College of Engineering
UNIVERSITY OF WISCONSIN–MADISON

SPRING 2025 NEWSLETTER

DEPARTMENT OF
MECHANICAL ENGINEERING

Greetings! The past year has been one of remarkable growth and progress for our department. From expanding hands-on design experiences to pioneering new research in batteries, robotics and aerospace, we continue to advance in ways that enhance student learning and amplify the impact of our research programs.

As part of this journey, we are proud to enter our 150th anniversary year as a department. Since our founding in 1875 with the appointment of William Nicodemus as a professor of mechanical engineering, we have been at the forefront of innovation and education. Today, we have undergraduate and graduate degree programs in engineering mechanics and mechanical engineering, with the BSME degree ranking as the fifth-largest and sixth-fastest-growing major at UW-Madison.

One of the most exciting developments this past year was the establishment of the Bjorn Borgen Design Program. Born in Norway, Bjorn relocated to Strum, Wisconsin, after his home was destroyed in World War II. Bjorn eventually made his way to UW-Madison, where he earned his BSME degree in 1962. He later earned his MBA and embarked on a highly successful career in finance. However, along the way, Bjorn never forgot his roots and has now generously given back to ensure that future generations of Badger engineers have access to the same transformative educational opportunities he did. The Borgen Design Fund supports hands-on design initiatives across the curriculum, while also providing crucial travel support for national competition teams, including rockets, robotics, aircraft, baja, formula, clean snowmobile, wind energy and autonomous vehicles. We are deeply grateful for the Borgen family's generosity and lasting impact on our students.

We also extend our gratitude to the Smart brothers, Tom (BSME '76) and Tim (BSME '80), whose generous contributions sustain the Smart Brothers Design Awards, which recognize the most outstanding capstone senior design projects each year. Beyond their financial support, Tom and Tim return to Madison to personally engage with students at the annual senior design showcase. Their dedication and mentorship inspire future engineers to push the boundaries of creativity and technical excellence, much as they did in their own careers.

Finally, we are thrilled to welcome back alumnus Devesh Ranjan to UW-Madison as the new dean of the College of Engineering. Devesh earned his MS and PhD at UW-Madison in 2007 under the mentorship of Professor Riccardo Bonazza, who now has the unique distinction of being on the faculty of a college led by his former student. We are excited to partner with Devesh, whose visionary leadership will drive innovation, strengthen academic excellence, and propel both the College of Engineering and the ME department into a dynamic future.

As always, we would love to welcome you back to the department for a visit and to tour our research and instructional lab spaces—critical environments that shape the next generation of Badger engineers. We extend our heartfelt gratitude to our alumni, whose interest, dedication and passion continue to propel us forward, shaping the future of mechanical engineering and engineering mechanics at UW-Madison. **On, Wisconsin!**

Darryl Thelen
John Bollinger Chair of Mechanical Engineering
& Bernard A. and Frances M. Weideman Professor
(608) 262-1902
dgthelen@wisc.edu

On the cover: Robert Lorenz Professor David Rothamer (left) gives Dorota Grejner-Brzezinska, UW–Madison vice chancellor for research and ECE professor, and Grainger Dean of the College of Engineering Ian Robertson a tour of the new Altitude and Climatic Testing Lab. A first-of-its-kind lab at a U.S. university, the facility pushes the boundaries of engine research and education. Photo: Todd Brown.

Meet the college's next dean

Devesh Ranjan, a mechanical engineer and a leader at one of the country's largest and highest-ranked engineering programs, will be the college's 10th dean. He will begin on June 16.

Ranjan, the Eugene C. Gwaltney Jr. School Chair and Professor of Mechanical Engineering at the Georgia Institute of Technology, remembers the promise he felt when he first arrived at UW-Madison in 2003 to begin graduate school in the college he will now lead.

"I've been blessed from that day onward," Ranjan says. "The thing I say about UW-Madison is if you dream about doing something here, it will happen. It will happen because of the opportunity and the support here for you at UW-Madison."

Read more about incoming Dean Ranjan.

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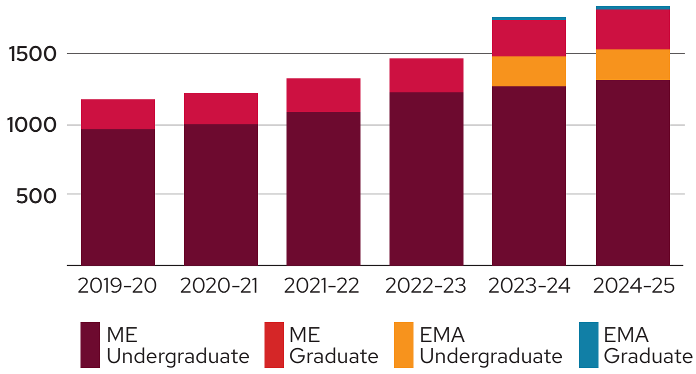
ME DEPARTMENT 2024-25

STUDENTS



SCHOLARSHIPS

$1,000,000
in scholarships awarded to nearly 300 undergrads in fall 2024

144
undergrad scholarships awarded to women in the ME and EMA programs

9
Faustin-Prinz research fellows

34
awards to first-year students

43
STAR (Strategic Targeted Achievement Recognition) scholarships

5th
largest undergrad program at UW-Madison

6th
fastest growing major over the last 5 years

#9
graduate ranking among public universities

#14
undergraduate ranking among public universities

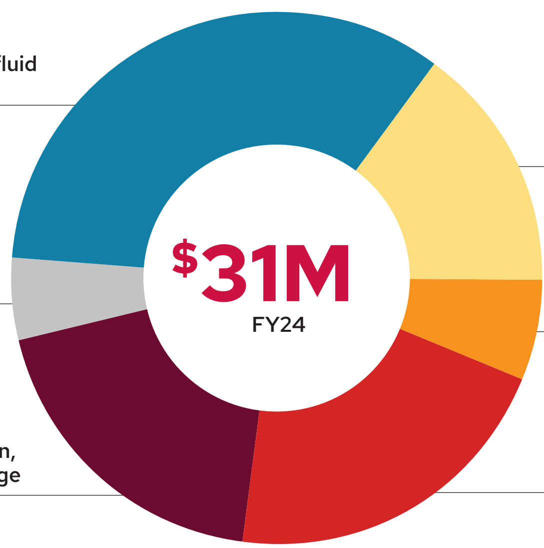
7
faculty with active NSF CAREER awards

EXTRAMURAL RESEARCH

Mechanics - bio, fluid and solid
34%

Advanced manufacturing
5%

Energy generation, conversion, storage
19%



Computational engineering and design
15%

Robotics, controls and sensing
6%

Energy systems for transportation
21%

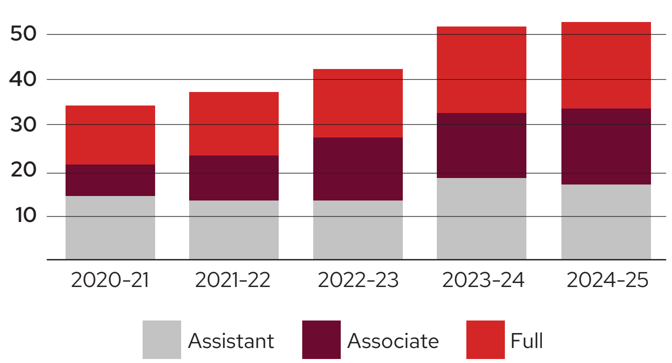
4
faculty hires in 2024-25

Weiyu Li • Prateek Jaiswal • Thomas Breunung • Xiao Kuang

7
new and remodeled instructional labs focusing on:

Mechatronics • Measurements • Dynamics Systems, Vibrations and Controls • Intro to Mechanical Engineering • Intro to Aerospace Engineering • Aerodynamics Lab • Automation

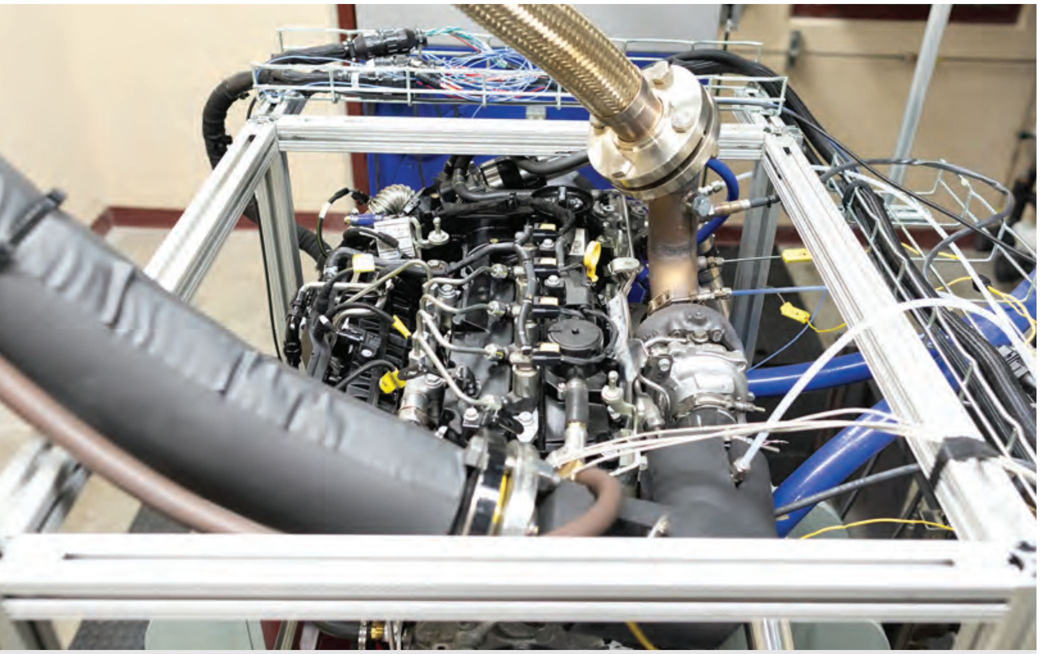
FACULTY



At aircraft altitude, in sweltering heat and bitter cold, unique new engine lab is a testbed for futuristic sustainable fuels

While there's an industry trend toward electric vehicles, there are many mobility sectors—aviation, heavy-duty trucking, rail, off-road machinery, and marine, for example—that will continue to rely on internal combustion engines for the foreseeable future.

UW-Madison engineers are researching engine technologies with a lower carbon footprint that could power vehicles in these "hard-to-electrify" sectors. Their fundamental research will pave the way for hybrid-electric engines capable of running smoothly and reliably on a variety of fuels, including a range of net-low-carbon fuels such as ethanol, methanol and ammonia.



Equipment in the UW-Madison Altitude and Climatic Testing Laboratory, housed in the Engine Research Center, is being used to research the performance of multi-fuel, hybrid-electric engines in extreme environments. Photo: Todd Brown.

A new facility at UW-Madison—the Altitude and Climatic Testing Laboratory—will enable the researchers to advance their work and investigate the performance of multi-fuel, hybrid-electric engines in extreme environments, such as at high altitudes.

"This testing lab is designed to simulate conditions up to 26,000 feet in altitude, which is an extraordinarily unique capability," says David Rothamer, Robert Lorenz Professor and principal investigator for the project. "There are increased challenges for engines operating at high altitudes, and this facility really allows us to push the limits of engine performance over a full range of conditions and for multiple types of fuels."

The facility is also capable of simulating a range of climates, which is particularly useful for testing ground vehicle engine systems in harsh environments. The U.S. Army Combat Capabilities Development Command's Army Research Laboratory is supporting the research and the new lab.

"Obtaining experimental data at higher altitudes and in cold temperatures is challenging and extremely costly," says Mike Kweon, program manager of the U.S. Army Combat Capabilities Development Command Army Research Laboratory's Versatile Tactical Power and Propulsion Essential Research Program. "Researchers have faced difficulties developing and validating models under extreme operating conditions. I am confident that the Altitude and Climatic Testing Laboratory will play a major role in generating this crucial data, advancing technology development in energy, power and propulsion."

Many heavy-duty vehicles run on diesel fuel, which readily auto-ignites in compression ignition engines; however, net-low-carbon fuels do not. To overcome this barrier, the researchers are developing techniques for assisting the ignition process with net-low-carbon fuels. Essentially, the goal is to develop an engine that has the performance of a diesel engine while running on more sustainable fuel.

Rothamer says the team's research advances will be useful in various industries, including emerging air taxi companies. This work could also help enable viable alternatives to leaded aviation fuels, which the industry is trying to phase out.

With its state-of-the-art facilities, the new lab will enrich the educational experience and give students valuable hands-on learning opportunities. "UW-Madison is the only university in the country with a facility that has these cutting-edge capabilities," Rothamer says. "This will allow our students to expand the range of problems they can tackle and prepare them well for careers in industry."

3D-printing breakthrough mitigates three defects simultaneously for failure-free metal parts

In laser powder bed fusion, a high-energy laser beam melts and fuses thin layers of metal powder, 3D printing parts in layers from the bottom up. In a major breakthrough, Associate Professor Lianyi Chen and his collaborators have developed a method to simultaneously mitigate three common defects—pores, rough surfaces and large spatters—that compromise the finished part's reliability and durability.

"Our approach also allows us to produce a part much faster without any quality compromises," Chen says.

By providing a path for simultaneously increasing part quality and manufacturing productivity, the researchers' advance could lead to widespread industry adoption of laser powder bed fusion.

The team's innovation uses a ring-shaped laser beam, rather than the traditional bell-curve-shaped beam, coupled with advanced imaging, theoretical and simulation techniques that allowed them to study how the metal behaved as it was printing.

The researchers also demonstrated that they could use the ring-shaped beam to drill deeper into the material without causing instabilities in the process. This enabled them to print thicker layers, increasing the manufacturing productivity. "Because we understood the underlying mechanisms, we could more quickly identify the right processing conditions to produce high-quality parts using the ring-shaped beam," says Chen.

From left: Associate Professor Lianyi Chen and PhD students Jiandong Yuan and Ali Nabaa work on developing beam shaping approaches for defect-lean and high productivity metal additive manufacturing. Photo: Joel Hallberg.

FOCUS ON NEW FACULTY

Thomas Breunung studies nonlinear structural dynamics for myriad applications

Thomas Breunung's structural dynamics research has broad and impactful applications across multiple fields.

In addition to applications in aerospace and energy harvesting, Breunung's research can be useful for investigating phenomena ranging from rogue waves in the ocean to the vibrations of molecules in a biological system.

His research focuses on the nonlinear dynamics of structures: when the physical response or movement of a structure is not proportional to the amount of force being applied.

"In many cases, advanced engineering applications involve nonlinear dynamics," says Breunung, who joined the department as an assistant professor in January 2025. "I want to see what happens when this nonlinear behavior occurs. It can have detrimental effects, such as causing instability or vibrations that can break a structure. But it can also have advantageous effects. For instance, we could leverage this motion for energy-harvesting applications where the vibration energy is converted into electricity."

In his research, Breunung uses a blend of analytical studies, computational approaches and experiments, and he particularly enjoys the interdisciplinary nature of his work. "My research combines applied mathematics and physics with cutting-edge data science technologies and computer science to address engineering challenges, and I find it exciting to bring together all these areas," he says.

Breunung received his bachelor's and master's degrees in mechanical and process engineering from Technische Universität Darmstadt in Germany. He earned his PhD in mechanical engineering from ETH Zurich in Switzerland in 2020. Prior to joining UW-Madison, Breunung was a postdoctoral researcher in the Department of Mechanical Engineering at the University of Maryland, College Park.

At the University of Maryland, Breunung worked on developing a new tool that can predict unusually large and seemingly random waves, known as rogue waves, up to five minutes in advance. The tool, which leveraged AI and neural networks, could give an early warning to ships and offshore oil rigs and installations to take safety measures.

Art and engineering forge partnership for practical learning

ME students gained practical experience casting screwdriver handles in the art department's foundry in a collaboration between the two departments.

For one week in October 2024, the foundry was the classroom for ME 311: *Manufacturing: Metals and Automation*, where more than 200 students worked on creating the handles they had designed.

In this course students learn processes for manufacturing metal parts, including casting. The curriculum focuses on designing parts to make them easier to manufacture, with an eye toward increasing productivity.

Students compact sand around a model to create the mold cavity for a screwdriver handle. Photo: Sarah Maughan/UW-Madison.

Mike DeCicco, an ME teaching faculty member and the course's lab coordinator, says it's important for aspiring engineers—even those who don't plan to work in a production environment—to learn the process of casting.

"Many products are initially cast," he says. "It's really a fundamental skill."

DeCicco says understanding fundamental manufacturing processes such as casting can help students design better products. Professor Frank Pfefferkorn, the course's lecture instructor, agrees.

"Students gain a better understanding of a manufacturing process that is used to produce almost every metal part at some point in its manufacturing life cycle," Pfefferkorn says. "This exposure will help more students decide if they are interested in pursuing a career at one of the 115 metal casting facilities in Wisconsin or the 1,750 foundries in the United States."

Students said the foundry experience was fun and enlightening. "I personally love the hands-on side of engineering, so all of the ME 311 labs are fun for me," says student Aubrey Olson. "But this one was one of my favorites, because the process of making the mold and seeing the part we made in the same lab was really satisfying."

The collaboration didn't stop with ME 311. The art department's foundry also hosted 16 students from ME 601: *Advanced Metal Casting* on Friday afternoons throughout the fall 2024 semester. These students cast Wisconsin mugs, frying pans and individual designs using aluminum.

Students learn the ropes of shipbuilding in Italy

Colby Milligan was still trying to sort out his summer plans when an email in his inbox caught his eye. He read the message, which advertised an opportunity for UW-Madison engineering students to spend two summer months interning at a ship-building company in Italy.

"That sounded pretty sweet," says Milligan, who hadn't yet been able to fit a study abroad experience into his busy engineering class schedule. "I was glad to be able to mesh a work experience with being able to go abroad."

Milligan was one of four undergraduate students in the ME department who spent two months during summer 2024 in the port city of Trieste, Italy, working for Fincantieri, one of the world's largest shipbuilding companies.

They were the first international students to work at the company's headquarters in the northeastern tip of Italy near the Slovenian border. The internships were part of the UW Signature Internships program offered by the UW-Madison International Academic Programs office, which connects engineering students to study- and intern-abroad experiences.

Milligan, fellow ME major Cesar Velez and engineering mechanics major Petar Vorkapich worked as design engineers, while ME major Marcus Thelen served on Fincantieri's project management team.

Thelen, a senior from Madison who graduated in December 2024, says his two months in Italy showed him just how challenging project management can be—particularly when working on the gargantuan cruise ships Fincantieri produces for some of the world's leading cruise lines.

Milligan, Velez and Vorkapich, meanwhile, designed diagrams and performed underlying calculations for ventilation systems—work that's being implemented by the company.

"I know a lot of internships kind of give interns the 'side' projects, but it was super cool to hear that the work we did was actually impactful and meaningful," says Milligan, a junior from San Francisco.

Students Colby Milligan, Cesar Velez and Petar Vorkapich and other UW-Madison staff members toured Fincantieri's shipyard in Marinette, which builds frigates for the U.S. Navy. Submitted photo.

New mechatronics course prepares students for high-demand engineering jobs

Students in ME 376 work on a lab assignment. Photo: Adam Malecek.

Mechatronics—integrating mechanical systems with electronics and software—is essential to a growing number of products and systems, including cellphones, vehicles and robots.

"There is a significant demand for engineers with mechatronics training and experience in embedded systems across various industries," says Steve Nackers, a director of design engineering at Sub-Zero Group, Inc. and ME industrial advisory board member. "Mechatronics engineers are increasingly sought after in sectors such as manufacturing, automotive, aerospace and healthcare, where they play a crucial role in developing and maintaining advanced automation systems, robotics and smart technologies."

To prepare students for success in these high-demand jobs, the department created a new required core course, ME 376: *Introduction to Mechatronics*. In addition to lectures covering the theory and analysis, the course includes weekly hands-on lab assignments that teach students the fundamentals of circuits, integrating electronics, microcontrollers, sensors and actuators, and basic feedback control to create a mechatronic system.

"The course is almost like an introduction to electrical engineering for mechanical engineering majors," says Lei Zhou, an assistant professor in ME and ECE, and one of several faculty who developed the course. "Many engineering jobs today require working across disciplines on integrated projects, and this course allows students to gain those crucial skills and competencies that will enhance their career opportunities. This skill set is also beneficial for students interested in entrepreneurship."

In weekly lab sessions, students gain hands-on experience using industry-relevant tools and technologies. The labs teach a progression of practical skills, from using key electronics tools like function generators and oscilloscopes, to building and testing basic circuits and programming embedded microcontrollers to control electric motors.

"I really enjoyed the hands-on labs in the course, where I applied the theoretical concepts I'd learned and gained skills in working with real circuits," says Henry Huth, a fourth-year student. "This applied electronics knowledge and experience will be highly valuable for me going forward. Electronics have such a wide variety of applications in the mechanical engineering field that it is essential for mechanical engineers to have a good knowledge base in the subject."

To enable rich hands-on learning experiences in the course, the mechanical engineering department renovated the mechatronics lab in summer 2024, converting the space into two new laboratory-style classrooms with improved layout, increased capacity, room to grow and updated equipment.

In addition to Zhou, professors Peter Adamczyk and Wei Wang and former ME faculty associate Erick Oberstar, along with teaching assistants Bolun Zhang and Megh Doshi, contributed to the course's development. The development team will actively incorporate stakeholder feedback to refine the curriculum, ensuring the course stays at the forefront of emerging fields like mobile robotics and sustainable automation.

Nackers applauds the department's forward-looking vision and commitment to enhancing the educational experience. "As technology evolves, mechatronics represents the future of engineering education, preparing students for dynamic and interconnected modern engineering roles," Nackers says. "By offering mechatronics training, UW-Madison ensures its engineering students are well-prepared to meet industry demands and contribute meaningfully to technological progress."

New hands-on course launches first-year students' journey into aerospace engineering

Students in EMA 200 designed a tabletop wind tunnel for a class-wide project. Photo: Caitlin Scott.

A growing number of the department's engineering mechanics undergraduate students are choosing to add the aerospace option to their major. The EMA program prepares students for in-demand careers in the aerospace industry, where engineers can apply their skills to diverse challenges involving rockets, spacecraft, airplanes and more.

Amid this increased interest, Associate Professor Jennifer Franck created a new course for first-year engineering mechanics students to set them up for success in their engineering education. The course, EMA 200: *Introduction to Mechanics and Aerospace*, launched in fall 2024.

"A big motivation for creating this course was to give engineering mechanics students a way to connect with each other and the engineering mechanics faculty in their first year, while also allowing them to work on aerospace-specific topics much earlier in their college career," Franck says.

Building community among students in the course is especially important to Franck, because it supports her goal of creating an inclusive learning environment where all students can thrive and feel like they belong. "Studies have shown that women and students from underrepresented groups do better in engineering if they have a sense of belonging and feel welcomed," Franck says. "With this course, I hope to have an impact in retaining and growing the number of women and underrepresented students in engineering."

In the first half of the semester, the students learn the basics of key software, mathematical and design tools—such as the 3D solid modeling program SolidWorks—as well as some fabrication skills in the college's Grainger Engineering Design Innovation Lab.

In weekly labs, the course features many hands-on learning experiences. One lab assignment challenged the students to work in teams to build small wind tunnels using a box fan and simple materials such as cardboard pieces and masking tape. The students were given a miniature wind turbine to test in their wind tunnels, and they needed to assemble a simple circuit to obtain voltage and current measurements. The activity set the stage for the students' visit to the college's wind tunnel.

"My favorite part of the course so far is all the hands-on activities we get to do in our labs that allow us to really apply what we're learning and get a deeper understanding," says student Jada Matson. "The course also gives a great overview of the topics that we'll study over the next few years, which is helpful for thinking about future career paths in aerospace."

In the second half of the semester, the students worked in teams on a class-wide project to design a tabletop wind tunnel. Each team was responsible for designing an individual component—and that required all of the teams to collaborate and communicate effectively to ensure each component integrated into the final system. Franck structured the project in this way to emulate the design process used in the aerospace industry.

To introduce students to the many different career options for aerospace engineers, Franck brings in regular guest speakers. One guest speaker in fall 2024 was Winston Jackson, a systems engineer at NASA's Jet Propulsion Laboratory, who shared his experiences, including working on NASA's Europa Clipper space probe, which launched in October 2024.

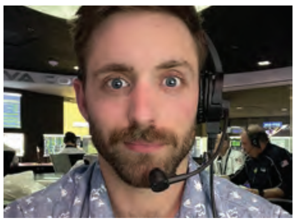
"(Jackson) gave the class a really great overview of his career path and how he ended up with a prestigious job at JPL," says student Arlo Gaskill. "It was a wonderful opportunity to be able to ask him questions and learn about steps we can take in our education and future careers."

EMA alumni soar in industry

The Engineering Mechanics + Aerospace option prepares students to succeed in the booming aerospace engineering industry. Meet four alumni who are shining examples of where UW-Madison grads can wind up if they keep their eyes on the stars.

Melanie Solomon (BSEM ’23) works at Blue Origin, where she started as a component test engineer in Kent, Washington, and is now a test engineer in Van Horn, Texas. She works on flight instrumentation (pressure transducers, silicon diodes, thermocouples, RTDs, speed sensors).

Koby van Deelen (BSEM ’22) has been a liquid engines engineer for United Launch Alliance in Denver, Colorado, for almost two years. “I’ve sat on console for 13 ULA launches monitoring engine systems and even gave the final ‘Go’ callout from Cape Canaveral for the RL10s on the first ever flight of Vulcan in January 2024,” he says.



Don Kuettel III (BSEM ’15) works as the ground navigation filter lead at Intuitive Machines. After graduating from UW-Madison, he went on to earn his PhD in astrodynamics at Colorado University-Boulder. He was part of the team that landed a robotic lander on the moon in February 2024, marking the first time the United States has soft landed on the moon since the Apollo program.

Clayton Fellman (BSME ’19) has worked as an engineer at Boom Supersonic since graduating in 2019. In January 2025, the plane he’s been working on for the last five years, the XB-1, conducted its first supersonic flight test and broke the sound barrier. Fellman was in the control room during the test monitoring the aeroelastic behavior of the aircraft.

Harnessing machine learning to target ‘forever chemicals’ in drinking water

Someday, your drinking water could be completely free of toxic “forever chemicals.”

These chemicals, called PFAS (per- and polyfluoroalkyl substances), are found in common household items like makeup, nonstick cookware, dental floss, batteries, and food packaging. PFAS permeate the soil, water, food, and air, and they can remain in the environment for millennia. Once inside the human body, PFAS can persist for years, suppressing the immune system and increasing cancer risk.

A multi-university team of researchers, led by Georgia Tech, is using a cutting-edge machine learning model to design a better membrane that efficiently removes PFAS from drinking water, a significant source of human exposure. The research aims to provide a scalable, efficient and sustainable solution for mitigating these chemicals’ impact on human health and the environment.

The team set out to discover the ideal membrane material to separate PFAS from the water stream. Georgia Tech researchers performed the machine learning modeling. At UW-Madison, Associate Professor Ying Li validated the model with molecular simulations, while Arizona State University researchers trained it using data from scientific literature and their lab.

Using machine learning modeling allowed the team to find eight membrane candidates 10 to 20 times faster, reducing discovery time from years to a few months.

“Our molecular dynamics simulations reveal that electrostatic interactions, size exclusion, and dehydration play critical roles in governing the transport of PFAS molecules across polyamide membranes,” Li says. “The simulation results provide fundamental insights that align with machine learning predictions, highlighting the key molecular determinants of PFAS removal efficiency.”

College of Engineering honors elite alumni

2023 EARLY CAREER AWARD RECIPIENT

Jay Flores

BSME ’12

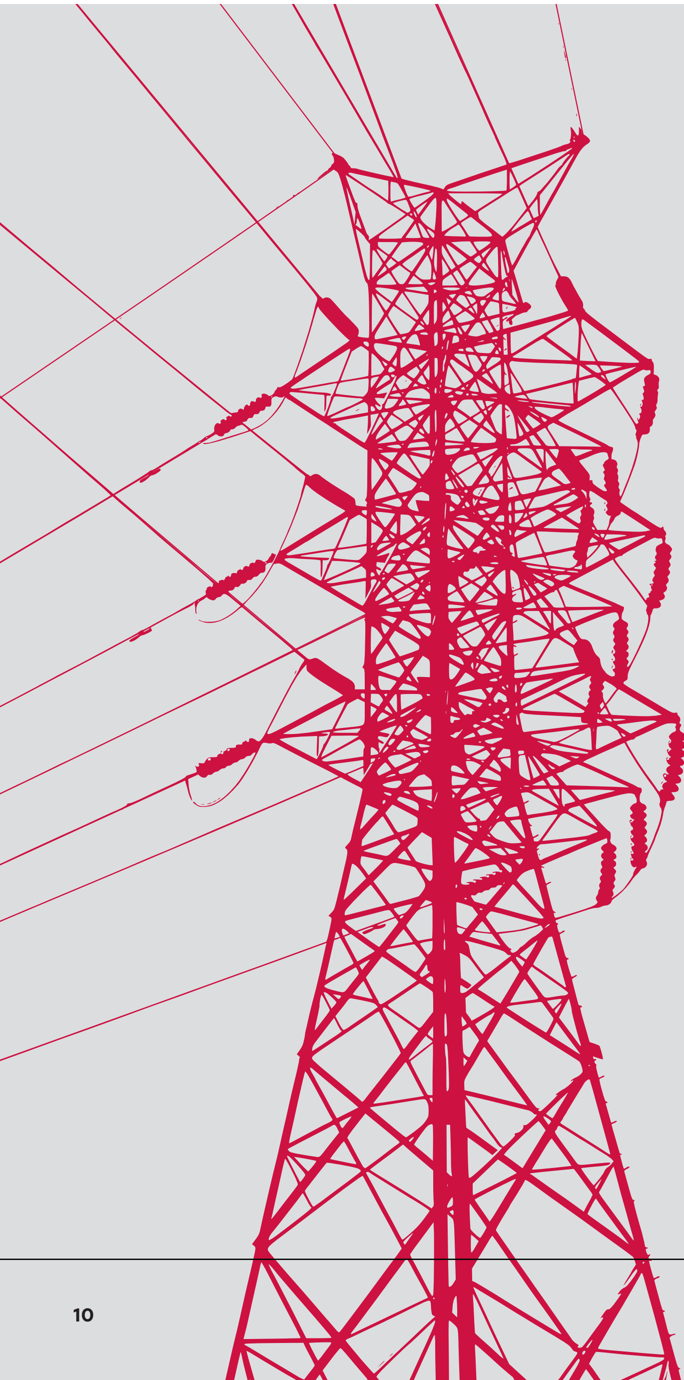
Whether he’s leaping across an obstacle on the NBC show American Ninja Warrior, cooking up a new science demonstration or delivering a motivating keynote, Jay Flores inspires millions of young people worldwide to become tomorrow’s innovators. Through his entertaining STEM YouTube series, It’s Not Magic, It’s Science!; as a mystery guide on Discovery Education’s Mystery Science; and in his engaging live science shows, he’s among today’s most influential advocates for STEM education.

2024 DISTINGUISHED ACHIEVEMENT AWARD RECIPIENT

Rod Copes

BSME ’88 (MSME ’93, MIT; MBA ’93, MIT)

After more than two decades in executive positions with iconic motorcycle manufacturer Harley-Davidson and later, with Royal Enfield Americas, Rod Copes set his entrepreneurial sights on the future of electric vehicles. As the first chief operating officer for electric vehicle manufacturer Rivian, he helped the company rapidly scale up. Now focused on growing several startups, he’s also bringing to market a desirable, safe and affordable electric vehicle as executive chairman of a new company called Slate.



Team earns $2.3 million in ARPA-E funding for electrochemical power transfer system

The United States electrical grid is fragmented, which means transferring excess power from one region to another is no easy feat. The U.S. Department of Energy is searching for promising solutions to this challenge through its Advanced Research Projects Agency-Energy (ARPA-E), including ways of transferring power using chemicals.

With that in mind, ARPA-E selected a project led by Leon and Elizabeth Janssen Associate Professor James Pikul for a three-year, $2.3 million grant as part of the agency’s Vision OPEN 2024 program.

Pikul is working with ME colleagues Eric Kazyak and Luca Mastropasqua, both assistant professors, to create a system for electrochemically charging chemicals, which could then be shipped or piped to locations where the energy could be extracted back into electricity.

Specifically, the researchers will use the ARPA-E funding to develop an electrolyzer, essentially a fuel cell that converts electrical energy into chemical energy, containing a class of sulfur-based compounds that are naturally found in broccoli and manufactured domestically as food additives.

“The energy-density of our materials is about three times more than a lithium-ion battery,” says Pikul. “That is critically important for reducing the cost of shipping power, because you’re paying for the mass and weight when you’re shipping chemicals. We have a material that’s liquid, it can be shipped very easily, it can be stored for a long period of time, it’s domestically produced, and it’s low cost.”

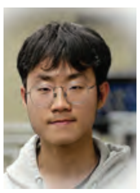
The researchers previously worked on the backend of the process—discharging the chemically stored energy into electricity—in a laboratory setting, work they’re planning to publish.

Pikul specializes in using electrochemistry for applications ranging from energy storage to robotics. Mastropasqua adds expertise in electrochemical systems operating at elevated temperatures, while Kazyak brings experience using lithium metal and solid electrolytes, which are key components in the group’s effort.

Undergrads gain hands-on research experience

Five students received Faustin-Prinz research fellowships for projects starting in spring 2025. The fellowships support undergraduate mechanical engineering and engineering mechanics students who want to develop a research project with department faculty, get access to cutting-edge laboratory equipment and work closely with a faculty project advisor.

Lincoln Devine is working with Xiaoping Qian, Elmer R. and Janet Ambach Kaiser Professor, to use a generative machine learning model to optimize the design of pin fin heat sinks, which could unlock innovative thermal management in small electronics.



David Han is working with Assistant Professor Eric Kazyak to better understand a lithium-ion battery's internal state during operation, which will enable improved battery performance and safety. Their research will focus on embedding optical fiber sensors inside lithium-ion batteries for operando temperature measurement during thermal events.

Evan Jaklitsch is working with Assistant Professor Luca Mastropasqua to use additive manufacturing, specifically stereolithography (SLA) 3D printing, to produce ceramics. Their research could enable manufacturing of ceramic parts with complex geometries.

Benjamin Prunuske is working with Professor Mike Zinn on a project that aims to develop a robust and sturdy serial chain robotic manipulator with two degrees of freedom, capable of controlling the position of the end effector. They will also implement haptic control for manual manipulation by a human.

Abigail Winn is working with Assistant Professor Xiangru Xu on a project that aims to develop a novel and scalable reachability analysis algorithm for perception-based autonomous control systems—such as self-driving cars and autonomous aircraft taxiing systems. The goal is to verify the safety of image-based neural network control systems.

Faculty news

Associate Professor **Franklin Miller** has received a $1 million grant from NASA for research on a vanadium superconducting heat switch for adiabatic demagnetization refrigeration. Many future discoveries in astrophysics will be enabled by space flight photon detectors cooled to temperatures within 50 milliKelvin of absolute zero, and these detectors will be cooled by state-of-the-art continuous adiabatic demagnetization refrigerators (CADRs). Using vanadium in CADRs could improve thermodynamic system efficiency and reduce the required mass of these space flight magnetic cooling systems by more than 30%.

Associate Professor **Ying Li** received an ASME Rising Star in Mechanical Engineering Award. Li was honored for his innovative work and distinguished achievements in mechanical engineering, which include receiving federal support through prestigious research programs. He received a National Science Foundation CAREER award for research that quantifies the link between synthesis, microstructure and mechanical properties of thermoplastic elastomers. He has also earned an Air Force Office of Scientific Research Young Investigator Program Award for his project "Deep reinforcement learning for de novo thermosetting polymer design," which furthers his research in computational modeling and design of novel polymers for extreme conditions with the help of machine learning techniques.

Mead Witter Foundation Professor **Krishnan Suresh** received the ASME CIE Excellence in Research Award for 2024. The ASME CIE (Computers and Information in Engineering) Division award recognizes a current ASME member for outstanding research contributions in any field associated with the use of computers in engineering. The award honors Suresh for his work pushing the boundaries of quantum mechanics and design optimization. His research harnesses the immense computational power of modern computing systems such as GPUs, CPU-clusters and quantum computers to solve previously intractable problems and unlock new frontiers in design and optimization.

Pavana Prabhakar, Charles G. Salmon Associate Professor in CEE and ME, has been named a 2024-25 Fulbright Scholar. A leader in the field of engineering composite materials, Prabhakar is spending nine months in Chennai, India, conducting fundamental research to enable more sustainable next-generation composite materials, especially fiber-reinforced polymer composites.

Department of Mechanical Engineering
UNIVERSITY OF WISCONSIN–MADISON

1513 University Ave., Room 2107
Madison, WI 53706
engineering.wisc.edu/me

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Teaching specialist Aidan Butula operates the new flight simulator, which he helped design and build. Photo: Joel Hallberg.

Flying high, virtually

There's a growing student interest in aerospace engineering, as well as strong career prospects in the aerospace industry. That's one reason Christian Franck, the Bjorn Borgen Professor of Mechanical Engineering, and teaching specialist Aidan Butula built a state-of-the-art flight simulator, housed in the college's Flight Simulator Laboratory.

Its cockpit and avionics are a one-to-one replica of a modern Cessna 172 Skyhawk, which is one of the most prominent general aviation aircraft. A licensed pilot with an aerospace engineering background, Franck drew on his extensive experience flying the Skyhawk to help create a simulator with a realistic look, functionality and feel. The simulator has wraparound screens to provide a 180-degree view, creating an immersive experience that feels like sitting in a real cockpit.

Franck plans to use the simulator, which he expects will receive FAA certification, to provide students an interactive learning experience in his EMA 523: *Flight Dynamics and Controls* course.

"Students learn the physics of controlling a flying aircraft in three-dimensional space," he says. "Some of these concepts can be difficult to understand just from working on math problems. My goal with the new flight simulator is to enable students to directly experience how the equations apply to aircraft control."

The custom-built simulator includes additional components, such as a display that gives real-time flight performance data, allowing students to analyze the stability of the aircraft and verify their calculations. Among its many potential uses, the flight simulator could help students in design projects to analyze the performance of new types of experimental aircraft.

"There's an appetite for establishing a full aerospace engineering major at UW-Madison, and I think this new flight simulator is an important step on that path," Franck says.