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The University of Texas at Austin
Walker Department of Mechanical Engineering
Cockrell School of Engineering

DEAR FRIENDS

Welcome to the latest issue of the Texas Mechanical Engineer Magazine! This issue's cover story focuses on the role of artificial intelligence in mechanical engineering. AI is an increasingly useful tool in the practice of mechanical engineering and in the research conducted by UT faculty and students. This issue shares several examples of how AI is being implemented across a range of ME research topics, including computational modeling, energy, design, health care, and in art restoration.

An equally important topic is the use of AI in the classroom. AI platforms such as ChatGPT are now widely embraced by students. In the past two years these systems have become more accessible, capable, and accurate. For example, faculty report that the UT Sage model, when trained on an instructor's lecture notes, can generate complex homework assignments, exams, and provide correct answers to nearly all questions posed by the instructor.

The rapidly improving capabilities of AI have prompted the department and the Cockrell School to implement changes in our teaching practices. These changes are motivated by the following considerations:

» How do we ensure that students absorb the foundational engineering knowledge that enables them to be creative, make ethical technical decisions, and devise solutions to modern engineering challenges?

» What body of knowledge regarding AI algorithms and usage modes do ME students need to know to be at the forefront of engineering?

» What engineering applications best exemplify the benefits of AI tools?

» How can student learning be assessed in an environment where AI can solve homework problems, draft lab reports, and complete take-home exams? Can AI improve student learning?

While our planning (and debating) is currently ongoing, the department is converging on modifications to our curriculum that would expose all ME undergraduates to the fundamentals of AI and machine learning. With this foundation students will, at a minimum, be knowledgeable users of AI, but also be prepared for more advanced applications. I will share more details regarding these curricular changes in a future issue of this magazine.

I'd love to hear your opinions on the use of AI in engineering education. Please email me at: Donald.Siegel@austin.utexas.edu

As always, I'm eager to hear about and share updates of developments in the lives of our alums. If you have a milestone you'd like to share, please submit it using the QR code on page 16.

Thank you for your support of the Walker Department of Mechanical Engineering,

DON SIEGEL

CHAIR, WALKER DEPARTMENT OF MECHANICAL ENGINEERING

TEXAS MECHANICAL ENGINEER

Texas Mechanical Engineer is published annually for alumni and friends of the J. Mike Walker Department of Mechanical Engineering in the Cockrell School of Engineering at The University of Texas at Austin.

—

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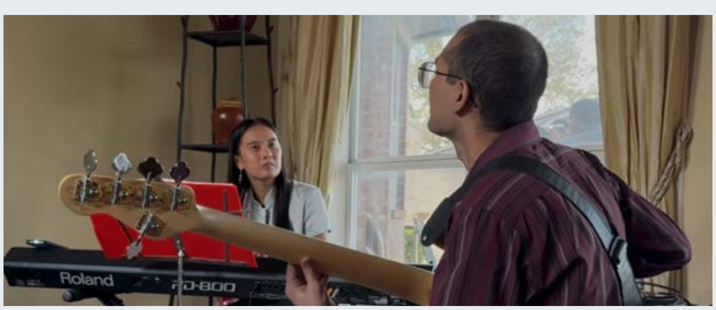
—

ON THE COVER

Stylized depiction of the operation of a thermal energy storage material. Courtesy Don Siegel.



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COMMUNITY, CULTURE AND WELLNESS COMMITTEE

Our department is committed to fostering a vibrant campus community The Community, Culture and Wellness Committee was created to provide resources and opportunities to help this mission. Through social events, town halls, workshops, grant programs and more, our members work together to create a safe and supportive environment for all.

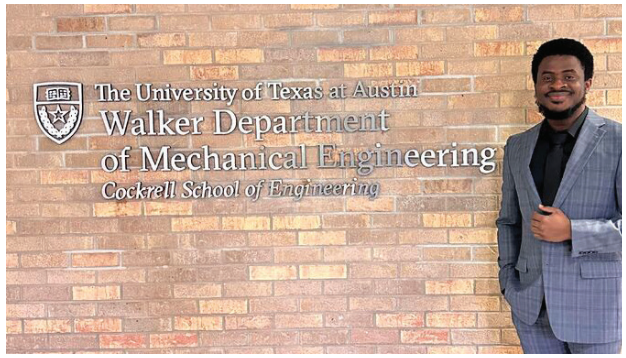
> "THIS COMMITTEE STRENGTHENS OUR COMMUNITY BY PROMOTING CONNECTION, INCLUSION AND WELL-BEING AS ESSENTIAL FOUNDATIONS FOR EXCELLENCE IN RESEARCH, EDUCATION AND SERVICE."
>
> **— Yaguo Wang, associate chair for community, culture and wellness**

Scan the QR code to learn more or become a member today!

ICYMI

OUR STUDENTS STAND OUT

Emmanuel Bamido, graduate student in mechanical engineering in professor Michael Cullinan's lab, has been named a **30 Under 30 honoree by SME Media**. ■



FOLLOW US ON LINKEDIN TO HEAR MORE ABOUT OUR STUDENTS AND FACULTY

DISCOVERY TO IMPACT FACULTY

AMBASSADORS

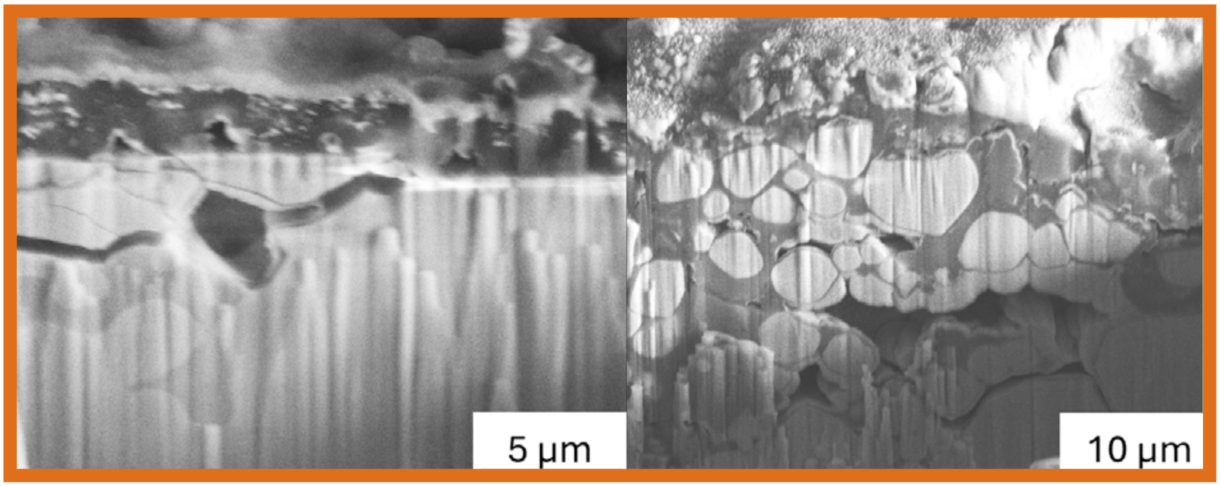
Associate professors Farshid Alambeigi and Chris Rylander were named as faculty ambassadors in a new pilot program launched by Discovery to Impact, UT Austin's resource hub for researchers, inventors and entrepreneurs. Alambeigi and Rylander are both startup founders who hope to share their knowledge with students and faculty looking to begin their journey of bringing research to market. Ambassadors will provide resources and personal expertise in all parts of the process from filing patents, licensing, commercialization and more. This pilot cohort launched with four faculty from the Cockrell School with plans to expand to additional colleges across the University. ■

> "I'M ABLE TO SERVE AS A BRIDGE TO CONNECT ANYONE WITH AN IDEA OR PROMISING TECHNOLOGY TO THE RIGHT RESOURCE WITHIN THE MANY DISCOVERY TO IMPACT OFFICES. I LIKE TO ENCOURAGE ANYONE THAT IF THEY WANT TO PURSUE THIS, I CAN HELP THEM."
>
> **— Farshid Alambeigi**

A GEM OF A

BATTERY BREAKTHROUGH

A pair of ceramic materials could unlock the potential of safer, longer-lasting solid-state batteries.



Above: Zirconia-enhanced electrolyte (left) avoids cracking seen in the baseline sample (right). Courtesy David Mitlin.

A team led by UT Austin developed a new approach for solid-state batteries, improving their performance while reducing manufacturing costs. Solid-state batteries are an emerging energy storage technology that could unlock enhanced performance for drones, electronics and electric vehicles.

> “THE BIGGEST GAME IN TOWN FOR NEXT-GENERATION BATTERIES IS MAKING THEM ALL SOLID-STATE, ALLOWING FOR IMPROVED SAFETY AND HIGHER ENERGY.”
>
> **— professor David Mitlin, lead investigator on the new research published in *Nature Materials***

Today, most lithium-ion batteries use an organic liquid electrolyte, a maple-syrup-like substance that allows lithium ions to reversibly shuttle back and forth inside the battery. Despite being technologically mature, liquid electrolytes are the hydrocarbon “fuel” in the oft-reported battery fires.

Solid, ceramic-based electrolytes reduce fire risks, eliminating the hydrocarbon fuel that sustains battery thermal runaway reactions. However, ceramic electrolytes face their own hurdles, including high costs, quality control and premature failure due to metal filament (termed dendrite) induced short circuiting.

Oxide ceramics based on the garnet structure are key materials for all solid-state batteries. Garnet’s unique structure allows lithium ions to move quickly and efficiently, making it ideal for energy storage. But even garnet has struggled to overcome the dendrite problem, which is directly linked to the formation of small cracks inside the electrolyte.

Like a jeweler refining a gemstone, the researchers have “polished” the garnet to reveal its full potential. Dispersing micro-scale zirconia particles throughout the garnet grains, suppresses both the cracking and the dendrites.

In tests, the zirconia-modified garnet achieved nearly double the critical current density—the maximum current it can handle before short-circuiting—compared to unmodified garnet. This means batteries using this material can operate at higher power levels without compromising safety.

Beyond batteries, these results could be applied to a wide variety of manufacturing sectors for high quality ceramics, where defect control is essential. ■

EXPLORING THE INTERCONNECTION

THIRST FOR POWER

OF WATER AND ENERGY

In 2025 the documentary film, "Thirst for Power" was released on PBS. The full-length film, based on professor Michael Webber's 2016 book of the same name, explores our dependence on water for energy and the hidden vulnerabilities in our modern, water-dependent energy systems.

With filmmaker Mat Hames, Webber embarks on a global journey to uncover the often-overlooked links between energy and water, exploring how these forces shape our past, present and future.

"The point was to help explain to people the importance of energy and water and how they're interrelated. We need water for life and energy for quality of life and they are interconnected. That's the part that's surprising for many people: how much water we use for energy," said Webber.

Inspired by a childhood trip to France, Webber takes viewers and his family through the engineering marvels of ancient Roman aqueducts to the colossal infrastructure of modern hydroelectric power stations.

The film is available to stream on PBS.org and has been aired in 47 states. In May 2025, Austin PBS hosted a live screening of "Thirst for Power" open to the entire Austin community. The event included a panel discussion featuring water and environmental experts from across Texas. ■

Funding for "Thirst for Power" was provided by Itron, Inc., the State Energy Conservation Office of Texas, and HEB. It was created in partnership with Alpheus Media, Austin PBS, American Public Television and The University of Texas at Austin. This film was directed by Mat Hames and produced by Alpheus Media with executive producers Juan Garcia and Beth Hames.

FROM THIN AIR TO TOP PRIZE

innovative water-harvesting device, AirGel, wins big at inventor competition

Weixin Guan and Yaxuan Zhao, inventers of AirGel, won first place in the graduate category of the 2025 Collegiate Inventors Competition (CIC), one of the most prestigious awards for engineering students in the United States.

Guan and Zhao are graduate researchers with the Walker Department of Mechanical Engineering and Texas Materials Institute. They are a part of the Yu Research Group led by professor Guihua Yu.

The pair were recognized for their innovative and cost-effective device, AirGel, which extracts drinking water from humidity in the air. Their invention also won the competition's People's Choice Award and received a USPTO Patent Acceleration Certificate from the U.S. Patent and Trademark Office.

> "IT WAS AN HONOR TO REPRESENT UT AND BRING A TEXAS-BORN INVENTION FROM THE FORTY ACRES TO THE NATIONAL STAGE."
>
> **— Weixin Guan**

The solar-powered atmospheric water-harvesting device produces clean drinking water using hydrogels made from agricultural and food waste. The hydrogel sorbents pull in water vapor like a sponge and then release the collected liquid using sunlight, making AirGel a low-energy solution to water scarcity — an issue affecting more than 2 billion people worldwide.

Designed to work entirely off grid, the sustainable device is ideal for arid climates and for producing clean water after natural disasters.

A major goal of the project was to show that making clean water from air doesn't have to be expensive, fragile or tied to geography.

"The system can cycle multiple times per day and link into larger arrays, so it can serve both a single household and potentially an entire community. That flexibility is what makes it practical in the real world," added Zhao.

Next, Guan and Zhao will work toward real-world applications and deployments of AirGel.

"We are currently working on further optimizing and iterating our system design to be more efficient, productive and more durable in real-world conditions," said Guan. "After that, we hope to send AirGel to places globally that need water most, where we can further study their field performance and cost effectiveness to bring AirGel one step closer to practical implementation." ■

GETTING TO THE BARE BONES

new grant supports research into aging, bone health and disease prevention

A new Research Career Award grant is supporting Maryam Tilton, assistant professor in the Walker Department of Mechanical Engineering, as she investigates how aging alters bone cells at the most fundamental level and how those changes may contribute to osteoporosis and other chronic diseases.

The award, funded by the National Institutes of Health and the National Institute on Aging, supports early-career independent investigators in launching new, innovative research directions.

Although age-related bone loss is widely recognized, Tilton's research looks beyond visible symptoms to examine what happens inside bone cells over time. Her work focuses on osteocytes, the most abundant type of cell in bone and one that plays a central role in maintaining bone homeostasis (the processes that maintain bone health).

As people age, these cells can enter a state known as cellular senescence. Senescent cells, also referred to as "zombie cells", remain stuck in a stress response state and release inflammatory signals that can disrupt how bone senses and responds to mechanical forces. These signals can act locally within bone and can also enter the circulatory system, potentially influencing distant tissues as part of broader aging-related inflammation.

"What we're trying to understand is what happens to these cells during aging that leads to tissue and organ degeneration. We're taking a step back to look at the fundamental biology and mechanics involved."

–Maryam Tilton

In her lab, Tilton and her team have found that as bone cells age, some become stiffer and less responsive to everyday physical forces. These physical changes track with shifts in cell shape, the nucleus and patterns of gene activity over time.

By combining physical measurements with genetic and molecular data, the research aims to build a clearer picture of how aging bone cells contribute to osteoporosis and other bone-related diseases. The findings could also help explain why the aging bone microenvironments can become more vulnerable to cancer spread and other long-term health problems.

A major goal of the project is to help shift medicine away from reacting to injuries and toward preventing them. Tilton noted that many current treatments focus on repairing fractures after they occur, often using implants or other medical devices, rather than addressing the root causes of bone weakening.

The project also contributes to broader efforts to rethink how aging-related diseases are treated, emphasizing cellular and molecular interventions rather than invasive procedures. Data generated through the grant will support future large-scale federal funding proposals, helping position the research for long-term impact.

"This award gives us the opportunity to generate biophysics insights that are largely missing in aging research," Tilton said. "By understanding how aging changes cells at a fundamental level, we can lay the groundwork for more targeted, disease-modifying treatments."

As populations continue to age, insights from this research could help redefine how clinicians and scientists approach bone health, aging and prevention, starting with the cells that keep the skeleton strong. ■

ENGINEERIN A BETTER ATHLETE

Texas Engineers are making a major impact in the field of biomechanics.

Ella Small knows how to make a big impression, at the doctor's office and on the balance beam.

She won a national championship for UT's gymnastics team in that event in 2023. She came close to a repeat win in 2024, just a few months before finishing her Ph.D. in mechanical engineering at the Cockrell School. But Small has paid a price for her achievements.

In middle school, she dealt with spondylosis — a condition that causes wear and tear on the spine. She's suffered labral tears in both hips due to dislocations, as well as countless bumps, bruises and sprains. She may need both knees replaced before her 30th birthday.

Small is part of a growing group of Texas Engineering students and alumni dedicating their careers to advancing what our bodies are capable of using engineering principles. She took what she knew — pain and peak performance — to the growing field of biomechanics.

Biomechanics is the study of how the human body generates forces and motion. Knowing more about these forces can help people with motor impairments regain function. And this knowledge can serve as the backbone of new devices and technologies to encourage participation in daily activities. The field has entered popular culture in recent years because of advancements in sports science aimed at optimizing performance and preventing injury by equipping athletes with sensors to monitor every movement.

However, the competitive nature of sports means franchises determined to engineer a winning season keep their biomechanics operations top secret. Researchers at UT are exploring how to advance the discipline in a public way so that we all can understand why our bodies do what they do, and how we can keep them healthy.

"For all the energy and time we've put into medicine and understanding our bodies, there's still so much we don't know about the biomechanical processes behind everything we do on a daily basis."

–Rick Neptune, professor, Walker Department of Mechanical Engineering and leader, Neuromuscular Biomechanics Lab.

From the Beam to the Lab

Growing up in Atlanta, Small competed in gymnastics and also coached younger gymnasts. She even spent time in Russia, learning from top coaches there.

But by the time college entered her mind, Small was burnt out on the sport and wanted to stay as far away from gymnastics as possible. Her undergraduate institution, Swarthmore College, didn't have a gymnastics program at all, a point in its favor.

There, she studied physics but wanted something more practical. That led her to biomechanics. At UT, Small originally planned to focus on helping stroke patients, but the COVID-19 pandemic restricted the possibility of bringing vulnerable people into a lab for studies. Neptune encouraged Small to focus her research on what she knew best: gymnastics.

Outside the lab, Small originally planned to explore a return to the sport on UT's recreational team, but insistence from her teammates got her back into the world of competing. She zeroed in on the back handspring, a move as common to a 10-year-old gymnast as it is to Simone Biles. What she found was surprising: gymnasts naturally perform back handsprings in three different ways, and one is far better for the body than the others.

"The optimal technique is called sequential flection," Small said. "They keep their legs straight, bend their chest forward, and then they bend their knees and execute the flip. It's actually really similar to a proper deadlift technique."

Small collected data by analyzing more than 20 gymnasts of different ages and skill levels. These subjects visited the motion capture lab within Darrell K. Royal-Texas Memorial Stadium. The lab is rigged with a ring of cameras, with force plates embedded in the floor. Subjects are outfitted with more than 50 sensors — which Small calls polka dots — as well as electrodes that detect muscle activity.

These devices help the researchers create a digital twin of their subject that they can analyze.

In her research, Small found that her back handspring did not fall under the optimal technique. Her back bends significantly, which has led to spinal issues.

"It's successful; I stay on the beam and get a good score," Small said. "But it's not optimal for the long-term health of a gymnast because it puts so much pressure on the spine."

As Small continues to pursue this research for her Ph.D., she's also landed a job with the Pittsburgh Pirates as a biomechanist. By better understanding optimal movements,

the hope is to prevent the injuries Small and countless other gymnasts have experienced.

> “GYMNASTICS IS A VERY INTENSE SPORT THAT DEMANDS A TON OF HOURS FROM THESE TEENAGERS AND WREAKS HAVOC ON THEIR BODIES. OTHER BIG SPORTS HAVE HUNDREDS, IF NOT THOUSANDS, OF STUDIES ABOUT INJURY AND PERFORMANCE. FOR GYMNASTICS, IT’S LESS THAN 100. ANYTHING WE CAN DO TO MAKE IT SAFER; I WOULD LOVE TO BE ABLE TO SEE THAT.”
>
> **— Ella Small**

Like Teacher, Like Student

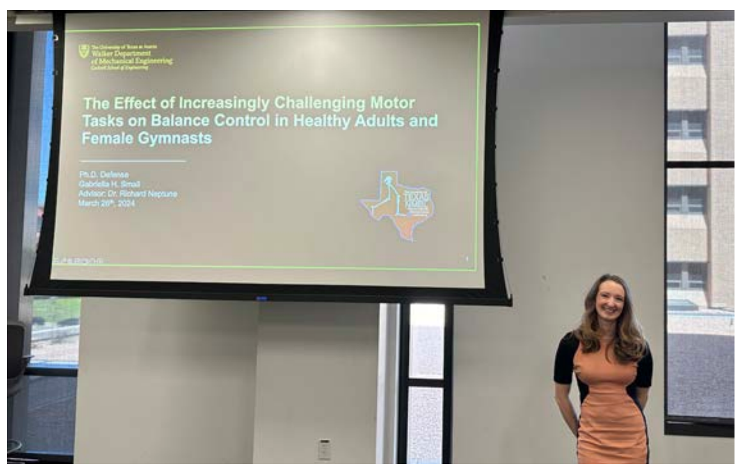
Neptune became fascinated with the human body’s capabilities because of his background as a competitive skier and football player at the University of California, Davis.

Now as a faculty member, Neptune works with people who have experienced strokes, limb amputations, spinal cord injuries and more. A hybrid approach of experimentation and simulation aims to estimate things that can’t be measured directly, such as joint contact forces. The goal is to better understand how these parts work together to power the human body, the same way an engine makes a car run.

Neptune recently received a pair of grants totaling $5.5 million to advance his research on the medical side of biomechanics. A $4 million grant from the Congressionally Directed Medical Research Program will support testing three modern, carbon fiber ankle-foot orthoses to help stroke survivors recover mobility and improve their quality of life. The other, a $1.5 million grant from the National Institutes of Health, focuses on developing stronger prosthetic devices to improve balance control for people who have undergone lower limb amputations.

One of the challenges in the field, especially when it comes to the athletic side of biomechanics, is the insular nature of the work. The competition is high stakes, so leagues and teams either develop, license or buy technology that becomes proprietary. So, the public literature in biomechanics for athletic performance is less than robust.

“We are trying to advance the field of biomechanics and neuromotor control of human movement to help people know more about the body and apply it to those struggling with injuries or other conditions,” Neptune said. ■



OATMEAL and the Future of Composite Manufacturing

Joseph Kirchhoff's path to advanced manufacturing started long before he set foot in a university clean room or a NASA lab. It began in a small town in North Carolina, where a long bus ride to school and an early opportunity to work in a research lab sparked a fascination with composite materials that has stayed with him ever since.

Now a Ph.D. candidate in the Walker Department of Mechanical Engineering, Kirchhoff has received $200,000 in combined Center Innovation Fund (CIF) and Internal Research and Development (IRAD) support from NASA to continue developing OATMEAL, a new composite manufacturing technology with the potential to reshape how large structures are built.

OATMEAL, short for Out of Autoclave Amorphous and Semi Crystalline Thermoplastic Materials for Energy Efficient Aerospace Grade Laminates, is designed to address one of the biggest limitations in modern manufacturing. Producing large composite parts such as airplane wings typically requires massive ovens and slow heating and cooling cycles, which limit production rates and consume enormous amounts of energy.

"With current methods, you end up waiting on the material instead of making parts," Kirchhoff said. "That slows everything down."

The core idea behind OATMEAL is deceptively simple. Instead of forcing the entire material to melt and recrystallize during processing, the approach controls where crystallinity is needed and where it is not. This allows composite layers to bond together efficiently without needing slow cooling.

In practice, that means manufacturers can keep producing parts with fewer interruptions, increasing throughput while reducing energy use.

Kirchhoff's interest in composites began in high school, when a professor at North Carolina State University invited him to work in a research lab and held him to the same standards as graduate students. That early experience built both technical skills and confidence, and it set the foundation for his future work.

He went on to study aerospace engineering at Purdue University, where he deepened his focus on composite materials and mechanics. Internships at Boeing followed, giving Kirchhoff a firsthand look at aircraft production lines and the practical challenges of manufacturing at scale.

"Seeing how airplanes are actually built really changes how you think about materials," he said. "You start asking how we can make this faster, cheaper, and more efficient without compromising safety."

A SMARTER REC

Above: Initial tests of OATMEAL yield fully bonded panels (left) compared to commercial benchmarks (right).

That question ultimately led him to UT Austin, where he was drawn to the Oden Institute for Computational Engineering and Sciences and the opportunity to combine experimental research with advanced modeling. He is co-advised by Mehran Tehrani, now at the University of California San Diego, and Omar Ghattas in the Walker Department of Mechanical Engineering.

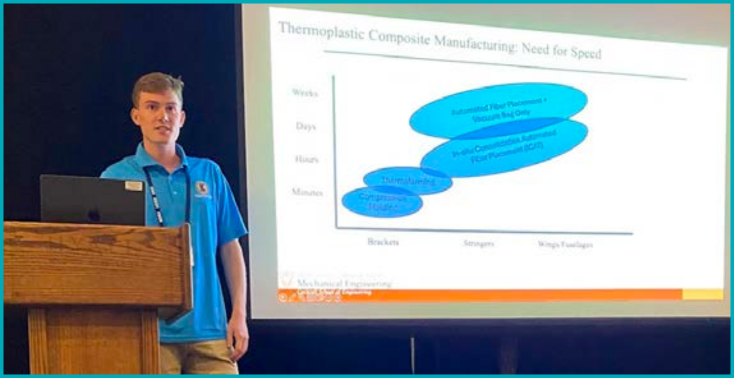
Kirchhoff's collaboration with NASA began through the Space Technology Graduate Research Opportunities fellowship, where he partnered with Tyler Hudson at NASA's Langley Research Center. Over the past two years, the team has refined OATMEAL, secured patents through UT Austin and NASA, and shared early results with the research community.

The new CIF-IRAD funding allows the project to move beyond lab scale experiments toward real world testing. The team aims to reach Technology Readiness Level 5 by demonstrating OATMEAL in manufacturing environments that closely resemble actual production settings.

While aerospace manufacturing is the immediate focus, OATMEAL has potential applications well beyond airplanes. The technology could support in-space assembly of large structures, automotive manufacturing, and more recyclable composite systems for wind energy.

> "AT ITS HEART, OATMEAL IS ABOUT EFFICIENCY," KIRCHHOFF SAID. "IF WE CAN MAKE THINGS FASTER AND USE LESS ENERGY, THAT IMPACT CAN SCALE ACROSS A LOT OF INDUSTRIES."
>
> **— Joseph Kirchhoff**

For Kirchhoff, a path that began with early curiosity in composites has grown into a NASA-supported effort poised to influence how large, high-performance structures are manufactured on Earth and beyond. ■



A CLOSER LOOK AT

MECHANICAL ENGINEERING

In 2025, our department continued its commitment to educating courageous engineers, hiring exceptional faculty, and expanding research pursuits.

RESEARCH ON THE RISE

$46.5M

in research expenditures

ALUMNI

15,346

alumni around the world

192

Members of the Academy of Distinguished Alumni

OUR GRADUATES ARE LEADERS IN:

- research
- government
- industry
- academia
- military
- and more

Are you one of the more than 15,000 alumni from the Walker Department of Mechanical Engineering at UT Austin? ***Scan the QR code to take a short survey and we might feature your story in our next magazine!***

STUDENTS

$84.2K

average starting salary, B.S. graduates

ENROLLMENT, FALL 2025

UNDERGRADUATE	**1,261**
Women	344
Black	42
Hispanic	347
GRADUATE	**591**
Women	144
International	229
DEGREES AWARDED 2024-25	
Bachelor's	270
Master's	120
Doctoral	65

AWARDS

- **Yinshuang Xiao | Editor's Pick Award,** ASME Journal of Computing and Information Science in Engineering
- **Mark Hamalian & Karey Maynor | Outstanding Paper Award,** 2025 ASME Energy Sustainability Conference
- **Isaac Sorensen & Arianna Monteiro | NSF Graduate Research Fellowship**
- **Bam Thongmak | Travel Award,** ASME CIE Graduate Poster Competition
- **Xingang Li | ASME Artificial Intelligence/ Machine Learning 2025 Best Paper Award**
- **Weixin Guan & Yaxuan Zhao | 1st Place,** 2025 Collegiate Inventors Competition
- **Eesha Bilal | Barry Goldwater Scholarship**
- **Daniela Cordon | Best Student Poster Award,** International Conference on Electron, Ion, Photon Beam Technology and Nanofabrication
- **Chris Martin & Apurva Patil | Best Student Paper Award,** Modeling, Estimation, and Control Conference
- **Emmanuel Bamido | 30 Under 30,** SME Media
- **Amria Ajmera | Columbia Crew Memorial Undergraduate Scholarship,** NASA Texas Space Grant
- **Chirag Gokani | Frederick V. Hunt Postdoctoral Research Fellowship,** Acoustical Society of America
- **UT Austin INFORMS student chapter | 2025 Magna Cum Laude Student Chapter Annual Award**

FACULTY

TENURE/TENURE-TRACK FACULTY **67**

HONORS AND AWARDS

1 **Nobel Laureate**
6 Members, *National Academy of Engineering*
32 Winners, *National Science Foundation CAREER Award*

PROMOTIONS

- **Farshid Alambeigi,** Associate Professor with Tenure
- **Chih-Hao Chang,** Full Professor
- **Zhengui Sha,** Associate Professor with Tenure

ENDOWMENTS/PROFESSORSHIPS

- **Farshid Alambeigi,** Leland Barclay Fellowship in Engineering
- **Joseph Beaman,** Cockrell Family Dean's Chair in Engineering Excellence
- **Adela Ben-Yakar,** Cockrell Family Chair in Engineering #14
- **Chih-Hao Chang,** Earl N. Margaret Brasfield Endowed Faculty Fellowship in Engineering
- **D. Emma Fan,** Harry L. Kent, Jr. Professorship in Mechanical Engineering
- **Nicholas Fey,** J. Hugh & Betty Liedtke Centennial Fellowship in Engineering
- **John Hasenbein,** Cullen Trust for Higher Education Endowed Professorship in Engineering #4
- **Yuanyue Liu,** Temple Foundation Endowed Faculty Fellowship No. 1
- **Filippo Mangolini,** Temple FDN Endowed Teaching Fellowship in ENG #1
- **David Mitlin,** Annis & Jack Bowen Endowed Professorship in Engineering
- **Zhenghui Sha,** June and Gene Gillis Endowed Faculty Fellowship in Manufacturing Systems Engineering
- **Venkat Subramanian,** Cullen Trust for Higher Education Endowed Professorship in Engineering #2
- **Yaguo Wang,** Robert & Jane Mitchell Endowed Faculty Fellowship in Engineering
- **Michael Webber,** Cockrell Family Chair in Engineering #16
- **Guihua Yu,** John J. McKetta Centennial Energy Chair in Engineering
- **Yuebing Zheng,** Temple Foundation Endowed Professorship No. 2

RANKINGS IN THE U.S.

NO. 11 *Mechanical Engineering Undergraduate Program*

NO. 13 *Mechanical Engineering Graduate Program*

DEPARTMENT AWARDS

- **Raghu Bollapragada,** Outstanding Teaching by an Assistant Professor
- **David Bogard,** Outstanding Teaching by a Professor or Associate Professor; Outstanding Service by a Professor or Associate Professor
- **Tanya Hutter,** Outstanding Research by an Assistant Professor
- **Rick Neptune,** Outstanding Research by a Professor or Associate Professor

UNIVERSITY AWARDS

- **Filippo Mangolini,** UT President's Associates Graduate Teaching Excellence Award

EXTERNAL AWARDS

- **Eric Bickel,** 2025 Society of Petroleum Engineers' Management Award
- **Omar Ghattas,** 2025 Ivo & Renata Babuška Prize; Association for Computing Machinery Gordon Bell Prize
- **Ram Manthiram,** 2025 Olin Palladium Award, The Electrochemical Society
- **Zhenghui Sha,** Associate Editor of the Year, ASME Journal of Mechanical Design; SAE International Educational Award Honoring Ralph R. Teetor
- **Guihua Yu,** Mohammed bin Rashid Al Maktoum Global Water Award from the United Arab Emirates; Grand Discovery Prize, Global Prize for Innovation in Water

EMERGING I

NTELLIGENCE

THE ROLE OF AI IN MECHANICAL ENGINEERING

Artificial intelligence is no longer just a buzzword. In the Walker Department of Mechanical Engineering at UT Austin, it has become a connective thread that is reshaping how faculty approach some of society's most pressing challenges from energy efficiency and battery storage to nuclear safety, health care innovation and human-centered design.

Rather than replacing traditional engineering methods, our faculty use AI to accelerate discovery and build systems that learn from the real world. What unites these efforts is a shared belief that artificial intelligence works best when paired with physical insight, experimental validation and human judgment.

"Machine learning may not be the solution to everything," said professor Yuebing Zheng, "but when you have problems with very specific physical requirements, AI can help you design things that were previously unimaginable."

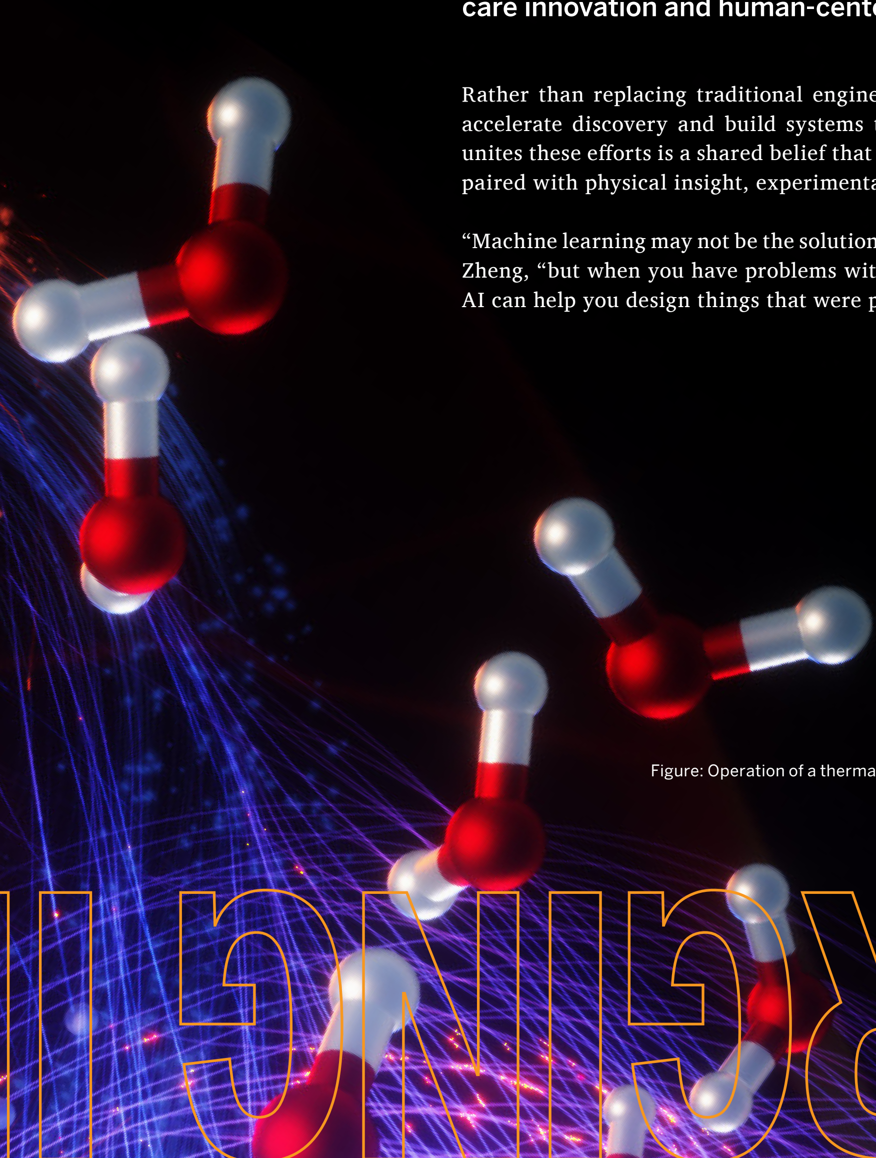


Figure: Operation of a thermal energy storage material. *Courtesy Don Siegel.*

Let's explore how this approach is taking shape across the department, as researchers apply AI to some of engineering's most pressing challenges.

Super-Power

AI-assisted engineering is beginning to influence how energy systems are designed and operated.

Zheng and his collaborators have developed a machine learning framework for designing thermal meta-emitters, advanced materials that precisely control how surfaces absorb and release heat. These materials reflect most incoming sunlight while emitting heat at carefully selected wavelengths, allowing surfaces to remain significantly cooler than conventional coatings.

Traditionally, designing such materials has been a slow, trial-and-error process that limits how complex structures can be. Using AI, the research team explored more than 1,500 different materials that can selectively emit heat at various levels and in different manners, making them ideal for energy efficiency through more precise cooling and heating.

To test their platform, the researchers fabricated four materials to verify the designs. They further applied one of the materials to a model house and compared it to the cooling effects of commercial paints. After a four-hour midday exposure to direct sunlight, the meta-emitter-coated building roof came in between 5 and 20 degrees Celsius cooler on average than the ones with white and gray paints, respectively. This difference translates directly into energy savings.

Beyond buildings, thermal meta-emitters could help mitigate urban heat islands, reduce heat buildup in parked vehicles and manage spacecraft temperatures in orbit. The work highlights how AI can expand the design space for materials that address both everyday comfort and extreme environments.

Current Affairs

As transportation and power systems shift toward electricity, batteries matter more than ever. At UT Austin, researchers are combining decades of experimental expertise with artificial intelligence to rethink how batteries are designed, tested and deployed.

For professor Arumugam Manthiram, the central challenge is scale.

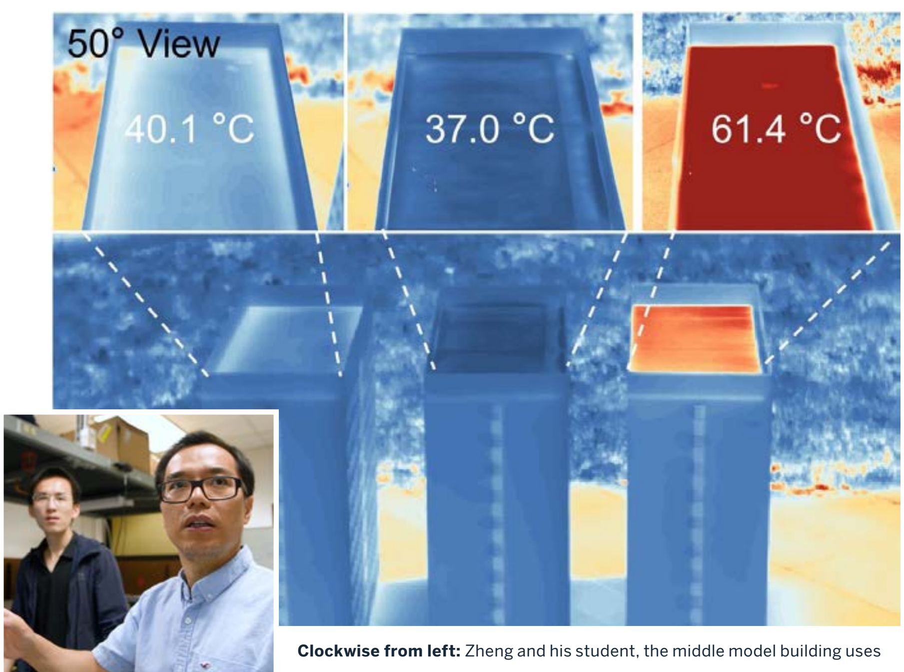
"As batteries get bigger, cost and durability become much more important," Manthiram said. "You cannot replace a grid battery every few years."

At the heart of the issue is the battery cathode, which accounts for roughly half of a battery's material cost. Many widely used cathodes rely on cobalt and nickel, metals that are expensive and vulnerable to disruptions in the global supply chain. Manthiram's earlier work helped pioneer iron-based cathodes that rely on one of the most abundant and affordable elements on Earth.

Iron-based batteries have already seen global adoption, but they involve trade-offs in energy density and performance. Addressing those trade-offs is where artificial intelligence plays an increasingly important role.

Decades of experimental data now exist across battery research. Machine learning tools allow researchers to analyze that data systematically, identify patterns and suggest new material combinations that would be difficult to uncover through conventional experimentation alone.

> **"JUST COMPUTATION ALONE WILL NOT HELP. THE FUTURE IS IN COMBINING EXPERIMENTS, DATA, AND HUMAN INSIGHT."**
>
> —Arumugam Manthiram



Clockwise from left: Zheng and his student, the middle model building uses the researchers' new cooling materials, showing a lower temperature.

Clockwise from left: Students work in Manthiram lab, reactor from the Nuclear Engineering Teaching and Research Lab.

Complementing this materials-focused approach is the work of professor Venkat Subramanian. His group develops digital twins, virtual representations of real batteries that update continuously using operational data to predict performance, degradation and safety under different conditions.

“The most powerful approach is a hybrid one,” Subramanian said, referring to the integration of physics-based and data-driven models.

Subramanian’s group has also developed operating-system-agnostic battery models that can be embedded into larger simulations, such as electric vehicles, without requiring specialized software. Together, the work of Manthiram and Subramanian illustrates how AI is reshaping battery research by guiding experiments more efficiently rather than replacing them.

Reactor Factor

AI is also transforming the field of nuclear engineering through the development of digital twins. Associate professor Kevin Clarno leads a Texas-funded effort to create real-time digital replicas of nuclear and molten salt systems.

The project integrates operational data from the University’s nuclear reactor with high-performance computing models that are continuously calibrated against real-world measurements.

“Digital twins allow us to explore scenarios we would never attempt in a real reactor,” Clarno said.

Once validated, the models can simulate extreme operational and accident scenarios, generating data used to train real-time systems that run alongside the physical reactor. These systems continuously compare predicted behavior with measured data, giving operators greater insight into reactor performance.

The technology has already delivered practical benefits, helping operators optimize reactor schedules for producing medical isotopes while reducing overtime labor. Clarno’s team is also exploring how AI could smooth power fluctuations that currently limit reactor output, potentially allowing operation closer to licensed maximum levels.

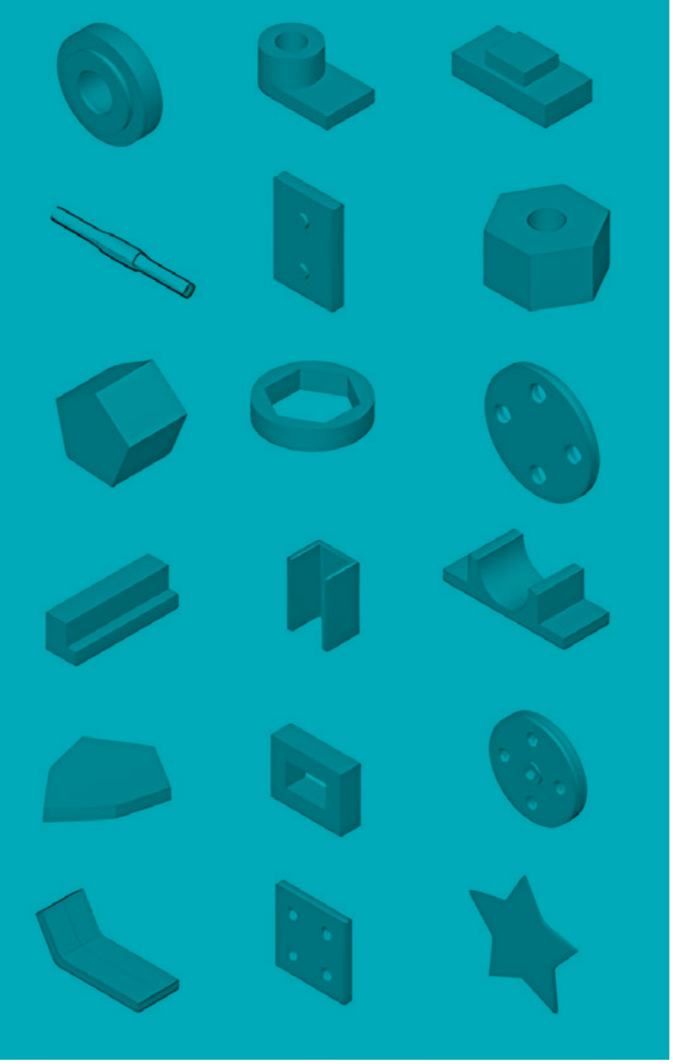
Intelligent Design

AI is reshaping not only how engineers manufacture products, but how they approach design itself. Our faculty are examining how AI tools influence creativity, confidence and collaboration, with a strong emphasis on keeping people at the center of the process.

Assistant professor Leah Chong studies how engineers interact with AI during the design process and how those interactions affect decision-making.

“When AI enters the design process, the way engineers think and make decisions changes,” Chong said.

Her research shows that while designers often calibrate their trust in AI



Enabling AI to understand space and complex geometry can dramatically speed up the design process and lower the barrier to entry.

based on performance, their confidence in their own expertise frequently declines when working alongside automated tools. That loss of confidence can lead to overreliance on AI outputs without sufficient critical evaluation.

Design cognition and stakeholder engagement are central to the work of assistant professor Anastasia Schauer. To address limited access to stakeholders, particularly in humanitarian contexts, her research explores large language models trained on real interview data. The model can simulate live interviews to get to know the needs of the end user.

"It gives students access to perspectives that otherwise would be omitted," Schauer said.

On the technical side of design and manufacturing, associate professor Zhenghui Sha is developing AI systems that dramatically accelerate the path from idea to prototype. His research focuses on translating sketches, text descriptions or images directly into editable three-dimensional CAD models.

> "THE GOAL IS TO LET DESIGNERS FOCUS ON IDEAS INSTEAD OF CURRENT SOFTWARE COMPLEXITY."
>
> **— Zhenghui Sha**

By enabling AI to understand spatial relationships and complex geometries, Sha's work compresses design cycles from months to minutes while lowering barriers to participation in engineering design.

Together, this work shows how AI can enhance design and manufacturing by supporting creativity, improving decision-making and keeping human insight at the center of the process.

Left: AI is streamlining the design process across products, from basic components (top) to bicycle seats (bottom).

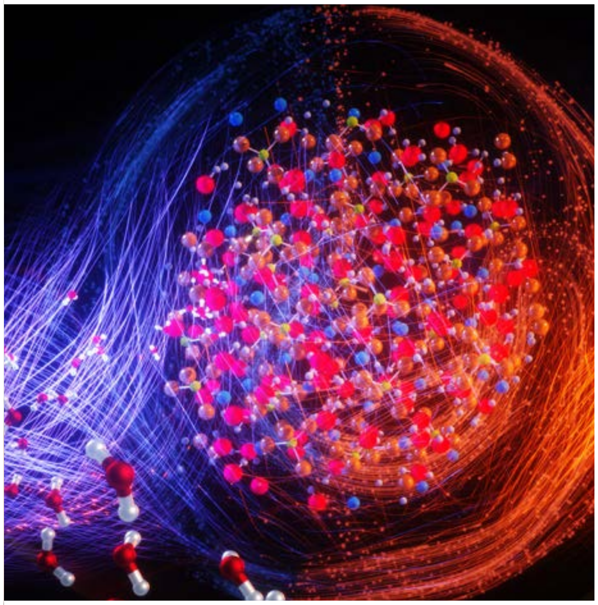
Right: Adela Ben-Yakar, professor.

Heathier By Design

AI is also transforming how researchers observe, analyze and interpret complex biological systems. Professor Adela Ben-Yakar is integrating AI with advanced optical imaging technologies to push the limits of what scientists can see and measure inside living systems.

Ben-Yakar's research centers on high-resolution optical methods that use ultrafast lasers and advanced microscopy to study cells and tissues at extremely small spatial and temporal scales. These techniques allow researchers to capture biological events in real time, from cellular motion to early structural changes associated with disease. While powerful, these imaging systems generate enormous amounts of data that are difficult to analyze manually.

Machine learning tools developed in Ben-Yakar's lab help process and interpret these complex data sets more efficiently and consistently. AI-driven tools can identify subtle patterns in imaging data, track dynamic biological processes over time, and distinguish meaningful biological signals from noise. This capability is especially important in biomedical research, where small changes at the cellular level can have significant implications for diagnosis and treatment.



Above: Siegel (left) employs machine learning to pinpoint material properties that drive thermal energy storage.

> "AI ALLOWS US TO IDENTIFY PATTERNS AND FEATURES THAT WOULD OTHERWISE BE MISSED."
>
> **— Adela Ben-Yakar**

By automating image analysis, results are more consistent from one experiment to the next and reduce differences caused by human judgment. This consistency allows researchers to compare findings more reliably and move discoveries forward more quickly. It also supports progress toward personalized medicine, where imaging data can help tailor diagnostics or treatments to individual patients rather than a one-size-fits-all approach.

Through this combination of advanced imaging and artificial intelligence, Ben-Yakar's work demonstrates how AI can serve as a force multiplier in biomedical engineering, expanding researchers' ability to see, understand and ultimately improve human health.

Built to Last

Artificial intelligence is expanding the frontiers of materials science by helping researchers understand and predict how materials behave under complex and extreme conditions. Don Siegel, chair of the Walker Department of Mechanical Engineering, is using AI to bridge long-standing gaps between theory, simulation and experiment.

Siegel's research employs high-performance computing to model materials at the atomic scale. The objectives are to characterize properties that are not easily measured experimentally, and to discover new materials with superior performance. Recent focus areas include materials for electrical, thermal, and chemical energy storage.

Siegel's calculations often generate large datasets that link predicted properties with the composition and structure of candidate materials. These datasets are valuable because they can be used to improve our understanding of why certain materials exhibit promising performance, while others are dead ends. This approach, known as feature importance, involves training a machine learning algorithm to reproduce the previously predicted properties using elementary properties (e.g., electronegativity, density, elastic properties) as input. Feature importance analyses reveal which elementary properties are most important in predicting the property of interest, allowing subsequent analyses to be done more efficiently.

In addition to using ML to improve our understanding of materials, Siegel has used it to accelerate materials discovery. Recent work has used ML to evaluate millions of metal-organic frameworks for their ability to store hydrogen or natural gas, and to screen thousands of salt-hydrates for use as thermal energy storage materials.

At the intersection of materials science and biomedical engineering, professsor D. Emma Fan is using AI to better understand how materials interact with biological systems. Her research focuses on biomaterials designed for medical applications, where small changes in composition, structure, or surface properties can significantly influence how cells respond.

Fan's research uses data-driven analysis to link material properties with how biological systems respond to them. This helps researchers design biomaterials that encourage outcomes such as better tissue integration or more controlled biological responses. AI-based tools also make experimental analysis more consistent and reproducible, which is especially important in biomedical research where reliability can directly affect patient outcomes.

By pairing machine learning with deep physical and biological understanding, Siegel and Fan's research shows how smarter materials can be designed to perform reliably in complex, real-world environments.

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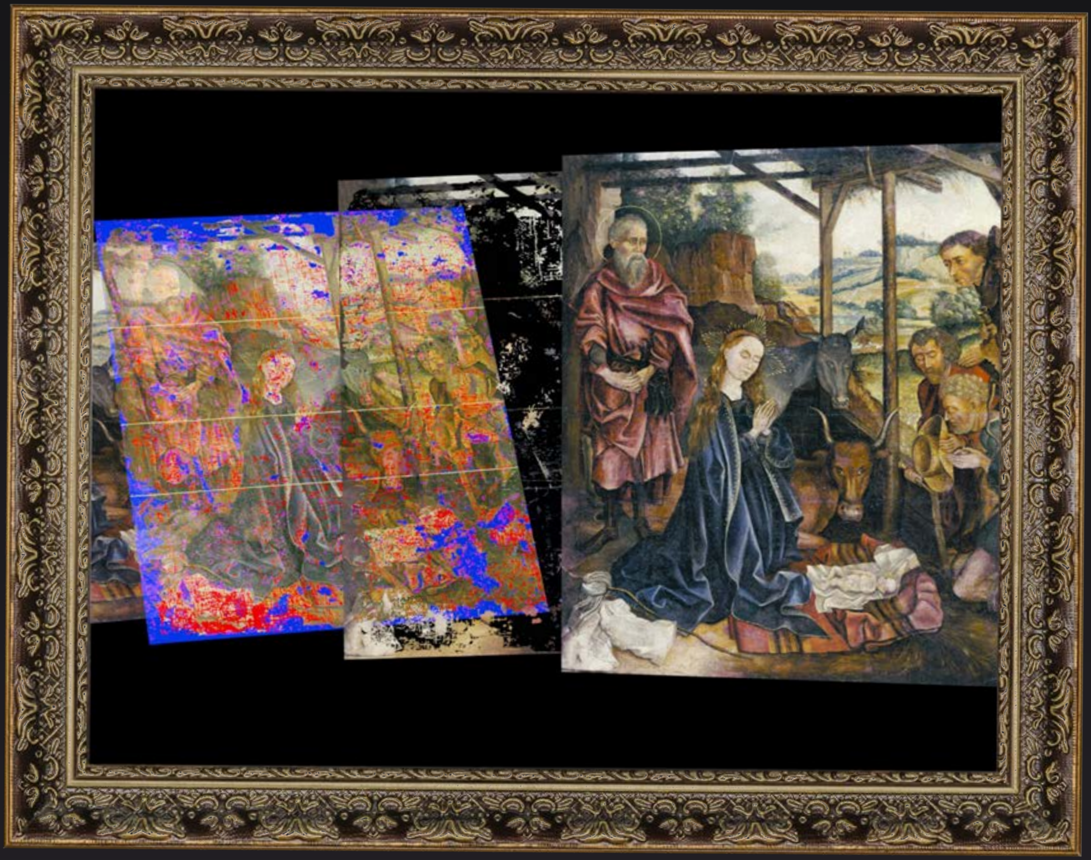
As AI tools become more capable, our researchers are working to ensure they are deployed thoughtfully, transparently and responsibly. Whether designing batteries, operating reactors, or training the next generation of engineers, the goal remains the same: engineering solutions that serve society. AI is not a replacement for engineers, rather it is a toolkit that enables engineers to do their jobs more effectively.

What's featured in this story only scratches the surface of how artificial intelligence is influencing mechanical engineering. Beyond the examples highlighted here, AI is enabling new ideas and applications across disciplines even including the intersection of engineering and art. ■



UNMASKING THE PAST

HOW AI IS BRINGING DAMAGED MASTERPIECES BACK TO LIFE

For centuries, restoring damaged art has been a painstaking endeavor, with a single painting taking anywhere from a few weeks to over a decade. In recent years, digital restoration tools have opened a window to creating virtual representations of original, restored works.

Still there has been no way to overlay digital restorations directly onto an original work, until now. Alex Kachkine, a mechanical engineering alumnus who is now a graduate student at Massachusetts Institute of Technology, developed a new method to physically apply a digital restoration directly onto an original painting.

In Kachkine's approach, the restoration is printed on a very thin polymer film, in the form of a mask that can be aligned and adhered to an original painting. It's also easy to remove and store digitally to track restoration of the painting.

> "BECAUSE THERE'S A DIGITAL RECORD OF WHAT MASK WAS USED, IN 100 YEARS, THE NEXT TIME SOMEONE IS WORKING WITH THIS, THEY'LL HAVE AN EXTREMELY CLEAR UNDERSTANDING OF WHAT WAS DONE TO THE PAINTING. AND THAT'S NEVER REALLY BEEN POSSIBLE IN CONSERVATION BEFORE."
>
> **—Alex Kachkine speaking to MIT News**

As a demonstration, he applied the method to a highly damaged 15th century oil painting. The method automatically identified 5,612 separate regions in need of repair, and filled in these regions using 57,314 different colors. The entire process, from start to finish, took 3.5 hours, which he estimates is about 66 times faster than traditional restoration methods. ■


RD-800


Roland
RD-800

BEHIND THE MUSIC

Graduate students combining their love of music and the study of acoustics

On a piano bench at a department holiday party, two graduate students lean shoulder to shoulder, trading melodies as easily as conversation. One riffs a jazz phrase, the other echoes it back with a twist. For Lizette Wong and Chirag Gokani, moments like this are where science and art meet.

Both are graduate students in the Walker Department of Mechanical Engineering with a concentration in Acoustics, a field that studies the physics of sound and how it interacts with the world around us.

Wong's musical journey began as a child when she watched her sister take classical piano lessons and was inspired to do the same. When it was time to start college, she took on an ambitious double major in jazz piano and electrical engineering at UT Austin and was a member of the Jazz Combos in the Butler School of Music. After graduation, she found herself searching for a discipline that could unite both worlds.

"I wanted to do something in the middle — so I took the average of the two and went into Acoustics," said Wong.

As a first-year Ph.D. student, she studies the intersection of acoustic metamaterials and fluid flow. In collaboration with Johns Hopkins University, this project seeks to use these metamaterials to control noise and turbulent flow.

Gokani also got into music at an early age. He is self-taught on the piano and later picked up bass and guitar before going on to study Physics with a minor in Music at The University of Texas at Dallas. Today, as a fifth-year doctoral student preparing to defend his dissertation, Gokani focuses on topics in physical acoustics like understanding how sound waves interact with objects through scattering and diffraction.

The pair first connected through acoustics seminars. They describe the acoustics community on campus as a family, with faculty advisors Mark Hamilton, Preston Wilson and Michael Haberman be a guiding force.

"Grad school has this image of being stressful with no time for anything else," Gokani says. "But here it's been the opposite. Our advisors actively support us having lives outside research."

At the time, both were enjoying their own musical pursuits, Wong with her jazz fusion band The Reading Club and Gokani as a solo artist. Once Gokani invited Wong to play with him at the Georgetown Art Center, a permanent duet was formed. Soon they were playing together around Austin and at faculty gatherings. The two see acoustics as a way of better appreciating music.

"I think my love for music has grown through my academic studies. Acoustics is a reminder of the beauty of nature and the fact that we're surrounded by waves of all types."

- Chirag Gokani

Professor Hamilton reminds his students that 'a wave is a wave'. Meaning if you can understand acoustic waves, then you can also understand electromagnetic waves or quantum mechanical waves, even waves in the ocean. Studying acoustics can connect students to a range of topics like biomechanics, architecture and energy.

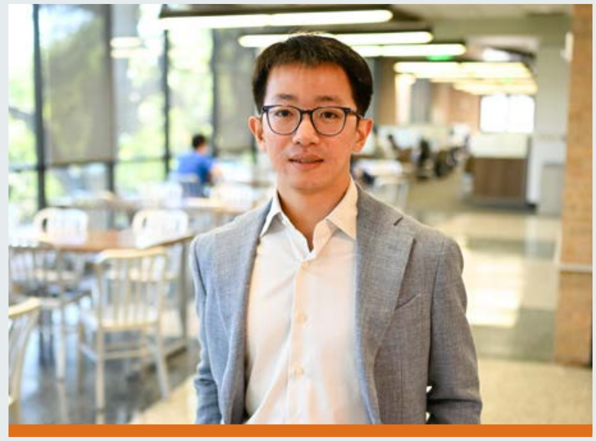
As Wong puts it, "Acoustics is everywhere — in nature, in buildings, in music, in people's lives. It's a science that connects everything."

Looking ahead, Gokani has been awarded the F.V. Hunt Postdoctoral Fellowship by the Acoustical Society of America and will head to the National Center for Physical Acoustics at the University of Mississippi post-graduation.

Wong is only just beginning her graduate research but envisions working in architectural acoustics or audio technology, getting to the root of the human experience of sound.

Neither sees music as something they'll leave behind as they pursue their careers. It remains for both of them a creative outlet and a reminder of why sound matters. ■

WELCOME NEW FACULTY



ZHANTAO CHEN

Assistant Professor

Advanced Materials Science

Q: TELL US ABOUT YOUR RESEARCH.

My research sits at the intersection of AI and materials science. I develop AI and machine learning methods for materials modeling, characterization and discovery, with the long-term goal of enabling AI-driven, closed-loop, autonomous materials research that integrates design, synthesis and characterization. For example, I work on developing AI systems that can help identify or design new materials with targeted properties by learning from data and guiding computations and experiments.

Q: WHAT HAVE YOU ENJOYED MOST ABOUT JOINING UT?

I've really enjoyed the collaborative and energetic environment at UT, especially the breadth of fields and opportunities for collaboration, as well as the enthusiasm and curiosity of the students. I've also appreciated UT's strong computational resources. The support from faculty and staff has made the transition especially smooth and welcoming.

Q: HOW DO YOU SPEND YOUR FREE TIME?

Outside of work, I enjoy spending uninterrupted time fulfilling my curiosity: learning new things, coding, and testing new ideas. Even though most new ideas don't work out, the process itself is still fun. I also enjoy watching detective and mystery TV shows and experimenting a bit with cooking. In general, I simply enjoy free and unstructured time. ■

ANDREA PICKEL
Assistant Professor
Thermal Fluids Systems

Q: TELL US ABOUT YOUR RESEARCH.

My research is in the area of nanoscale heat transfer, and my group's work has a particular emphasis on developing new optical techniques to measure temperature at the nanoscale. We frequently employ luminescent nanoparticles as temperature sensors. In doing so, we aim to take advantage of the unique properties of luminescent materials to develop thermometry techniques with spatial resolution better than the optical diffraction limit. We also apply the new techniques to address a variety of micro to nanoscale heat transfer challenges, including thermal management of microelectronics and batteries.

Q: WHAT HAVE YOU ENJOYED MOST ABOUT JOINING UT?

I've started off by teaching heat transfer, which is a subject I really enjoy teaching given its close connections to my research, and it has also been a great way to connect with many undergraduate students. I'm also very excited about the incredible breadth and depth of research expertise among the faculty at UT, and I've been having great discussions about how our research groups could come together and initiate interesting new collaborations.

Q: HOW DO YOU SPEND YOUR FREE TIME?

Outside of work, I like to take dance classes (primarily ballet, along with some jazz and tap) and go rock climbing. I've also been enjoying exploring Austin by bike and on foot, and I'm looking forward to paddle boarding as well. ■

HAIRONG WANG
Assistant Professor
Operations Research & Industrial Engineering

Q: TELL US ABOUT YOUR RESEARCH.

My research focuses on developing knowledge-informed, data-efficient machine learning models and algorithms, and pursuing their practical applications in addressing pressing, high-stake clinical challenges. Specifically, my work develops and leverages tools from machine learning, generative AI, large-scale optimization and high-dimensional statistics to create data-driven methodologies for building and training machine learning models with data and computational efficiency, interpretability, generalizability and robustness, as well as to propose principled approaches for fusing domain knowledge into model design to assist clinical diagnosis and optimal treatment in high-stake scenarios.

Q: WHAT HAVE YOU ENJOYED MOST ABOUT JOINING UT?

I've really enjoyed the collaborative and interdisciplinary research environment at UT. The strong culture of openness and intellectual exchange across engineering, medicine and data science has made it exciting to start new projects and connect with colleagues and students. I've also been very grateful for how supportive and welcoming my colleagues have been and for the many opportunities to exchange ideas and seek guidance within the ME department.

Q: HOW DO YOU SPEND YOUR FREE TIME?

I enjoy spending time with my family, including our two dogs. Many of our weekends are spent at parks, taking long walks and enjoying the sunshine. It's a simple routine that helps me unwind and stay energized. ■

NEW HUMANITARIAN ENGINEERING DIRECTOR

GREG RULIFSON

Greg Rulifson is stepping into the role of director of the Humanitarian Engineering Program housed within the Walker Department of Mechanical Engineering. His background in structural engineering and humanitarian assistance make him well suited to take the mantle.

Growing up in California, Greg Rulifson found engineering early on during a class field trip to a bridge near Sacramento. Later, at the University of California, Berkeley as a freshman, he unknowingly signed up for a class that would introduce him to the world of humanities. This led him to a new minor program and a class called Global Poverty and Practice where he was the only engineering student. During the required practicum, Rulifson had his first experience working with communities abroad in Nicaragua. He had finally found his lane: engineering for global good.

Rulifson went on to graduate school at Stanford University where he led projects related to tsunami risk mitigation in Indonesia. He then entered the workforce as a structural engineer.

Ready for the next chapter, he was given the opportunity to pursue a Ph.D. at the University of Colorado Boulder. There, his research focused on socially responsible engineering education and his passion for teaching started to grow. Soon after, Rulifson began a teaching position at the Colorado School of Mines for what would eventually become the Division of Engineering, Design, and Society.

In that position he helped strengthen and grow the Humanitarian Engineering minor program. But he started to feel imposter syndrome creeping in. He didn't know enough about development work, he needed to experience it head on.

“I had students asking me great career questions that I didn't have answers to. I needed to find a pathway to actually do this work,” said Rulifson.

So he applied for an American Association for the Advancement of Science's Science and Technology Policy Fellowship in Washington D.C., with the U.S. Agency for International Development (USAID) in 2019. During his time there his focus was environmental sustainability in humanitarian supply chains. The main thrust being how to reduce waste when sending assistance to countries in need.

He couldn't get away from teaching during this time and became part of a team educating colleagues on why the work they were doing was relevant. Rulifson also made a point to integrate student projects into his work as a way to help get them more experience.

Six years into his tenure in D.C., Rulifson received an email from a former graduate student of Janet Ellzey, professor and then director of the Humanitarian Engineering program at UT Austin, looking to collaborate on a portable plastics waste processing device. This introduction to Ellzey and her upcoming retirement cracked the door open for Rulifson to return to academia.

The next few months came with much uncertainty as USAID was shut down and Rulifson was left without a job. It wouldn't last long because soon his dream job would be available and the door would be wide open for him to step through and land in Austin.

Since starting the director position in Fall 2025, Rulifson has spent his time teaching as well as connecting with potential supporters and partners. He's also working on building out his future goals for the program.

> "ENGINEERING CAN DO MORE FOR THE GOOD OF THE WORLD. OUR STUDENTS NEED TO GET THE EXPOSURE TO KNOW WHAT THE ISSUES ARE AND KNOW THAT THEY CAN DO SOMETHING ABOUT IT. WE WANT THEM TO SEE THEIR FUTURE SELVES AS AGENTS OF CHANGE."
>
> **— Greg Rulifson**

This program helps to provide those opportunities to work on real projects and travel to real underserved communities. It also aims to connect students with role models they can look up to and guide them through their journey through a humanitarian lens.

And more can be done to raise the profile of the program even further by expanding university partnerships, growing involvement with student groups, and utilizing resources to grow community impact here at home. Rulifson believes that by using these efforts we can have a Texas-sized impact with humanitarian engineering. ■

Learn more about the Humanitarian Engineering program and how you can get involved.

FALL '26
SNEAK PEEK

Check out our additional faculty joining the department this fall

JISUN LEE
Assistant Professor

Operations Research & Industrial Engineering

Joining from Georgia Tech

YASHASWINI MURTHY
Assistant Professor

Operations Research & Industrial Engineering

Joining from California Institute of Technology

CARLO SFERRAZZA
Assistant Professor

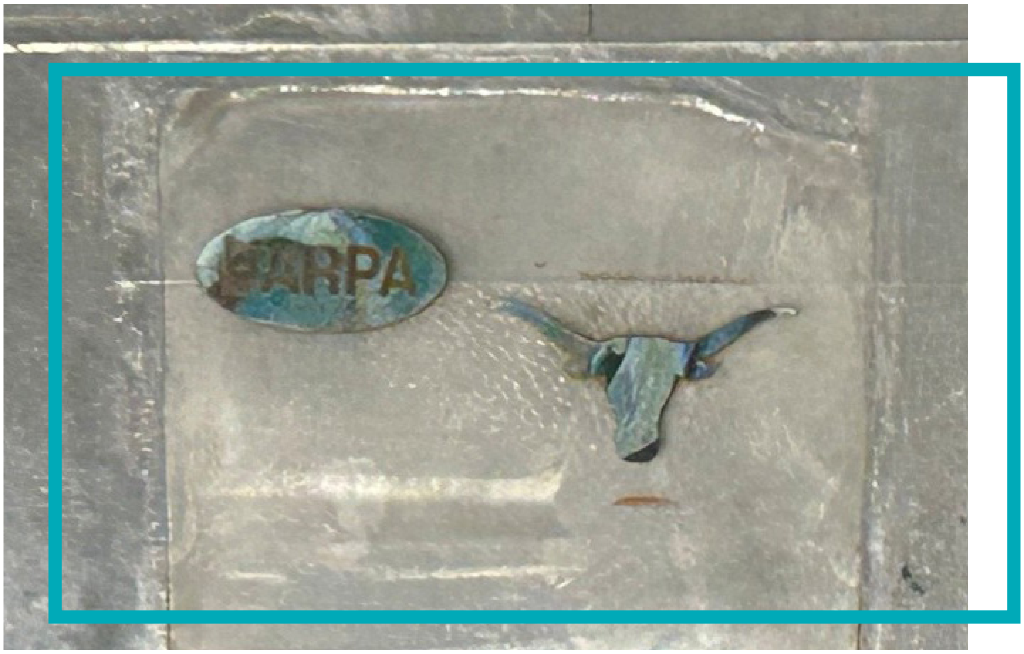
Robotics

Joining from University of California, Berkeley

PRINTING POWER

3D PRINTED CHIP PACKAGES COULD SUPERCHARGE SEMICONDUCTOR MANUFACTURING

Texas Engineers are leading an academic and industry all-star team that aims to revolutionize the production of semiconductor chips with a new 3D printing method. The new approach, which the researchers are calling Holographic Metasurface Nano-Lithography (HMNL), aims for faster, more efficient and environmentally friendly production of advanced electronics.



IN THE LAB Silver longhorn and DARPA logo embedded in a polymer matrix.

HMNL has applications ranging from smartphones to robotics to aerospace. It can create designs that were previously impossible, such as 3D printed capacitors, which store energy in electronic devices, or electronic packages that fit into unconventional spaces. For example, it would make it possible to embed artificial intelligence in customized configurations to fit the specifications of robots or rockets.

"Our goal is to fundamentally change how electronics are packaged and manufactured," said Michael Cullinan, an associate professor in the Walker Department of Mechanical Engineering, who is leading the team.

> "WITH HMNL, WE CAN CREATE COMPLEX, MULTIMATERIAL STRUCTURES IN A SINGLE STEP, REDUCING PRODUCTION TIME FROM MONTHS TO DAYS."
>
> — Michael Cullinan

The team, comprising researchers at the University of Utah, Applied Materials, Bright Silicon Technologies, Electroninks, Northrop Grumman, NXP Semiconductors and Texas Microsintering, has received a $14.5 million grant from the Defense Advanced Research Projects Agency (DARPA) to pursue this work.

Electronics manufacturing today is a complex, time-consuming process that involves layering materials one step at a time. This approach not only limits design flexibility but also generates significant material waste. HMNL offers a faster, more sustainable alternative.

The key to this technical leap lies in metasurfaces, which are ultra-thin optical masks capable of encoding high-density information. When exposed to light, these metasurfaces create holograms that enable the simultaneous patterning of a hybrid resin made of metal and polymer into intricate 3D structures. The process is so precise that it can achieve resolutions smaller than the width of a human hair.

Additionally, by eliminating multiple production steps and reducing material waste, the process minimizes the environmental footprint of industrial activities. The increased speed will make it easier to develop unique prototypes.

THE RESEARCHERS CREATED FOUR PROTOTYPES AS PART OF THIS PROJECT FOR A VARIETY OF APPLICATIONS:

Commercial electronics: A fan-out module for consumer devices, showcasing faster production and improved design flexibility.

Defense systems: Advanced prototypes for high-frequency communication and reconfigurable electronics.

Nonplanar designs: Electronics packages that fit into challenging spaces.

Active packages: Structures that serve mechanical and electrical functions, such as precise beam-pointing systems for optical applications.

"This isn't just about making electronics faster or cheaper; it's about unlocking new possibilities," said Cullinan.

NEXT STEPS:

The researchers plan to commercialize the technology through Texas Microsintering Inc., a startup founded by Cullinan.

HIGHLIGHTING OUR DEDICATED AND TALENTED

STAFF

CHRISTINA LAMBOTT

Events Program Coordinator

Christina holds a Bachelor of Arts in project management & organizational leadership from Arizona State University. She joined the department in 2023 after working as the Catering Service Manager at Lakeway Resort & Spa. In 2025, she received the ME Staff Excellence Award which highlights her continued dedication to the department.

WHAT DO YOU ENJOY MOST ABOUT WORKING WITH ENGINEERING COMMUNITY?

Working in the engineering community has been an honor. It's inspiring to see the incredible work this department does every day. Even though I'm not the one designing robots or solving equations that look like ancient runes, I'm proud to support the people who are. It's nice knowing that in my own small way, I'm helping the people who are helping to better the world and our future.

WHAT LED YOU TO PURSUE A CAREER IN EVENT PLANNING?

I've always loved the idea of throwing a big, fun party. Seeing people come together, laugh and get creative. I started in the wedding industry, and it was really special to be part of one of the most important days in someone's life. Over time, I realized I basically have an ongoing checklist running in my head, so event planning just fits how I'm wired. I feel privileged to work at UT because helping create community here feels fulfilling.

WHAT DO YOU LIKE TO DO IN YOUR FREE TIME?

On the weekends I fulfill my creative pursuits as a florist. I handle large floral installations for weddings, like ceremony arches, hanging greenery on chandeliers or creating cascading displays down a spiral staircase. Doing floral work lets me switch off my brain, focus on the moment and just make art!

MECHANICAL ENGINEERING

EXTERNAL ADVISORY COMMITTEE

Jason Cooper
CEO, Advanced Nuclear, GE Vernova

Cara Courtney
Managing Senior Engineer, Dell Technologies

Binz DeWalch
Chairman and CEO, DeWalch Technologies, Inc.

Amanda Dodd
Senior Manager, Computational Science and Analysis, Sandia National Laboratories

Oded Doron
VP of Engineering, X-energy

Karl Fisher
Executive Director, Applied Research Laboratories, UT Austin

Ginny Garriques
Chief Engineer - Pipelines, Offshore, and Infrastructure Subsurface & Subsea, ExxonMobil Technology and Engineering

Julio C. Guerrero
Founder and CEO, Cambridge Research and Technology LLC

Bunker M. Hill
Senior Technical Advisor, Downhole Emerging Technologies

Jeff Miers
Partner/Principal, EY Houston

Steve Mills
Mechanical Engineer, Meta Platforms

David Rigby
Senior Manager, Space and Missile Systems, The Boeing Company

Elliott Short
Senior Engineering Fellow (retired), Raytheon

Greg Smith
Technology Integration & Partnership Manager, NASA, Lunar Surface Program

Kari Stanley
Senior Program Manager, Space, Lockheed Martin

Peter Weaver
FE Team Lead, Engineering Supervisor, Chevron

Mark Williamson
Managing Director, Impact 20 Group Energy

CLASS OF 2025

ACADEMY *of* DISTINGUISHED ALUMNI

Established in 2004, induction into the Academy of Distinguished Alumni represents the highest honor the Walker Department of Mechanical Engineering bestows on its alumni. Including this year's honorees, 192 alumni have been selected for this award, recognizing them as highly respected professionals, dedicated engineers and supporters of higher education.

The academy honors alumni in four different categories: Outstanding Young Mechanical Engineer, Distinguished Mechanical Engineer, Mechanical Engineering Hall of Fame and Honorary Mechanical Engineer.

Outstanding Young Mechanical Engineer

Vivek Sakhrani
B.S. ME 2008, MSTP 2010, Ph.D. 2015
Vice President
Atlas AI

Distinguished Mechanical Engineer

Shatel Bhatka
B.S. ME 1999, M.S. SA 2007
Lunar Architecture Team Lead
NASA

Bunker Hill
B.S. PHY 1991, M.S. ME 1993, Ph.D. 1997
Vice President of Engineering
Quidnet Energy

Marc Polanka
B.S. ME 1992, M.S. ME 1993, Ph.D. 1999
Professor of Aerospace Engineering
Air Force Institute of Technology

H. Davis Thames
B.S. ME 1989, M.S. ME 1991, MBA 1999
Founder, President and CEO
Western LNG LLC

Tim Van Pham
B.S. ME 1994
Vice President of Sales
Amkor Technology

Mechanical Engineering Hall of Fame

Larry Keast
B.S. ME 1967
Founder and CEO
Venturetech, LP

Learn more about the inductees
http://tinyurl.com/me-ada

THE UNIVERSITY OF TEXAS AT AUSTIN
204 E. DEAN KEETON ST. C2200
AUSTIN, TX 78712-1221

RETURN SERVICE REQUESTED

TAILGATE TURNS TWENTY-EIGHT!
This year marked the 28th annual department tailgate, which brought together our mechanical engineering community to celebrate a Longhorn victory.

STAY CONNECTED @UTMECHENGR