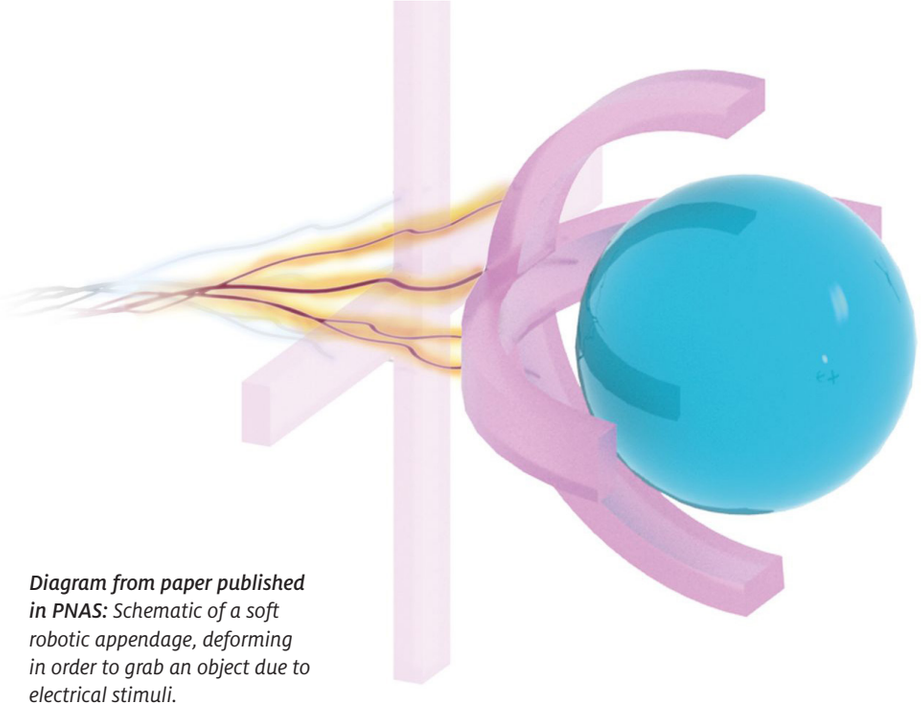


Diagram from paper published in PNAS: *Schematic of a soft robotic appendage, deforming in order to grab an object due to electrical stimuli.*

The University of Houston
Cullen College of Engineering

The University of Houston Cullen College of Engineering addresses key challenges in energy, healthcare, infrastructure and the environment by conducting cutting-edge research and graduating hundreds of world-class engineers each year. With research expenditures topping $35 million and increasing each year, we continue to follow our tradition of excellence in spearheading research that has a real, direct impact in the Houston region and beyond.

UNIVERSITY of HOUSTON | ENGINEERING

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Research MILESTONES