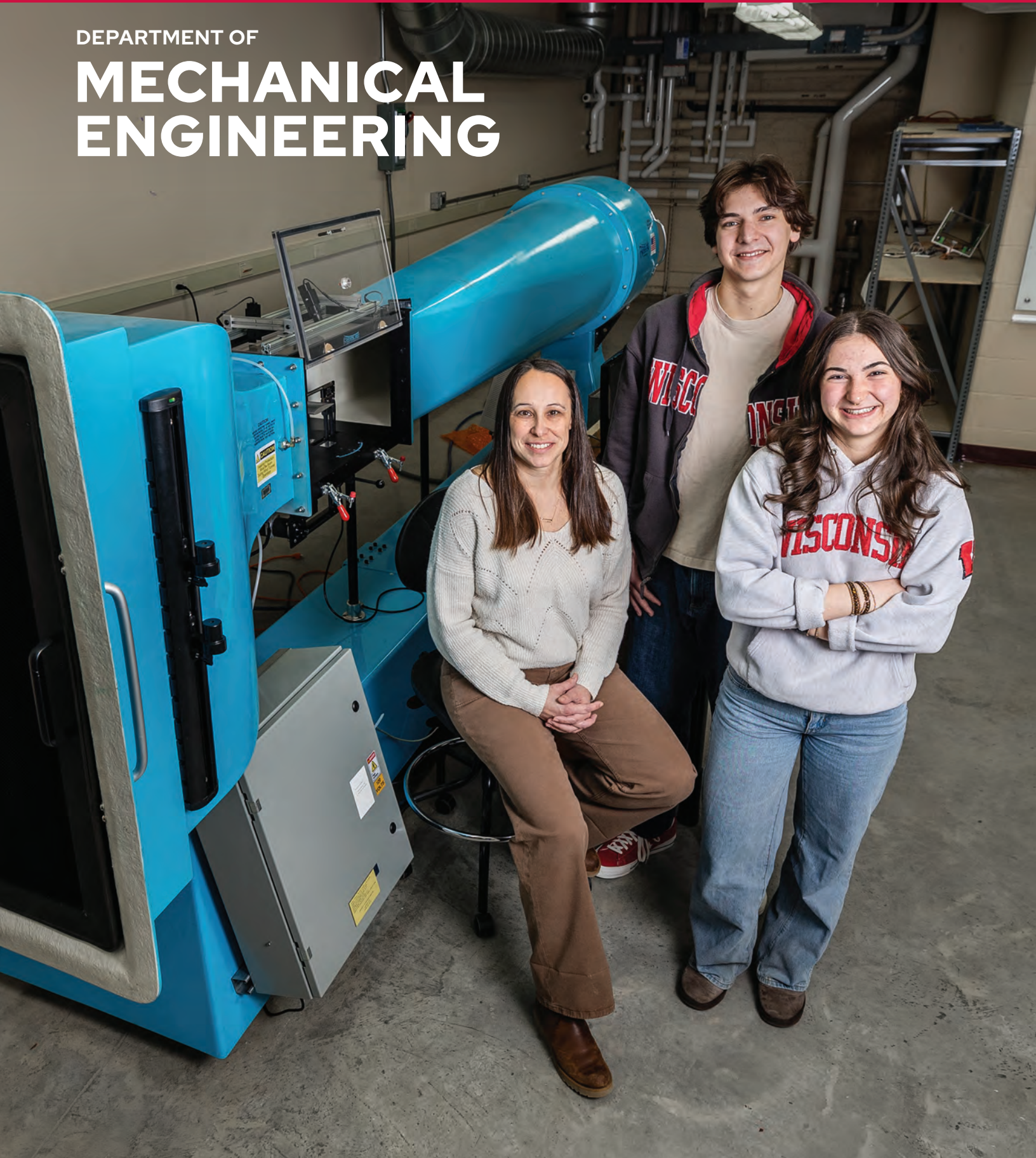




DEPARTMENT OF

MECHANICAL ENGINEERING





Greetings from Madison!

The 150th anniversary of the department has provided an incredible opportunity to reflect on our shared accomplishments, reconnect with alumni and chart an ambitious path forward. A central part of that future is our new BS in aerospace engineering degree program, which will officially launch in fall 2026. This program responds directly to exceptional student interest and strong industry demand, and we look forward to welcoming our first aerospace engineering students in August.

Our commitment to student success remains strong, made possible by the generosity of our alumni and partners. This year, we awarded more than \$1.2 million in undergraduate scholarships and more than \$400,000 through our First-Year Distinguished Graduate Fellowships, which is a strategic investment in recruiting outstanding PhD students and sustaining our research enterprise. We continue to grow our research portfolio with new faculty advancing work in battery materials, digital twins and low-carbon transportation, reflecting our steadfast commitment to the Wisconsin Idea.

As we look ahead, we also pause to recognize two remarkable colleagues. Jaal Gandhi retired in December 2025 after 31 years of service, including seven years as chair. His leadership was steady, thoughtful and deeply grounded in a commitment to people, setting the stage for much of the growth we are experiencing today. We also celebrate Riccardo Bonazza as he completes 33 years at UW-Madison. For nearly two decades, Riccardo has been the driving force behind aerospace opportunities in engineering mechanics. His vision and persistence helped make our new aerospace engineering degree possible. We thank Jaal and Riccardo and wish them the very best in their next chapters.

In April, we had the pleasure of hosting our ME150 Capstone event. We had a wonderful time reflecting on our history, showcasing student innovation, and bring together alumni, faculty and partners as we celebrate this milestone year.

Thank you for being an essential part of our community.
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: Associate Professor Jennifer Franck with undergraduate students Samuel Snyder and Isabella Belgiorno at the ME wind tunnel. Photo: Joel Hallberg



Accelerated Engineering Master's Programs

Our accelerated engineering master's programs allow graduates to get the jobs they want by obtaining an advanced degree in as little as one year. Delivered on campus and designed to be finished in 12–16 months, learners can choose from 12 programs in 7 disciplines.

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Celebrating Riccardo Bonazza and Jaal Gandhi on their retirements



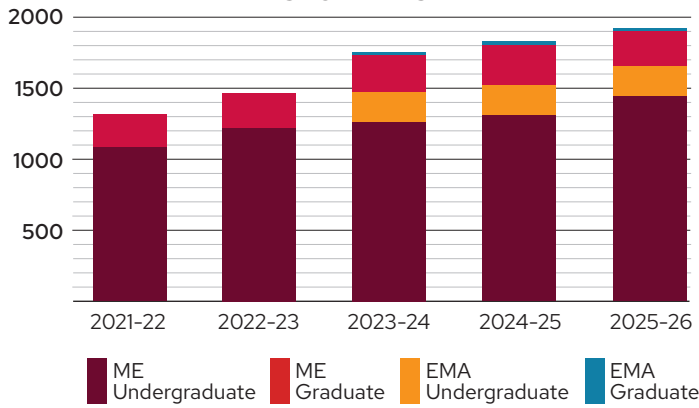
Riccardo Bonazza



Jaal Gandhi

DEPARTMENT FACTS AND STATS 2025-26

STUDENTS



SCHOLARSHIPS & FELLOWSHIPS

\$1,200,000

Awarded to undergraduate students in fall 2025

\$411,000

Awarded to 17 graduate fellows

43

STAR (Strategic Targeted Achievement Recognition) scholarships

8

Faustin-Prinz research fellows

#1

Aerospace engineering program in State of Wisconsin starting fall 2026

5th

largest undergrad program at UW-Madison

#9

graduate ranking among public universities

#13

undergraduate ranking among public universities

7

faculty with active NSF CAREER awards

EXTRAMURAL RESEARCH

Mechanics - bio, fluid and solid

34%

Advanced manufacturing

4%

Energy generation, conversion, storage

19%

Computational engineering and design

16%

Robotics, controls and sensing

8%

Energy systems for transportation

19%

\$33M+
FY25

4

faculty hires in 2025-26

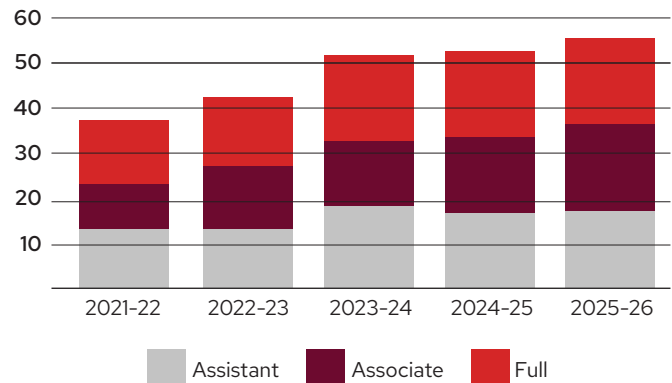
Harsh Sharma • So Yeon Kim • Adam Dempsey • Christopher "Kiffer" Creveling

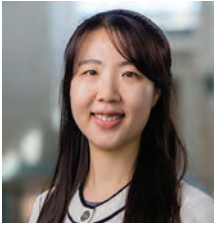
7

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





FOCUS ON NEW FACULTY
So Yeon Kim is designing more durable materials for next-gen energy systems

When So Yeon Kim tells people that she has worked on designing materials

for both solid-state batteries and next-generation nuclear reactors, they are often surprised, assuming that these energy systems are very different.

“But from the perspective of materials science and mechanical engineering, the problems I’m working on are actually pretty similar across these different applications,” says Kim, who joined the department as an assistant professor in January 2026. “In these energy systems, there are open-system reactions such as electrochemical or nuclear processes that induce huge stresses inside materials, which can cause damage and lead to degradation.”

That’s a problem because materials in battery electrodes and nuclear reactors must endure for years. “If we build an energy system but need to replace damaged materials after six months, for instance, that’s not economically sustainable,” she says.

Kim’s research focuses on understanding and engineering materials’ damage tolerance under these open-system reactions. She aims to design more durable materials with desirable properties that can enable scalable, efficient and long-lasting energy systems that are both environmentally and economically sustainable.

In many clean energy systems, it’s often impossible to avoid mechanical damage from occurring in materials. But not all damage is equally detrimental, Kim says, noting that some types of mechanical damage are relatively harmless for the material. Her research involves exploring how to design materials so that any damage stays benign and doesn’t lead to catastrophic failure.

Kim earned her doctorate in materials science and engineering from the Massachusetts Institute of Technology (MIT) in 2023 and subsequently conducted postdoctoral research in MIT’s Department of Nuclear Science and Engineering. She started out primarily as an experimentalist, but when the COVID pandemic prevented her from working in the lab, she developed computational skills and recognized the unique benefit of seamless iteration between computation and experiments within a non-siloed research workflow. Today, she leverages this integrated approach to screen materials computationally and then validate them experimentally, or to combine both methods to enable hypothesis testing beyond what either approach alone can achieve.

Kim was hired through the UW-Madison RISE-EARTH initiative, which was launched to strategically hire faculty members and improve interdisciplinary collaboration aimed at building sustainable energy and technical systems.



FOCUS ON NEW FACULTY
Adam Dempsey develops heavy-duty engine technologies to enhance sustainability

As a new associate professor, Adam

Dempsey is excited to return to his alma mater and the department where he earned his PhD 13 years ago.

“I’m actually taking over the same lab in the Engine Research Center where I did my PhD research,” says Dempsey, who joined the department in January 2026. “For my research area, working in the renowned Engine Research Center at UW-Madison is the best place to be for pioneering engine technologies that will have a big impact.”

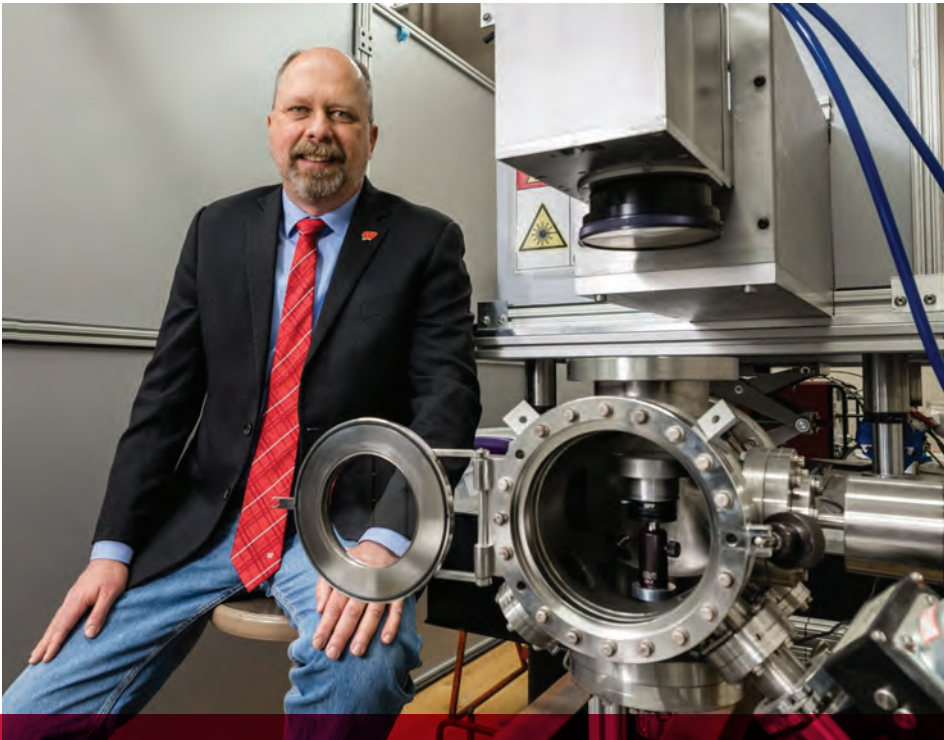
Using computer modeling and experiments, Dempsey is working to develop new internal combustion engine technologies that allow engines to use a wide variety of alternative, lower carbon fuels—without sacrificing performance and improving efficiency. Specifically, he’s focused on tackling sustainability challenges in commercial transportation, which is one of the most difficult sectors to electrify due to the high energy demands over long operating periods. The commercial transportation sector, which includes semi-trucks, off-road construction, agriculture and mining equipment, railroads and ships, primarily runs on diesel engines due to their unique operating characteristics.

“To improve the sustainability of heavy-duty transportation, we must reduce the emissions from diesel engines,” Dempsey says. “The most pragmatic way to do that is to keep the diesel engine but change the fuel to alternative, lower-carbon, cleaner-burning fuels.”

The problem, however, is that these alternative fuels—including ethanol, methanol, hydrogen and ammonia—don’t easily ignite in diesel engines, making it very difficult to use them for combustion. To overcome this challenge, Dempsey is developing various ignition assistance technologies that will allow alternative, hard-to-ignite fuels to burn rapidly.

“The goal with these new technologies is essentially to make alternative fuels act like diesel fuel in the engine,” Dempsey says. “This will enable fuel-agnostic engines that can use a wide variety of sustainable fuels while still performing like heavy-duty diesel engines.”

Dempsey received his bachelor’s and master’s degrees in mechanical engineering from Bradley University and earned his PhD from UW-Madison in 2013, with now-Professor Emeritus Rolf Reitz as his advisor. He went on to work as postdoctoral researcher at Oak Ridge National Laboratory and as a senior research engineer at Caterpillar, from 2015 to 2019, before joining Marquette University as an assistant professor of mechanical engineering.



New laser-based manufacturing course connects students on campus and in industry

A fourth-year undergraduate student sits in a classroom on the first floor of the Mechanical Engineering building on the UW-Madison campus, laptop open, chatting with an online master's degree student and a working engineer. The three are discussing which components of a laser-cutting setup at a manufacturing plant could be responsible for the system overheating.

That's the kind of scenario that regularly played out during the fall 2025 semester in a new ME course on laser-based manufacturing. To Professor Frank Pfefferkorn's knowledge, it's the first course in the college to bridge in-person undergraduate and graduate students, online degree program students, and online professional development participants.

Pfefferkorn and co-instructor Kevin Klingbeil also believe the course's breadth—spanning both the fundamental physics undergirding laser processes and all the components that must work together in tangible manufacturing applications—sets it apart.

“We wanted a course that lets somebody hit the ground running, to at least know what they don't know,” says Pfefferkorn, who studies manufacturing processes—including laser-based—for metal parts. “They can be put on the task of working with a laser system for manufacturing and at least know the right questions to ask. It doesn't mean they can just run it off the bat, but they really understand the space enough to figure out how.”

The course, which was classroom-based but featured Zoom discussion groups, emerged from Pfefferkorn's two-decadeslong collaboration with Klingbeil (BS '95, physics) on laser polishing and other techniques. Klingbeil has spent more than 25 years working in the laser-based manufacturing space, running his own consulting firm in Osceola, Wisconsin, since 2019.

Lasers have been deployed in manufacturing processes since the 1970s and have continued to grow in use in industries such as automotive lines, aerospace and flexible packaging.

They offer a fast, efficient and precise alternative for tasks like welding, cutting, heat treating and peening.

Pfefferkorn and Klingbeil set out to create a course that covered both physics principles and real setups found on factory floors. Enter Klingbeil, who worked at laser technology companies in Minnesota and northwest Wisconsin before striking out on his own. That experience provided ample fodder for the weekly case studies students worked on in groups, exploring possible solutions from their varied perspectives.

“That was my favorite part of the class, just because it's rare to hear what other classmates think and how they would approach problems,” says Kirstin Poppen, a student from Verona, Wisconsin, in the mechanical engineering accelerated master's degree program. “There's often more than one way to construct a laser system and different parameters and different ways to tackle a problem in manufacturing.”

Thomas Mitchell (BSME '25), another accelerated master's student from Skokie, Illinois, had seen laser systems on manufacturing lines at internships and co-op experiences during his time as an undergraduate.

“I wanted to learn more about how they work,” says Mitchell, who will join aerospace components manufacturer Woodward after finishing up his graduate degree in May 2026.

Pfefferkorn, who's also the academic director of the online master's degree program in manufacturing systems engineering at UW-Madison, and Klingbeil hope to make the course an annual offering after a successful pilot run.

“Our goal is to make the class the world's premier course on laser-based manufacturing,” says Klingbeil. “We want it to be the course that if you want to learn about laser-based manufacturing, this is the course that you need.”

Professor Frank Pfefferkorn (pictured) and co-instructor Kevin Klingbeil set out to create a course that covered both physics principles and real setups found on factory floors. Photo: Joel Hallberg.

With alum's support for design, mechanical engineering students channel passion into action, take learning to next level

In their senior years, UW-Madison mechanical engineers apply four (or more) years' worth of skills to a real design project. Historically, the ideas and support for those projects—designing a tool or devising a system, for example—have come via industry partners, faculty researchers or community organizations.

But for especially entrepreneurial students like recent graduate Frankie Iovinelli (BSME '25), that approach exposed a gap: What about funding for novel projects emerging from the minds of students, rather than from a sponsor with available resources?

Through the support of alumnus Bjorn Borgen (BSME '62), the department has, for the past two years, held the Borgen Design Competition, providing seed money for promising student-imagined projects.

The competition is just one outgrowth of a \$5 million gift from Borgen—itsself part of a larger \$25 million contribution that will also benefit the college's new building—to enable experiential, hands-on learning opportunities for all mechanical engineering students. That includes projects in courses such as introductory engineering courses, the senior capstone design, as well as for members of student organizations creating prototypes as part of national competitions.

“It unlocks their entrepreneurial and innovative spirit, and that extends across freshman through senior year,” says Darryl Thelen, the John Bollinger Chair of Mechanical Engineering and Bernard A. and Frances M. Weideman Professor. “If the students can pursue what they're passionate about, whether it's competition teams or a senior design project, they are really motivated to put in way more time and effort than if it's just a project assigned to them.”

That was the case for Iovinelli, whose group built a sensing-and-dispensing device and accompanying software for automatically maintaining the proper chemical balance in swimming pools and hot tubs. No such system is widely available on the market.

“I wanted to see how much I could learn in one year,” says Iovinelli, who's now a systems engineer at Honeywell Aerospace in Tempe, Arizona. “I didn't know anything about electronics. I ended up designing the entire circuitry for the unit. I ended up soldering all of the connections. It's just a testament of how much you can really learn here if you put your mind to it.”

Senior design students now have access to a laser cutter, rapid 3D printing equipment, instrumentation and an array of tools in the Borgen ME Design Lab on the second floor of



the Mechanical Engineering Building. But, beyond senior design, courses such as EMA 200: *Introduction to Aerospace Engineering* and ME 201: *Introduction to Mechanical Engineering* (which together serve more than 200 students each semester) have enhanced their design projects to provide students with deeper, more complex builds.

Meanwhile, more than 500 students annually participate in the college's various design-competition teams, ranging from rockets to robotics to an array of vehicles that are autonomous, electric, solar and even human-powered. With Borgen Design Program support, for example, the SAE Aero UW team, which

builds unmanned aircrafts, traveled to California in spring 2025 for a national competition.

“Being able to take what we learn in class and apply it to

designing, building and flying an aircraft shows just how pivotal these concepts are,” says senior Aiden Brion, president of SAE Aero UW. “I've learned a lot from school, and the club has taken my education to the next level by adding real-world challenges, teamwork and problem-solving into the mix.”

In May 2025, Borgen returned to his alma mater to attend the ME Spring Design Showcase, during which all seniors display their yearlong projects. He marveled at the array of technologies and met with students like Iovinelli.

“I was very impressed—just the imagination that some of these students have, the fact that they have to actually go and put these together, it's a hands-on learning experience as opposed to sitting in a classroom or just listening to how things are done,” he says. “When I was at the University of Wisconsin, of course, we didn't have a design lab or design requirement. So that's something very, very important, in terms of developing engineers who have that entrepreneurial instinct.”

ME students talk with alumnus Bjorn Borgen (BSME '62) during the department's spring 2025 design showcase, which features the results of their yearlong, hands-on projects. Photo by Todd Brown.

“This gift unlocks students' entrepreneurial and innovative spirit, and that extends across freshman through senior year.”



The safety breakthrough behind tomorrow's compact nuclear reactors

Compact heat exchangers could enable advanced nuclear reactors that are smaller, more efficient and more affordable—but a critical step in their adoption is verifying they can withstand the high temperatures and possibly high pressures in next-gen reactors while still staying structurally sound.

Developed by a multi-institutional team led by UW-Madison engineers, a new methodology for evaluating diffusion welds offers a unique way for manufacturers, regulators and vendors to “view” the material bonds integral to the exchanger to ensure they are strong.

“Our tool will help increase confidence in compact heat exchangers, paving the way for this technology to be certified for use in nuclear reactors,” says Professor Mark Anderson.

Printed circuit heat exchangers are built through a process called diffusion welding, which involves stacking grooved metal plates and applying heat and pressure to fuse them together. The result is a single component that contains networks of narrow channels that transfer heat with exceptional efficiency and can handle high pressures and temperatures.

“The diffusion welding process is kind of like if you have two chocolate bars, and you stack one on top of the other and then press them together until they fuse into a single chocolate bar,” Anderson says. “Our goal is to achieve the strongest possible bond between the layers.”

That’s important because high temperatures and pressures for long

“Our tool will help increase confidence in compact heat exchangers, paving the way for this technology to be certified for use in nuclear reactors.”

durations can weaken the welds between the metal plates, which can negatively impact the heat exchanger’s performance and pose safety risks in a reactor. But assessing the strength of the bonds in diffusion welded components has been challenging because manufacturers have lacked a reliable, standard method.

To develop their new tool, the researchers investigated two materials—stainless steel 316H and alloy 617—that are both already approved for use in high-temperature nuclear applications.

“We know these materials can perform well at elevated temperatures,

but we still need to prove that the manufacturing method—diffusion welding—can create suitably strong bonds where grain growth across the interface is sufficient to hold up under high temperature and pressure,” says scientist Ian Jentz.

The team worked with CompRex, a manufacturer based in La Crosse, Wisconsin, to create diffusion welded samples with these materials. Then, they cut the samples apart to expose the bonded interfaces and used microscopes to examine the extent of the grain growth across the interface layers. The higher the number of microstructure grains that grew across the interface during the bonding process, the stronger the bond.

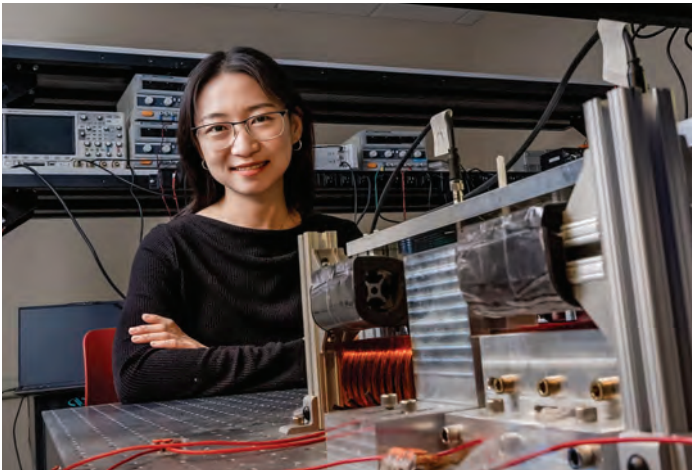
Manually counting and measuring the grains from microscope images is laborious, so the researchers collaborated with the company MIPAR and Electric Power Research Institute to develop a custom tool that harnesses automated image analysis software to detect and evaluate grains within a microscope image of a diffusion welded sample.

The tool calculates the total percentage of the weld that has seen grain growth across the interface, providing a standardized metric for bond strength that is necessary to

inform ASME code cases for diffusion welded components. For example, a future code case might specify the minimum required percentage of the interface grain growth in a bond to allow a component to be used in high-temperature boiler and pressure vessel applications.

“Our new tool and methods ensure that manufacturers can trust the integrity of every bond, every time, as they’re producing commercial-scale compact heat exchangers,” Anderson says. “This research program is delivering real and long-lasting benefits to reactor companies and the future of power generation worldwide.”

Graduate student Lukas Desorcy takes a microscope image of a diffusion welded sample. Photo: Joel Hallberg.



Joel Hallberg

With NSF CAREER Award, Zhou aims to develop mechatronic systems that increase productivity in computer chip manufacturing

There's a booming industry demand for microchips, which are used in virtually all electronic devices today. But meeting that demand is challenging for chipmakers, because current mechatronic systems have reached the limit for how fast they can produce chips.

With a National Science Foundation CAREER Award, Assistant Professor Lei Zhou aims to push mechatronic

systems past that limit. By developing theoretical methods and practical tools, she seeks to enable future integrated circuit manufacturing equipment that can complete critical manufacturing processes faster, thereby increasing the number of chips that can be produced.

In integrated circuit manufacturing, motion stages are mechanical platforms or systems that move and precisely position wafers or photomasks during critical manufacturing processes like photolithography and wafer inspection.

“The motion stages move at a very high speed and with nanometer-level precision, and how fast these platforms can accelerate and decelerate, along with the control performance, directly determines the chip throughput for the photolithography and wafer-inspection processes,” Zhou says.

However, in today's mechatronic systems, there is a fundamental tradeoff between the achievable acceleration for the motion stage and the control bandwidth needed to ensure nanometer accuracy. For her CAREER project, Zhou will create a new mechatronic hardware and control co-design paradigm to transcend this acceleration-bandwidth tradeoff and enable motion systems with substantially improved acceleration—without sacrificing control performance.

“This research has the potential for big societal impact by enabling improved productivity for chip manufacturers,” Zhou says.

For concentrating solar power plants, new model means smarter control strategy and more skilled operators

Concentrating solar power plants use a large array of mirrors to focus the sun's rays and capture their heat, which boils water for steam turbines to produce electricity. The technology and systems in these massive plants are complex—requiring skilled operators who can reliably make the correct control decisions to ensure the plants can achieve and sustain high performance levels.

Until now, operator training has lagged considerably behind the tech. Filling a critical need, UW-Madison engineers have developed a computationally efficient, high-fidelity model capable of simulating concentrating solar power plant dynamics faster than real time. These capabilities translate the model into a useful operator training simulator.

“We've developed a new simulation platform that allows plant operators to play around with the system and develop an intuition for how the plant is likely to respond to various control decisions, without the risk of causing damage to a real plant,” says Assistant Professor Mike Wagner, who led the research. “This new tool could accelerate the upskilling of operations staff and improve productivity of the actual plant over time.”

The researchers' new model is of a “parabolic trough” solar field, which is the most deployed type of concentrating solar power technology. These systems use long, curved mirrors that focus sunlight on tubes, heating a fluid flowing through the tubes. There are about 80 parabolic trough solar plants totaling 5.3 gigawatts operational or under construction worldwide.



iStock photo.

Overall, a solar collection field consists of thousands of individual heat elements, mirrors and piping equipment, and this vast complexity has made it challenging to create fully detailed models. Leveraging a neural network methodology, Wagner and recent graduate Matt Tuman developed a model that accurately captures every individual loop in the field and provides detailed performance information—while also being 100 times faster than previous models.

In the loop: New student organization is taking Badgers for a ride

Only the nerdiest among us take our first steps into Disneyland or Universal Studios and exclaim, “What a feat of engineering!”

But maybe more of us should. Theme parks (or “themed entertainment,” for those in the know) are massive engineering endeavors, from designing and maintaining roller coasters and complex rides to developing what are essentially entire cities of people (with an insatiable hunger for turkey legs).

The complexity of these magic kingdoms has always fascinated students Elizabeth Janicek and Levi Rudolph, both of whom have a lifelong love of theme parks. That’s why the ME juniors launched the student organization Badgers in Themed Entertainment (BiTE). Their goal is to educate fellow students about opportunities in the themed entertainment industry while developing connections and offering skills-building opportunities for members.

Janicek and Rudolph discovered their mutual passion for theme parks in ME 201, the introductory course for mechanical engineering majors. During an icebreaker session, the students talked about what they would like to do with their ME degree. Janicek mentioned animatronics; Rudolph said he wanted to build roller coasters. “I was kind of like, ‘Oh, there’s more of us out there!’” says Janicek. “So from that we decided to start a club.”

The pair recruited a few other coaster-heads as founding members and submitted paperwork for BiTE in spring 2024. When they opened the org to fellow students the following fall, it was unclear whether anyone else would show up. But they didn’t need to worry: Plenty of curious students came to their first few meetings, and interest has only grown since.



“From our founding group to our first members, everyone is so passionate about themed entertainment,” says Rudolph. “It was really refreshing to see the amount of interest for a niche industry like this.”

Now, the organization, which is open to every student at UW-Madison, has about 60 active members, including mechanical, electrical, civil, nuclear, biomedical and computer engineers as well as students from computer sciences and data science. Janicek currently serves as president.

As an organization, BiTE has two goals. Its first focus is professional development, which includes sending members to conferences and meetings within the themed entertainment industry and bringing guest speakers to campus. So far, the group has hosted talks by professionals from Disney, Universal Studios and the Wisconsin water park industry.

At the same time, the group offers a hands-on component: Members design working models of roller coasters and other rides to display at various events. In fact, they debuted a Madison-themed, pneumatic-powered mini coaster at the 2025 Engineering Expo, using it to pique interest and demonstrate roller coaster physics to middle school students. In the 2025-26 academic year, the club is working on a new coaster built to industry safety standards as well as a simulated interactive underwater dark

ride that includes animatronics and choreographed lighting design.

Last year, BiTE students participated in the Toronto Metropolitan University Thrill Design Competition, sponsored by Universal Creative. After participating in an open qualifying round in April and May of 2025, in which they were challenged to build a theme park ride, BiTE team advanced to the invitational competition held at the Universal Orlando Resort, which included 172 students from 32 schools.

During the hackathon-style competition, the team, including Janicek and ME seniors Leo Mazzocco and Cooper Conway, had three days to complete a design challenge and present it to a panel of industry judges. While there are no winners in the competition, the team did receive commendations on their innovation, human-centered design, and communication. BiTE hopes to field another team for the competition this year as well.

While the mini-coasters are fun to build and are great marketing for the group, they also give students experience working with safety standards and other constraints. “We’re really trying to offer our members both professional growth and technical growth by giving them experience working on things they will encounter in this field,” says Rudolph.

BiTE team members with their Madison-themed, pneumatic-powered mini coaster at the 2025 Engineering Expo. Submitted photo.

Physics-defying discovery sheds new light on how cells move

The cells in our bodies move in groups during biological processes such as wound healing and tissue development—but because of resistance, or viscosity, those cells can't just neatly glide past each other.

Or can they?

Using a pioneering method they developed to directly measure viscosity in a group of cells, UW-Madison engineers have made a surprising discovery that upends understanding of how cells move.

It's called "negative viscosity," and it propels cells, rather than impedes them.

"This advance can enable researchers to develop better models for cell motion, which could lead to future applications for human health, such as ways to speed up wound healing or facilitate essential processes in tissue development," says Associate Professor Jacob Notbohm, who led the research with PhD student Molly McCord.

Cells generate forces that cause them to move, but how the forces balance among groups of cells to create motion is not clear. That's why McCord and Notbohm wanted to find a way to measure the viscosity in the system; the magnitude of the viscosity was a missing part of the equation for understanding collective cell motion.

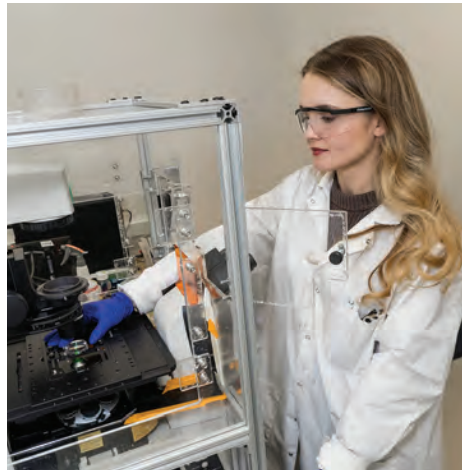
In experiments, the researchers used optical imaging to analyze how a single layer of epithelial cells deformed a soft gel surface as they migrated across it. This allowed them to calculate how much force the cells produced.

Then McCord developed a new approach for analyzing the data that involved looking at various multicellular regions, or cell groups. Her analysis revealed there were regions of cells where the viscosity, unexpectedly, was negative.

"This surprising discovery of negative effective viscosity implies injection—rather than dissipation—of energy into the flow," Notbohm says. "For example, if you were driving a car and the air had a negative viscosity, the air resistance would be propelling the car forward instead of resisting it, which goes against standard physical rules."

However, Notbohm says negative viscosity is possible for systems with an energy source—like cells that convert nutrients into energy. And he and McCord did find that regions of cells with negative viscosity had elevated metabolic activity—reflecting an increased energy demand in these cells.

"When we started this project, our question was how big is the number for viscosity," says Notbohm. "But we've now learned that we should be asking a different question: Is this number positive—or negative? This discovery reframes the problem and shows that it's meaningful to treat this viscosity as being either positive or negative, which hadn't been considered before."



Biophysics PhD student Molly McCord works in the lab. Photo: Joel Hallberg

ELITE ALUMNI

Two ME grads earned the college's top honor at a fall 2025 celebration

2025 Distinguished Achievement Award recipient



Donald Wahlin

BSME '60

Founder and CEO (retired), Stoughton Trailers, LLC

Through four decades of visionary

leadership, business acumen and patient wisdom, Donald Wahlin transformed a small truck body company into North America's fourth-largest semi-trailer manufacturer. Today Stoughton Trailers is a top-10 international supplier of semi-truck trailers and, with more than 1,000 employees, the company is Dane County, Wisconsin's largest durable goods manufacturer.

2025 Early Career Award recipient



Amir Mirzendehtdel

MSME '14,

PhDME '17

Assistant Professor of Aerospace Engineering, University of Kansas

As products in industries like aerospace and medical devices grow more complex, Amir Mirzendehtdel develops advanced computational methods for automated design, analysis and manufacturing—boosting performance, reliability and efficiency. An assistant professor at the University of Kansas, his research bridges design, manufacturing and emerging materials while inspiring future engineers.

DEPARTMENT NEWS

Undergrad Eva Stafne publishes research paper

Mechanical and international engineering student **Eva Stafne** has published a first-authored paper in *The Astrophysical Journal* exploring how Einstein's theory of general relativity could help preserve life-friendly conditions on planets orbiting white dwarfs.

She started pursuing research projects in her first year through the Undergraduate Research Scholars (URS) program. She has been a member of Astronomy Professor Juliette Becker's research group and now works within the new Wisconsin Center for Origins Research (WiCOR).

Stafne's current research is in theoretical astrophysics, where she works to predict which planets outside of our solar system could host life. "I'm essentially predicting the types of systems/planets aliens could inhabit," she says. "I've always been fascinated by the question, 'Are we alone?' By using simulations and mathematical models, I study the dynamics of what makes planets habitable. My recent paper shows that general relativity can create habitable worlds in white dwarf systems, when it was previously thought that these planets would be uninhabitable."

Kate Fu honored for research with lasting impact

Associate Professor **Kate Fu** received the inaugural Design Theory and Methodology Lasting Impact Paper Award at the recent ASME IDETC conference.

This new award recognizes a single paper from the DTM Conference held 10 years prior that has demonstrated sustained and significant influence on the field of design theory and methodology. Her team's work was selected by the award committee for its originality, continued relevance and enduring contributions to advancing design theory, methods and practice. The paper is "Design principles: The foundation of

design" with co-authors Maria C. Yang and Kristin L. Wood.

"I'm deeply honored to receive this award alongside my postdoctoral advisors," she says. "It's gratifying to see the impact the work has had; our paper has now been cited 82 times, with the journal version receiving 237 citations. When we first wrote it, our hope was simply that it might support and enrich the ways the design research and practice communities think about this area. It's rewarding to know that colleagues have found it useful enough to return to over time."

Jaal Gandhi retires

Professor Emeritus **Jaal Gandhi** retired in December 2025 after a long and successful career at UW-Madison. He is a Badger alum, graduating with his bachelor's and master's degrees in mechanical engineering before earning his doctorate in mechanical and aerospace engineering from Princeton University. Gandhi started his career at UW-Madison in 1995 as an assistant professor in ME and his research centered on the combustion and fluid mechanics of internal combustion engines. His research focuses on developing advanced, laser-based diagnostics for making planar measurements of the concentration and temperature fields within the combustion chamber of operating engines.

During his 31 years of service to the department, Gandhi taught or co-taught 11 courses in the department (361, 363, 364, 368, 370, 472, 563, 569, 669, 769, 770) and developed and taught another course for the online MEES program. He has graduated 21 PhD students (with two more pending), and 53 MS research students. All these students were supported by external research funding from government agencies (NSF, ARL, ONR, TARDEC, DOE, ORNL) and industry (Cummins, Caterpillar, John Deere, GM, Ford, Toyota, Delphi, Harley-Davidson, Mercury Marine, Kohler, Briggs & Stratton, Outboard Marine, Cummins Power Generation, Fleetguard). He led the

Wisconsin Small Engine Consortium from 2000 until 2020 and was the director of the ERCC's DERC consortium for approximately five years. Finally, he served as chair of the ME department for seven years, from 2013 until 2020, and ushered in a new era of the department in terms of research focus, operations and alumni development.

Riccardo Bonazza retires

Professor **Riccardo Bonazza** retired in spring 2026 after 33 years at UW-Madison. He became an assistant professor in September 1993. Over the years, he successfully created or redeveloped many courses, including EMA 521: *Aerodynamics*, which he completely reworked and continued to teach each year (with a few exceptions) until 2016.

In 1998, he developed a new class, EMA 522: *Aerodynamics Laboratory*, around the new wind tunnel facility, which was a favorite course among the undergraduates. With the goal of expanding the EMA program's aero-related course offerings, he decided to develop a new class, EMA 523: *Flight Dynamics and Control*, which launched in 2002. He made profound changes to the class content over the years, including adding the use of Matlab and Simulink to analyze an aircraft's stability and response to the pilot's commands.

In 2013, he introduced a new class, EMA 524: *Rocket Propulsion*, based on strong student interest in the topic, and continued to update and refine the class material. *Rocket Propulsion* was initially offered every other year until 2017, when it started being offered every fall semester.

Bonazza's research interests are the experimental investigation of impulsive, unsteady fluid flows such as shock-interface interactions, shock-driven mixing and shock-initiated combustion. With his start-up package, he established the Wisconsin Shock Tube Laboratory (WiSTL) and launched the first shock on February 20, 1998. The facility is still unique in the world for orientation, size and structural capability.



Submitted photo

Wisconsin Space Program team completes liquid engine hotfire

Our Wisconsin Space Program (WISP) student org competition team has successfully completed its first liquid engine hotfire.

After 11 months of designing, building and testing, the team's engine, Flamingo-1, hit 750 pounds of thrust three times across 12 total seconds of burn time. Based on the group's research, the students believe this is likely the seventh most powerful rocket engine ever fired by an American collegiate team.

WISP is building a rocket from scratch to compete in the FAROUT collegiate rocketry competition in June 2026.

Achieving this hotfire is one of the first steps in ensuring its rocket's success, but it can also be one of the trickiest things to accomplish, according to ME student Noah Levin, the team's president. A series of nine custom valves, pressure tanks, custom seals, and close to 100 tubing joints needs to survive extremely high pressures and temperatures for the hotfire to succeed to enable the rocket to reach speeds of more 1,000 mph during launch.

The validation of this engine is an important milestone in the team's journey to flying the first liquid-fueled rocket in UW-Madison's history. With more than 75 engineering students across multiple majors, this ambitious group is excited to continue to push its engine's limits and put UW-Madison on the map in the collegiate rocketry world.