RESEARCH MOMENTUM MILESTONES

IN MECHANICAL ENGINEERING

UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING
Department of Mechanical Engineering

Letter from the Chair

Dear Colleagues,

I hope that this message finds you safe and in good health. Despite the challenges presented by the novel coronavirus, our department has been hard at work in our continued pursuit of excellence in academia and research. I invite you to read through the following research breakthroughs, academic success stories and newly funded projects.

If you would like to learn more about how to support a project or collaborate with our department, do not hesitate to let me know.

Warm Regards,

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

UH ME **BY THE NUMBERS**

ONLINE M.S. RANKED

#16

FOR BEST MECHANICAL ENGINEERING PROGRAM AMONG THE TOP 60 ONLINE ENGINEERING DEGREES

**Source: Intelligent*

3 NSF CAREER AWARD-WINNING FACULTY

12.5% OF TENURE TRACK FACULTY ARE WOMEN

921 UNDERGRADUATE STUDENTS

144 GRADUATE STUDENTS

1,065 TOTAL STUDENTS IN DEPARTMENT

24 TENURE TRACK FACULTY

RECORD NUMBER OF BSME DEGREES AWARDED IN 2020 -

214 TOTAL

CULLEN COLLEGE

BEST BANG FOR YOUR BUCK

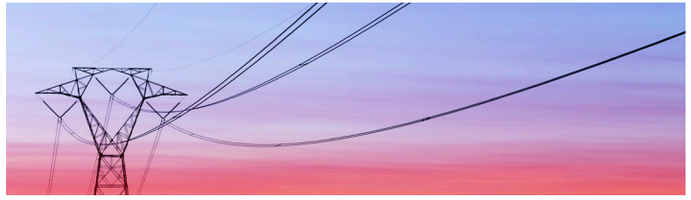
MECHANICAL ENGINEERING

CNBC recently released its list of “The top 50 U.S. colleges that pay off the most in 2020”.

THE UNIVERSITY OF HOUSTON CAME IN 7TH FOR ITS PUBLIC SCHOOLS LISTINGS.

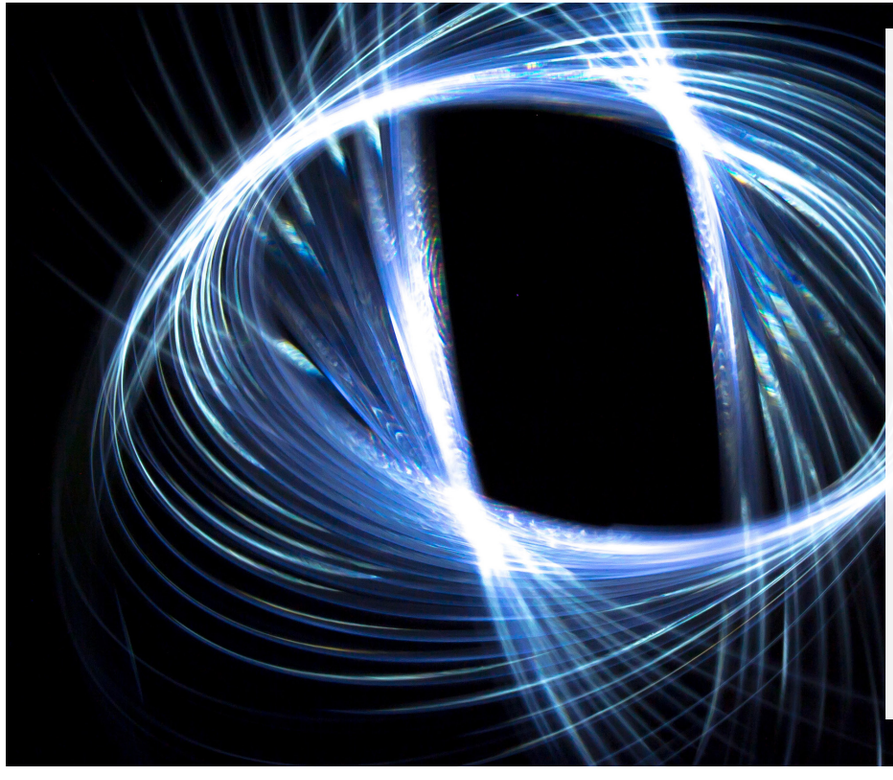
Rankings were determined by dividing the average net cost of a school for the average American student by the average earnings of graduates 10 years after entering the workforce.

To learn more and view the full list of institutions, visit: ***https://www.cnbc.com***



CAN A NEW KIND OF POWER PLANT **IMPROVE AIR QUALITY, RESILIENCE?**

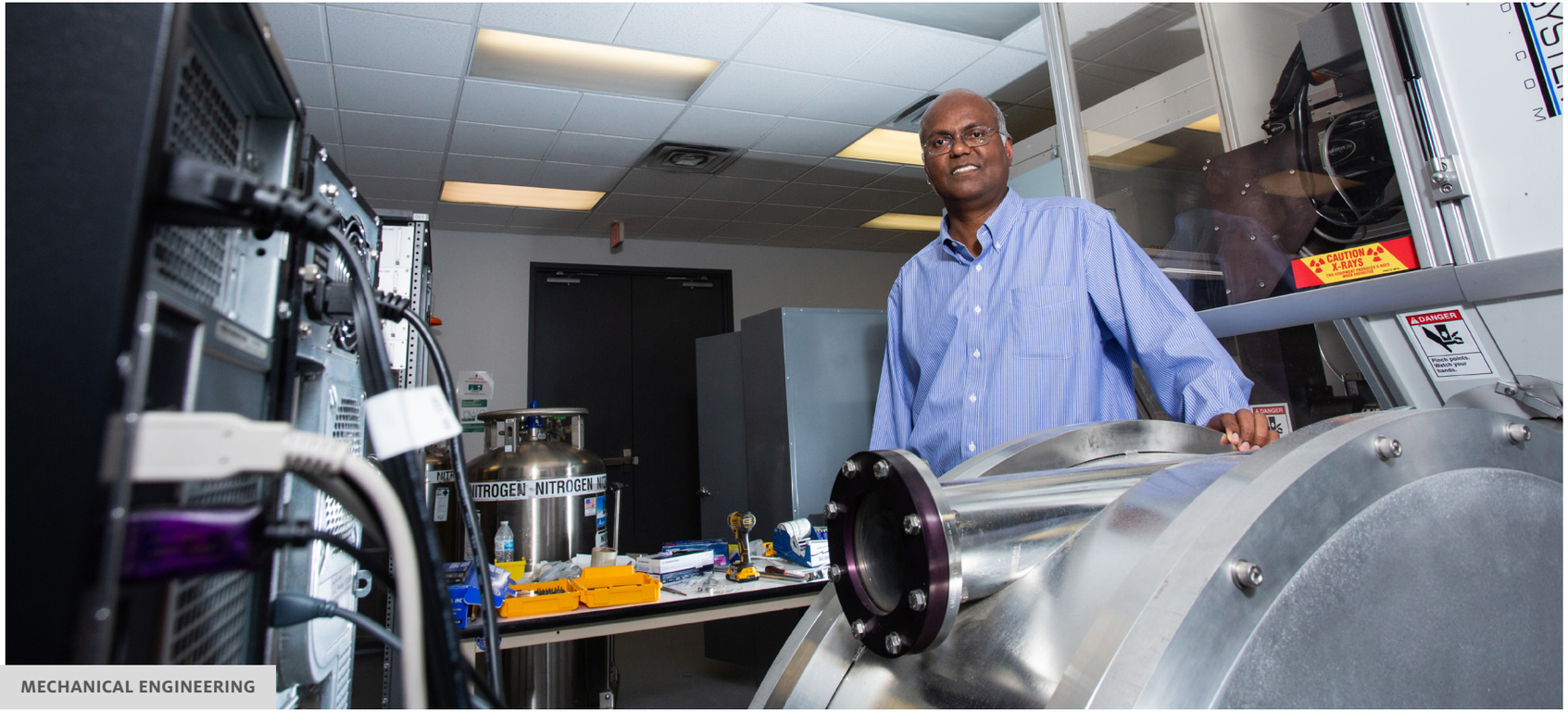
Researchers from the University of Houston, backed by $4 million in funding from the Texas Commission on Environmental Quality, have joined a pilot project testing the use of supercritical CO2, or pressurized carbon dioxide, to produce low-cost, low-emission electric power. The project, funded by the U.S. Department of Energy and located at the Southwest Research Institute in San Antonio, will demonstrate a new technology, known as Supercritical Transformational Electric Power, which can operate so efficiently that a desk-sized turbine is able to power about 10,000 homes. **Pradeep Sharma**, M.D. Anderson Chair Professor of mechanical engineering, is co-principal investigator, focused on understanding and assessing how efficiently the technology can generate electricity.



MÓNICO'S WORK **PULLS ORDER FROM CHAOS**

Turbulence is the main area of study for a $386,241 grant that **Rodolfo Ostilla Mónico**, an assistant professor of mechanical engineering, secured from the NSF in October for his project, "Controlling secondary flows by the use of non-wetting surfaces." He crafted the proposal with Kamran Alba, an assistant professor in the Department of Engineering Technology.

This project will involve experiments at the university, as opposed to just simulation and statistical analysis. They will explore ideas of how to control turbulent flows and will see if they can get their findings to work with a real, non-wetting surface. Mónico pointed to the lotus leaf as an example of a non-wetting surface in nature, with its microscopic bumps and ridges leading to contact angles greater than 90 degrees, and water "slipping" off. The goal is to investigate the use of non-wetting surfaces to induce, affect, and control secondary flows through selectively patterning solid boundaries. The project will last three years, between September 2019 and August 2022.



MECHANICAL ENGINEERING

UH BRINGING **FUSION ENERGY TO COMMERCIAL REALITY**

Despite growing scientific and commercial interest in fusion as an on-demand energy source – producing emissions-free energy through the fusion of hydrogen atoms – significant obstacles remain. A researcher from the University of Houston has joined an effort by the U.S. Department of Energy to jumpstart the technology.

Venkat Selvamanickam, M.D. Anderson Chair Professor of Mechanical Engineering, will lead a $1.5 million project to develop high temperature superconducting magnets made from low-cost raw materials and capable of handling high currents in a magnetic field greater than 20 Tesla, a unit used to measure the strength of magnetic fields. (The earth's magnetic field, by comparison, is about 0.000 1 Tesla.)

The work is part of a $29 million program through DOE's Advanced Research Projects Agency-Energy, intended to close fusion-specific technological gaps to accelerate deployment of a commercially viable fusion system.

‘DRAWN-ON-SKIN’ ELECTRONICS

OFFER BREAKTHROUGH IN WEARABLE MONITORS

A team of researchers led by **Cunjiang Yu**, Bill D. Cook Associate Professor of Mechanical Engineering at the University of Houston, has developed a new form of electronics known as “drawn-on-skin electronics,” allowing multi-functional sensors and circuits to be drawn on the skin with an ink pen.

The advance, the researchers report in *Nature Communications*, allows for the collection of more precise, motion artifact-free health data, solving the long-standing problem of collecting precise biological data through a wearable device when the subject is in motion. The drawn-on-skin electronics can be customized to collect different types of information, and Yu said it is expected to be especially useful in situations where it’s not possible to access sophisticated equipment, including on a battleground.

Faheem Ershad, a doctoral student in the Cullen College of Engineering, served as first author for the paper.

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MECHANICAL ENGINEERING

NEW METHOD OF FLUID GATING HAS IMPLICATIONS FOR DRUG DELIVERY, POWER GENERATION AND OTHER USES

Researchers led by a University of Houston engineer have reported a new understanding of the process and why some fluids stagnate in tiny channels, as well as a new way to stimulate the fluid flow by using a small increase in temperature or voltage to promote mass and ion transport. The work, published in *ACS Applied Nano Materials*, explores the movement of fluids with lower surface tension, which allows the bonds between molecules to break apart when forced into narrow channels, stopping the process of fluid transport, known as capillary wicking. The research was also featured on the journal's cover.

Hadi Ghasemi, Cullen Associate Professor of Mechanical Engineering at UH and corresponding author for the paper, said this capillary force drives liquid flow in small channels and is the critical mechanism for mass transport in nature and technology – that is, in situations ranging from blood flow in the human brain to the movement of water and nutrients from soil to plant roots and leaves, as well as in industrial processes. Doctoral student **Masoumeh Nazari** served as first author for a paper describing the discovery.

NEW MATERIAL, MODELING METHODS

PROMISE ADVANCES IN ENERGY STORAGE

The explosion of mobile electronic devices, electric vehicles, drones and other technologies have driven demand for new lightweight materials that can provide the power to operate them. Researchers from the University of Houston and Texas A&M University have reported a structural supercapacitor electrode made from reduced graphene oxide and aramid nanofiber that is stronger and more versatile than conventional carbon-based electrodes. The UH research team also demonstrated that modeling based on the material nanoarchitecture can provide a more accurate understanding of ion diffusion and related properties in the composite electrodes than the traditional modeling method, which is known as the porous media model. “We are proposing that these models based on the nanoarchitecture of the material are more comprehensive, detailed, informative and accurate compared to the porous media model,” said **Haleh Ardebili**, Bill D. Cook Professor of Mechanical Engineering at UH and corresponding author for a paper describing the work, published in *ACS Nano*. In addition to Ardebili, other co-authors from UH include first author **Sarah Aderyani** and **Ali Masoudi**.

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UH ENGINEER AWARDED PRESTIGIOUS

GUGGENHEIM FELLOWSHIP

Pradeep Sharma, a mechanical engineer at the University of Houston, was selected for a Guggenheim Fellowship, this year's only recipient in the engineering category. Sharma, M.D. Anderson Chair Professor of mechanical engineering and chairman of the department, uses mathematical and computational approaches to understand physical phenomena across a number of disciplines, from materials science to biology. In announcing the new fellows, the John Simon Guggenheim Memorial Foundation cited his work in explaining why some people are able to instantly reproduce a piece of music they just heard, while others – even those who are serious about music – cannot. The fellowship honors artists, writers, scholars and scientific researchers, who are chosen based on their previous accomplishments and what foundation officials describe as their "exceptional promise."

Sharma's work has long been nationally recognized; he received the 2019 James R. Rice Medal from the Society of Engineering Science for "creative contributions to understanding the science underpinning flexoelectricity and its applications to engineered and biological systems." He previously has been recognized with a Fulbright fellowship and the American Society of Mechanical Engineers Melville medal, among other honors.

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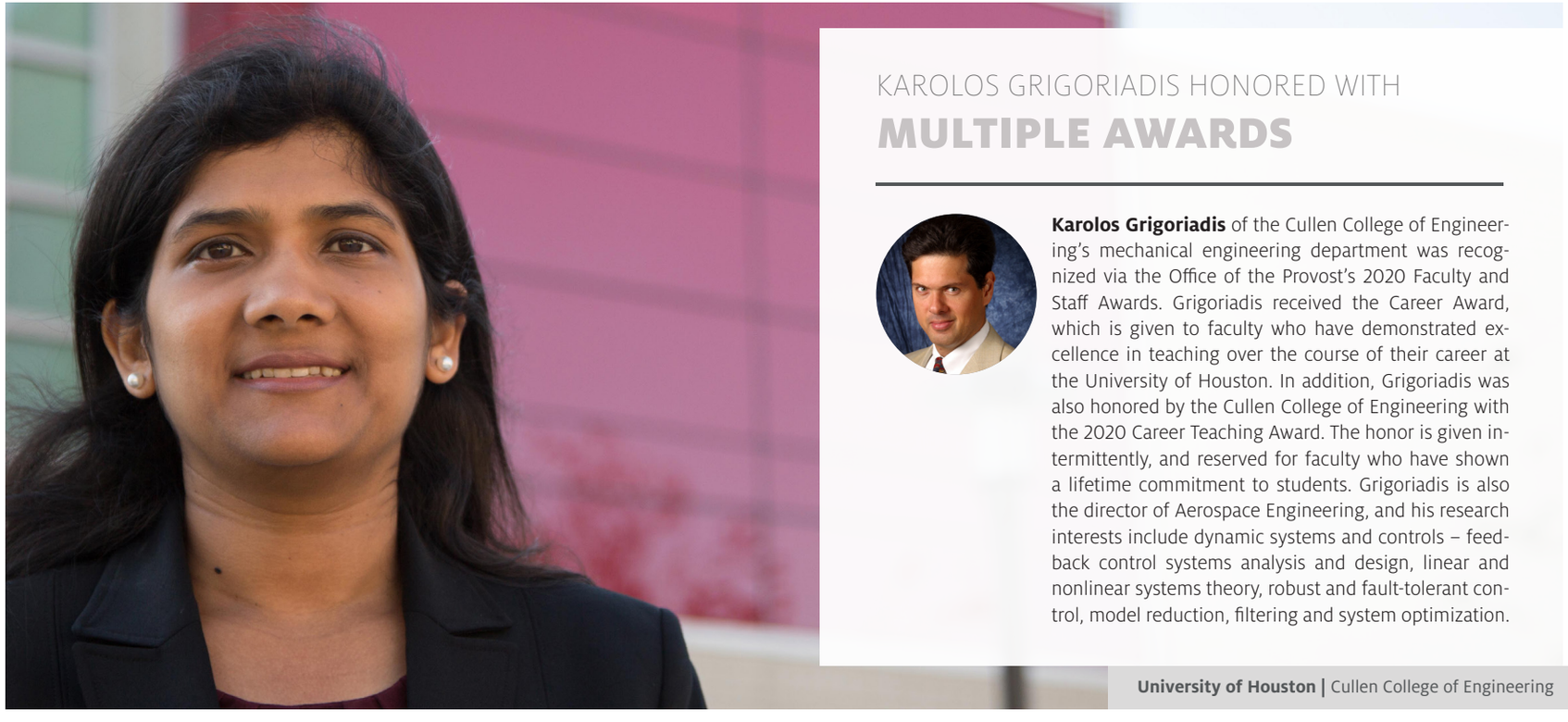
YASHASHREE KULKARNI **APPOINTED AS DIRECTOR** OF RESEARCH COMPUTING

Yashashree Kulkarni, Bill D. Cook Professor of Mechanical Engineering, was recently named the Cullen College's first Director of Research Computing. The mission of the Cullen College of Engineering's computing and information technologies infrastructure and programs is to better engage and educate the community in data science applications and computing. This initiative supports the creation of academic programs and offerings in engineering computing, information technologies, big data and high performance computing with CACDS, the Hewlett Packard Data Science Institute (HPE-DSI) and the Cullen College's academic units. Students can choose to pursue a master's or certificate in Engineering Data Science in the research computing program. Most recently the university acquired a third supercomputer to its stable of high-performance computers, dramatically expanding the computational power available to researchers at the University of Houston and across the UH System.

The new cluster, dubbed "Carya," is a $2.5 million supercomputer from Hewlett Packard Enterprise, a purchase made possible in part with a Governor's University Research Initiative award to Andrea Prosperetti, Distinguished Professor of mechanical engineering at UH and a member of the National Academy of Engineering.



KAROLOS GRIGORIADIS HONORED WITH **MULTIPLE AWARDS**

Karolos Grigoriadis of the Cullen College of Engineering's mechanical engineering department was recognized via the Office of the Provost's 2020 Faculty and Staff Awards. Grigoriadis received the Career Award, which is given to faculty who have demonstrated excellence in teaching over the course of their career at the University of Houston. In addition, Grigoriadis was also honored by the Cullen College of Engineering with the 2020 Career Teaching Award. The honor is given intermittently, and reserved for faculty who have shown a lifetime commitment to students. Grigoriadis is also the director of Aerospace Engineering, and his research interests include dynamic systems and controls – feedback control systems analysis and design, linear and nonlinear systems theory, robust and fault-tolerant control, model reduction, filtering and system optimization.

STUDENT SUCCESS IN THE MECHANICAL ENGINEERING DEPARTMENT

The mechanical engineering department has seen a great deal of achievement regarding student success.

Each spring, the Cullen College of Engineering names one outstanding junior and senior student, chosen for their GPA and academic credentials. In both 2019 and 2020, mechanical engineering students took home both honors. In addition, the department also awarded a record number of BSME degrees in 2020 - 214 total.

Enrollment has also reached an all-time high despite the ongoing effects of the novel coronavirus. The mechanical engineering department welcomed 1075 students in Fall 2020.

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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.

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