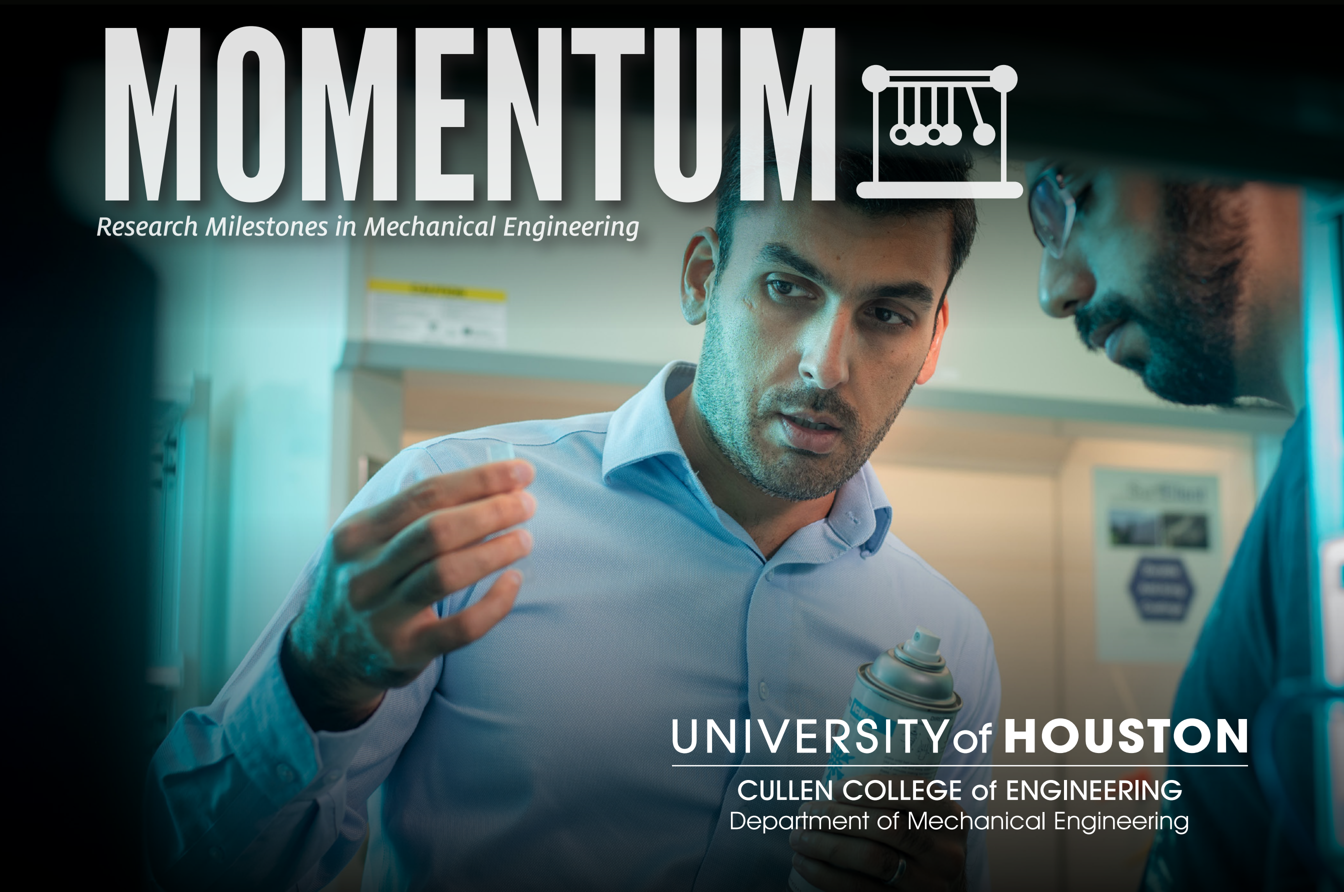
MOMENTUM

Research Milestones in Mechanical Engineering



UNIVERSITY of HOUSTON

CULLEN COLLEGE of ENGINEERING

Department of Mechanical Engineering

Letter from the Chair

Dear Alumni and Friends of the The Department of Mechanical Engineering,

I am proud to highlight the many exciting accomplishments of the UH ME community in this issue of Momentum.

In the mechanical engineering department at the University of Houston Cullen College of Engineering, our central mission is to educate the next generation of globally competitive engineers and perform cutting-edge research in the broad area of mechanical sciences. In this issue of Momentum, I invite you to explore some of the game-changing research going on in our department, from de-icing technology to the production of curved electronics.

The ME program has seen record growth in recent years, with a total enrollment of nearly 1,117 students. Mechanical engineering is currently one of the most sought-after degrees within the Cullen College of Engineering. With our high standards of admission and passion for teaching, we prepare our graduates with a strong foundation in mathematics, physical sciences and engineering principles for applications in industry, research and academia.

Thank you for being a friend of the UH Department of Mechanical Engineering. I look forward to hearing from you and seeing you at upcoming departmental, college and University events!

Warm regards,

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

UH ME BY THE NUMBERS

BEST ENGINEERING PROGRAM OF

2020

BEST GRAD SCHOOLS
U.S.News & WORLD REPORT
RANKINGS

#77
BEST MECHANICAL ENGINEERING PROGRAM IN THE U.S. (SOURCE: U.S. NEWS & WORLD REPORT)

22:1
UNIVERSITY-WIDE STUDENT TO FACULTY RATIO

80%
OF UH ENGINEERING UNDERGRADS ARE EMPLOYED IN TEXAS WITHIN ONE YEAR OF GRADUATION

1,117
TOTAL STUDENTS IN DEPARTMENT

946
UNDERGRADUATE STUDENTS

171
GRADUATE STUDENTS

UH ME Department Welcomes

NEW FACULTY MEMBER

Marzia Cescon recently joined the Cullen College as the David Zimmerman assistant professor of mechanical engineering. Her interdisciplinary research interests include areas of systems engineering and machine learning with applications in diabetic care, translational medicine and water management.

Cescon comes to UH from the Harvard John A. Paulson School of Engineering and Applied Sciences, where she worked as a postdoctoral fellow. Her project focused on the development and translation of novel control algorithms in human clinical trials to improve glucose control in people with type 1 diabetes.

At the same time, Cescon also worked as adjunct investigator with the William Sansum Diabetes Center in Santa Barbara, California.

Cescon received her bachelor's degree in information engineering and her master's in automation engineering from the University of Padova in Italy. She went on to earn a technical license and a doctorate in automatic control from Lund University in Sweden. Her thesis was titled "Modeling and prediction in diabetes physiology." In addition, she completed the Harvard Catalyst's Medical Device Development course in 2018.

She also served as the lead scientist with Dianovator AB, a Swedish startup focused on innovative diabetes technology; a research fellow at the University of Melbourne in Australia; and as a visiting research specialist at the University of California Santa Barbara on another type 1 diabetes research project.

Designing Innovative,

RELIABLE SMA ACTUATORS

Theocharis Baxevanis, assistant professor of mechanical engineering, was recently awarded $245,693 from the National Science Foundation for three years beginning in 2019. His project, titled "Collaborative Research: Fatigue Crack Formation and Growth in the Presence of Reversible Martensitic Transformation in High Temperature Shape Memory Alloys" will work to identify and examine the life-controlling microstructural fatigue mechanisms and mechanics for the fatigue reliability assessment of HTSMAs.

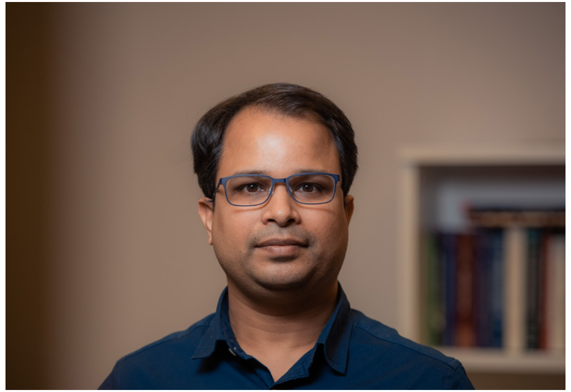
According to Baxevanis, the idea is to eventually provide guidelines for the design of a HTSMA microstructure for optimum resistance to fatigue crack formation and early growth and in turn to prolong service life. While HTSMAs will serve as model materials, the developed models and experimental findings will be directly transferable to other phase transforming materials.

Baxevanis is the principal investigator (PI) and UH is the lead institution. Co-PI is Ibrahim Karaman from the Texas A&M Engineering Experiment Station. The researchers hope the key outcomes of the proposed work to drive the fabrication and processing of HTSMAs will enable the development and design of innovative and reliable SMA actuators.

DAMAGE CONTROL:

Monitoring Damage Tolerance In Hcp Materials

According to **Shailendra Joshi**, Bill D. Cook Assistant Professor of mechanical engineering, HCP materials are strong candidates in increasing number of applications that span a broad spectrum of engineering fields. Joshi recently received a three-year grant from the National Science Foundation to study and design new HCP materials with improved strength and damage tolerance in a project titled "Collaborative Research: Multiscale Modeling of Damage Tolerance in Hexagonal Materials". The grant total is for $243,230 and began in 2019.



A clear scientific understanding of the underlying processes of strengthening and deformation is lacking, which stymies our ability to design HCP materials with the desired strength and damage tolerance that is needed. The complex crystallography of these materials gives rise to intricate coupling between fine-scale mechanisms of plasticity that include slip and twinning modes of deformation. These mechanisms of plastic deformation are known to influence macroscopic damage and ultimate failure, but their precise roles are not understood.

This project aims at predictive modeling of residual strength and ductility limits of HCP materials. If successful, the proposed research would advance the life assessment procedures and avoid material waste in processing and manufacturing operations. Joshi is the principal investigator (PI) and UH is the lead institution. Co-PI is Ahmed-Amine Benzerga from the Texas A&M Engineering Experiment Station.

Enabling Light-Driven Microfluidics With

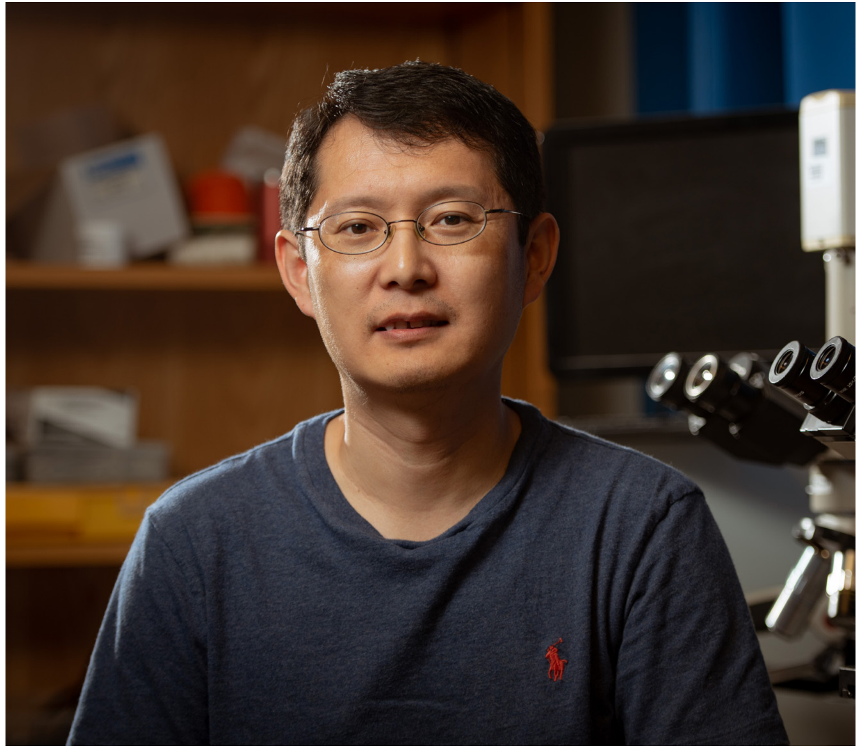
LASER STREAMING

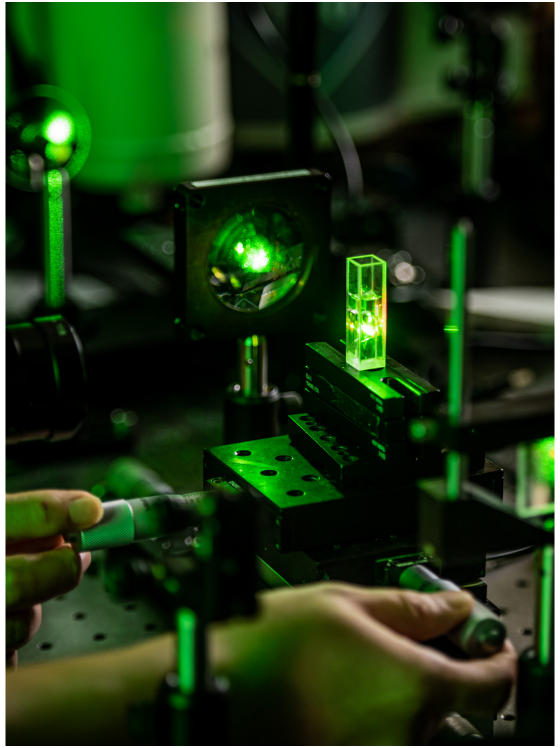
With the help of a three-year $378,386 grant from the National Science Foundation, **Dong Liu**, an associate professor of mechanical engineering, will study laser streaming microfluidics. Microfluidics has led to significant advances in a few niche areas in applied science and engineering. For lab-on-a-chip and point-of-care diagnostic applications alone, the global market will reach $8.78 billion in 2021.

At present, the manufacturing approach for microfluidics requires the performance factors, physical layout and fabrication processes to be considered simultaneously for all sensors and actuators integrated in a single chip. Modifying one portion of the device often entails redesigning the entire architecture. Consequently, most microfluidic devices are custom built and cannot be translated to low-cost scalable manufacturing.

Light-driven microfluidics, where light serves as both sensor and actuator, promises a radical solution: it needs neither immobilized on-chip actuators nor physical connections to external electric/hydraulic peripherals and provides robustness and versatility that are unavailable in standard microfluidics. This research project, which is built on Liu's previous work on laser streaming, aims to eradicate this fundamental limitation by establishing a new microfluidic principle.

The proposed laser streaming will emancipate light-driven microfluidics from its fundamental constraints and open a new pathway enabling all-optical devices, in which the microfluidic functions are controlled by light stimulation and can be reconfigured dynamically for optimal performance. Liu hopes his research will lay the scientific foundation for laser streaming by elucidating the underlying physics via experimental characterization and multiphysics modeling. His co-PI on the project is Jiming Bao, professor of electrical and computer engineering at the Cullen College.





Faculty Spotlight:

CHRISTIANA CHANG

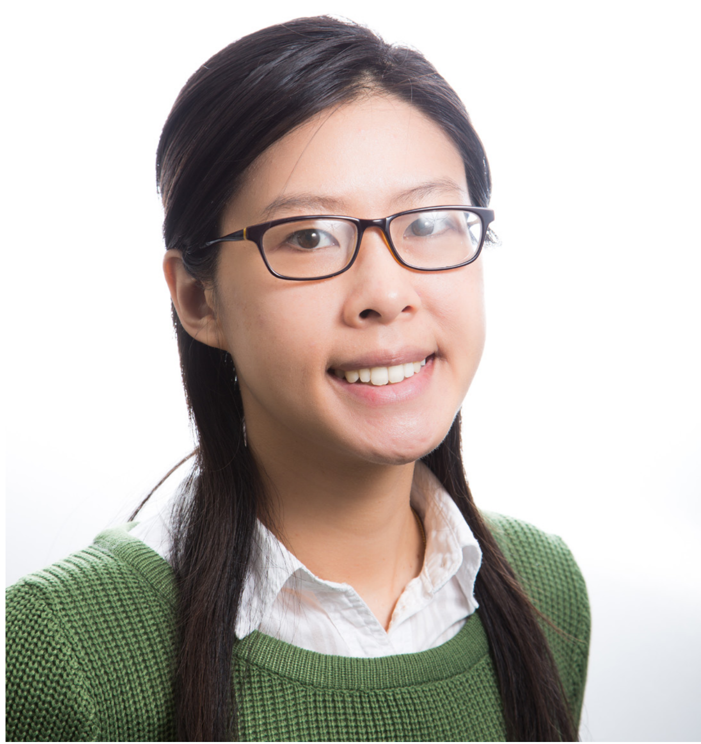
Christiana Chang, an instructional associate professor, is one of the Cullen College's most dedicated faculty. In fact, she recently received the college's inaugural William A. Brookshire Teaching Excellence Award. The award was created to honor faculty who demonstrate an unwavering commitment to exemplifying the highest levels of teaching excellence inside the classroom.

Chang designs "kitchen sink" quizzes from scratch, combining as many exam concepts as she can into each problem to challenge her students and help them build a strong knowledge base. She also creates hands-on design workshops to help students learn coding and instrumentation. Her open-door policy and office hours are resources available to any student needing help – whether it's clarification of a confusing concept, career advice or tips for more effective study habits.

Her passion for teaching has netted Chang several other awards. She's won the Cullen College of Engineering Outstanding Lecturer Award for 2014-15, the Student's Choice Professor of the Year Award in 2015 from UH's American Society of Mechanical Engineers (ASME) student chapter, and a UH Teaching Excellence Award in the Instructor/Clinical category for 2017-2018.

Chang serves as an instructor for the mechanical engineering capstone design class. She has guided many students to success, including one group who recently presented their planetary ice extraction project at NASA's Langley Research Center.

She earned her bachelor's and master's degrees as well as her Ph.D. in mechanical engineering from the Cullen College.



UH Startup SurfEllent

RAISES $470K IN FUNDING

SurfEllent, a UH startup which brings innovative and durable anti-icing coating technologies to the market, is hot, hot, hot. It has raised $470,000 in funding and the year is not over yet. The company tasted success and started its financial windfall at the 2019 Texas A&M New Ventures Competition (TNVC) earlier this summer. The first-time TNVC competitors won the second-place award and its accompanying $35,000 check as well as the Texas A&M Engineering Extension (TEEX) Product Development Center Prize of $10,000, walking away with a total of $45,000.

At the same competition, SurfEllent managed to snag the attention of several other interested parties, including the U.S. Department of Defense. Most recently, a private company, which wishes to remain confidential, invested $350,000 in seed funding. Meanwhile, an independent study out of the University of Iowa proved the efficacy of SurfEllent's current coating by trying it out on a jet engine. As a result, SurfEllent was also awarded a $50,000 Small Business Innovation Research (SBIR) grant and a $24,999 Small Business Technology Transfer (STTR) grant this summer.

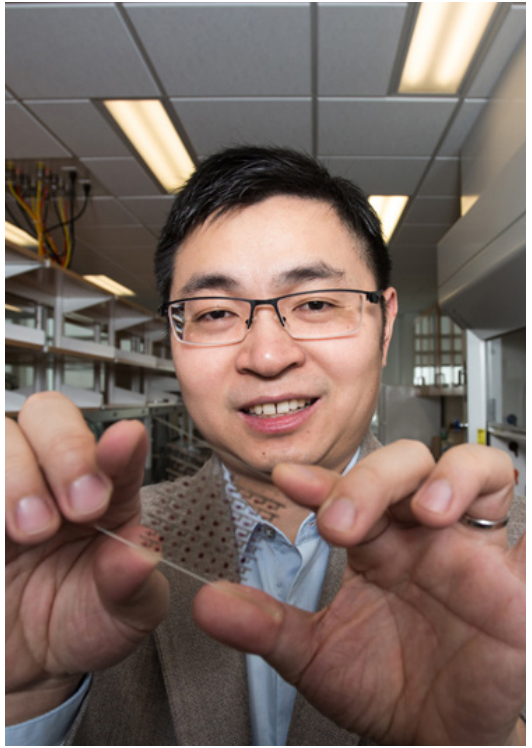
Hadi Ghasemi, Bill D. Cook Associate Professor of mechanical engineering, is the brain behind SurfEllent. The technology he nurtured into a product can be used to de-ice many things, from cars to airplane engines. According to Ghasemi, the end goal is to improve the quality of human life. There is a critical need for advanced anti-icing coating technologies and he looks forward to more opportunities for collaboration with various industries and business partners.

A New Way To Produce

CURVY ELECTRONICS

Contact lenses that can monitor your health as well as correct your eyesight aren't science fiction, but an efficient manufacturing method – finding a way to produce the curved lenses with embedded electronics – has remained elusive. Until now. A team of researchers from the University of Houston and the University of Colorado Boulder reported developing a new manufacturing method, known as conformal additive stamp printing, or CAS printing, to produce the lenses, solar cells and other three-dimensional curvy electronics. The work, reported in the journal *Nature Electronics*, demonstrates the use of the manufacturing technique to produce a number of curvy devices not suited to current production methods. The work is also highlighted by the journal *Nature*.

Cunjiang Yu, who is also a principal investigator with the Texas Center for Superconductivity at UH, and his team devised a new method, which they report opens the door to the efficient production of a range of curvy electronic devices, from wearables to optoelectronics, telecommunications and biomedical applications. This new method is known as conformal additive stamp printing, or automated CAS printing, which will make it easy to scale up production.



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 $30 million and increasing each year, we continue to follow our tradition of excellence in spearheading research that has real, direct impact in the Houston region and beyond.

UNIVERSITY of HOUSTON | ENGINEERING

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