

ELECTRICAL AND COMPUTER ENGINEERING



TEACHING INNOVATION

UW-Madison ECE faculty cultivate
high-impact learning experiences



Greetings from Engineering Hall! Springtime is an exciting period of growth and renewed energy here in ECE.

Our department has been abuzz with faculty recruiting activities across four searches. We are investing in new faculty in the areas of robotics and controls, energy systems and 2D/quantum materials for device applications. These are part of a cluster-hiring initiative across the College of Engineering in key technology areas central to our nation's global technology leadership position.

These newest faculty will be joining our diverse cohort of 14 tenure-track assistant professors who continue to shine at the highest levels as innovative researchers and educators. Here you will read about Dominic Gross's 2022 NSF CAREER award; in a future newsletter, you will have the chance to learn about Bhuvana Krishnaswamy's 2022 NSF CAREER award as well. We also celebrate major research awards and multiple fellow recognitions for our senior faculty this spring from IEEE, AAAS, AIMBE, NAI, IOP, and Intel—and the latest teaching honors at all levels, which cements ECE's reputation as a campus and national leader in education innovation.

Speaking of growth, our undergraduate student population has doubled over the past 10 years and our MS/PhD graduate student cohort this year is about 10% higher than our 10-year average. We just wrapped up our Wisconsin Engineering Experience events where we connect with admitted undergraduate students. It's always a pleasure to share the world of ECE with new students: from hands-on first-year and senior design classes in state-of-the-art industry-supported labs, to horizon-widening undergraduate research experiences, to student organizations such as Badgerloop which, as you will read, is creating UW-Madison's first solar car to compete in the Summer 2022 Formula Sun Grand Prix. What a great time to be a Badger!

The culminating event of spring is always commencement. While many may think of graduation as a good-bye, we give our graduates a warm welcome. Welcome to the group of more than 11,000 alumni, like you, who reflect brilliantly on ECE at Wisconsin through your technical leadership around the world. Join me in congratulating ECE alum and former CEO of Rockwell Automation, Keith Nosbusch (BSEE'74). Keith received an honorary doctoral degree from the UW-Madison this May for his contributions to industrial automation and his commitment to providing opportunities for traditionally underrepresented people to pursue education in STEM fields.

We are grateful for your continued support of our department through your involvement with our great university and through your generous gifts that further our endeavors here on campus. Please keep in touch, and if you find your way to campus, our ECE department "door" is always open.

On, Wisconsin!

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ENGINEERING FORWARD

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ECE: A national leader in teaching excellence and innovation

There are hundreds of excellent teachers at UW-Madison, but over the last decade, ECE has stood out from the crowd. Our instructors have been cited well over a dozen times for teaching excellence at both the college and university level and even internationally.

So what's the secret to teaching excellence in ECE? It's a combination of having instructors who are deeply committed to the student experience as well as a culture that encourages and supports instructors in innovating and improving their teaching techniques.

One way to keep students engaged is the use of a flipped classroom, which many ECE instructors employ. In the flipped classroom, students complete readings and listen to lectures before class, and then use in-class time for activities that help them understand and apply the concepts.

"The flipped format and active learning encourage a more inclusive classroom," says Assistant Professor Dimitris Papailiopoulos, who has received college, university and IEEE teaching awards in the last few years. "The instructor shifts from someone who's just talking at a podium to someone who is actively engaging in the learning process."

Another focus is keeping course content current and relevant to trends in the

fast-changing technology industry. That's something many instructors in ECE aspire to do. Assistant Professor Kassem Fawaz, who received the 2022 Emil H. Stieger Teaching Award from UW-Madison, for instance, overhauled ECE 454: *Mobile Computing Laboratory*, one of three capstone courses for computer engineering seniors, introducing new hardware and software for a series of mini-laboratory projects, with a commitment to evolve those labs as mobile computing changes.

Department and college support is another major aspect of teaching success in ECE. Papailiopoulos says that when he came to UW-Madison six years ago, he wasn't anything close to the teacher he is today. A campus series of seminars on teaching, the Madison Teaching and Learning Excellence program, as well as strong mentorship from senior ECE faculty, helped him rethink his approach to instruction.

The department's focus on serving the diverse goals of students also sets it apart. While some students will move into academia or research, many will join the quickly evolving technical workforce.

Instructors like Associate Teaching Professor Steven Fredette, the winner



Dimitris Papailiopoulos

of the 2022 college James G. Woodburn Award for Excellence in Undergraduate Teaching, who has taught at UW-Madison for 11 years after a career in industry, can speak to both sets of students.

"So you have these two paths. Someone like me with industry experience excels at meeting the needs of professional students, but undergraduates also enjoy the real-world perspective I bring to the class," says Fredette.

Perhaps the most important thing many ECE instructors bring to their teaching is a true passion for the material.

"We're not just here to pass on new knowledge, but also to shape individuals to become the engineers and academics of the future," says Papailiopoulos.

Over the past few years more than half of ECE assistant and associate professors have completed the two-semester Madison Teaching and Learning Excellence program as fellows, including Dominic Gross, Bhuvana Krishnaswamy, Kangwook Lee, Chu Ma, Dimitris Papailiopoulos, Line Roald, Joshua San Miguel, Eric Severson, Ramya Vinayak, Ying Wang and Zongfu Yu. Here's a list of our recent teaching awards over the past 15 years.

John Booske

- 2014 IEEE Major Educational Innovation Award
- 2018 College of Engineering Harvey Spangler Award for Innovative Teaching and Learning Practices
- 2019 Innovative Program Award ECE Department Heads Association

Kassem Fawaz

- 2021 College of Engineering Benjamin Smith Reynolds Award for Excellence in Teaching
- 2022 UW-Madison Emil Stieger Distinguished Teaching Award

Steven Fredette

- 2022 College of Engineering James G. Woodburn Award for Excellence in Undergraduate Teaching

Susan Hagness

- 2007 IEEE Mac Van Valkenberg Early Career Teaching Award
- 2009 UW System Alliant Energy Underkofler Excellence in Teaching Award
- 2014 College of Engineering Benjamin Smith Reynolds Award for Excellence in Teaching

Irena Knezevic

- 2011 College of Engineering James G. Woodburn Award for Excellence in Undergraduate Teaching
- 2020 UW-Madison Chancellor's Distinguished Teaching Award

Joe Krachey

- 2020 College of Engineering James G. Woodburn Award for Excellence in Undergraduate Teaching

Dimitris Papailiopoulos

- 2019 College of Engineering Benjamin Smith Reynolds Award for Excellence in Teaching
- 2021 UW-Madison Emil Stieger Distinguished Teaching Award
- 2021 IEEE Mac Van Valkenberg Early Career Teaching Award

Barry Van Veen

- 2014 College of Engineering Harvey Spangler Award for Innovative Teaching and Learning Practices
- 2015 UW-Madison Chancellor's Distinguished Teaching Award
- 2017 College of Engineering Benjamin Smith Reynolds Award for Excellence in Teaching

Giri Venkataramanan

- 2008 College of Engineering Benjamin Smith Reynolds Award for Excellence in Teaching
- 2022 College of Engineering Harvey Spangler Award for Innovative Teaching and Learning Practices

Chu Ma builds research lab where undergraduates thrive

Assistant Professor Chu Ma is a big advocate for getting undergraduates involved in research projects. That's why half of the eight students in her lab in Engineering Hall are undergraduates and key contributors to her research in acoustic sensing and functional materials.

While undergraduate engineering students get a full, state-of-the-art education at UW-Madison without signing up for shifts in a laboratory, the opportunity to participate in undergrad research is a big advantage for those hoping to pursue graduate education or a career in research and development.

"Undergraduate students have a role in every project in my lab, and I really appreciate their help," says Ma. "I hope the experience can help them learn more about how research works and how we approach a problem."

Ma knows firsthand the power of undergraduate research. She started working in research labs during her second year of undergraduate study; each year after, she joined a different research lab and contributed to many different projects. In one of those labs, she began working on electromagnetics

and antennas. "That work on waves, signal processing and communication was indeed the foundation for my current research on acoustics," says Ma.

Ma puts a lot of faith in the great work undergraduates can do. "A team of four undergraduate students helped me build an experimental system in my lab that we still use every day," she says. "Our ECE undergraduates are amazing and they have all of these interesting backgrounds."

Ma says she primarily recruits undergraduate researchers from a course she teaches, ECE 401: *Electro-Acoustical Engineering*. "I intentionally make the course related to my research projects. After taking the class, the students have learned about acoustics and imaging," she says.

Ma says that her research has many different facets, meaning that undergraduates can begin work on easier projects and progress to more and more difficult research problems.

Xiaohong Zhang began working as an undergraduate in Ma's lab in the fall semester of 2021. Currently he is helping on a project developing non-line-of-sight acoustic imaging, a sensing technology that can see around corners.



The experience so far has been very positive, and he says it will definitely help him when he applies to PhD programs. But beyond the resume boost, he says the research has really filled out his education. "I think there are a lot of things you cannot learn from the normal classroom. By doing a research project, you're going to learn a lot of detailed things you probably wouldn't be exposed to," he says.

Zhang says that at the beginning of his work in the lab, the graduate students and Ma took extra time to familiarize him with the equipment and show him how to do things like run computer simulations or understand theory. The result? He feels like a true, contributing member of the lab. "I've found that I really love doing research," he says. "It gives me a lot of sense of achievement, actually."



Chu Ma with the graduate and undergraduate members of her lab from left to right: Siddharth Subramani; Chu Ma; Leena Abdullah Fayyad; Jinaan Lin; Yizhou Wu; Dajun Zhang; Michael (Yaxuan) Wang; Xiaohong Zhang.

Dominic Gross earns NSF CAREER Award



Renewable energy is ramping up in a big way, with solar and wind power grabbing a larger and larger share of the electricity market

each year. That is great news for efforts to decarbonize the energy and transportation sectors, but it's not great news for the U.S. electricity grid, which isn't ready to integrate all those gigawatts of green energy just yet.

That's why Assistant Professor Dominic Gross is working behind the scenes to develop new frameworks and paradigms for control of renewables and grid-connected power electronics to help make the transition to green energy as seamless as possible.

Through a five-year, \$500,000 National Science Foundation CAREER Award, Gross will investigate a flexible universal

modeling, control and analysis framework for power electronics and renewable generation that will ensure and enhance grid stability as renewable energy increases its market share.

Currently, legacy power-generating sources like coal plants ensure the stability of today's power system through their feedback controls and inherent physical properties like rotational inertia. Most renewable energy sources, like rooftop solar, do not provide grid support and are a bit more erratic, injecting fluctuating power into the grid. At a certain point, too much of that power could destabilize the grid.

The solution is grid-forming power-electronic converters that autonomously regulate the grid frequency and voltage at the point where wind and solar power connect to the grid. Those converters are close to deployment, but they have one drawback—they are either on when the power is flowing, or off when it is not.

With his project, Gross is looking into the future and developing a new framework for the converters that will strengthen the grid. "The main problem is that the controls we have today can only do the two extremes. They don't support the entire spectrum of functions," says Gross. "In this new paradigm, if there is no sunshine or a little sunshine, at least your rooftop photovoltaic will still provide some grid services. And all of this will happen automatically."

In the future, energy will involve a mix of different kinds of power generation, energy storage and power transmission, like high-voltage DC transmission, wind power and photovoltaics, each with small differences in their controls. Gross hopes his control framework will be able to monitor the grid and smooth over those differences. "One of the hopes is that we can deploy the same control and all of these technologies will work together," he says.

ECE launches BS degree specialization in machine learning and data science



Matt Malloy

In fall 2021, ECE launched a machine learning and data science option for both undergraduate electrical engineering and computer engineering majors, skills many employers are looking for.

The option requires 18 elective credits in the 120-hour bachelor's degree consisting of courses focusing on machine learning and data science in engineering. Courses in the option cover coding for data manipulation, analysis, and visualization, and machine learning topics from applied linear algebra and probability through artificial neural networks and deep learning. When students graduate, the option is noted on their transcript, giving them a valuable credential in future employment searches.

"The creation of a new option for our BS electrical engineering and BS computer engineering degree programs was encouraged by our industrial advisory board members," says Susan Hagness, department chair and Philip Dunham Reed Professor. "They understand the importance of providing our students with formal recognition of concentrated coursework in machine learning, signal processing and other data science and engineering topics so highly valued in industry."

Assistant Teaching Professor Matt Malloy, who leads several of the courses in the option, says the demand for students with these skills is already huge. "The rigorous engineering coursework students do in ECE in addition to the data science coursework sets this option apart. It's not something that you would get from another part of the university."

So far, Malloy says the option is proving popular, with enrollment for its core courses doubling during its inaugural semester.



Younghyun Kim's \$1M NSF project may bring relief to America's Dairyland, and beyond



Recent heat waves have been tough on everything including people, shellfish, forests and crops. One casualty of the heat that doesn't

get much attention, however, is dairy cows.

Heat stress is a major threat to the bovines, which are particularly sensitive to hot weather because they have an average body temperature of 101.5 degrees. On hot days, farmers put the cows in the shade or barn, spritz them with water and blast them with fans, using a lot of water and electricity in the process. Even still, heat stress, which can reduce milk production and fertility, costs dairy farmers about \$1.5 billion per year in the U.S. and causes lots of animal suffering.

As climate change continues to lead to more (and more extreme) heat waves, the bovine climate control problem is only expected to get worse. That's why Assistant Professor Younghyun Kim and an interdisciplinary research team at UW-Madison are investigating cutting-edge technologies to keep Bessie and her sisters from suffering unnecessary heat stress.

Kim is the lead principal investigator on a new three-year, \$1-million project funded by the National Science Foundation and U.S. Department of Agriculture that will develop

cyber-physical systems to maintain optimal microclimates inside barns and mitigate the impact of heat stress on dairy cows.

"Advances in machine learning and the Internet of Things have made it possible to understand and manage not only the digital world but also living animals," Kim says. "We want to answer the question of how we can promote productivity, sustainability and animal welfare in dairy farms using technologies. Wisconsin is the best place to investigate this research question and make the biggest impact with the best experts as a team."

Researchers from across UW-Madison are collaborating on the project, including Christopher Choi, a professor of biological systems engineering; Jennifer Van Os, an assistant professor and extension specialist in animal and dairy sciences; and Sabrina Brounts, a clinical professor in the Department of Surgical Sciences in the UW-Madison School of Veterinary Medicine.

Most of the large-scale, freestall barns currently preferred by the dairy industry are not particularly high tech and do not rely on advanced sensing technology to tell when animals are stressed. The aim of the new project is to develop external sensors and sensors implanted in the cows that can continuously monitor their microenvironment and physiological stress using thermal-induced behavior analysis and computational fluid dynamics-based microclimate control.

The data will allow analysis of heat stress in real time, leading to automatic adjustments to barn cooling systems using a minimum amount of energy and water. The goal is to keep the cows cool, comfortable and productive; to improve the economics of the dairy business; and also increase sustainability and animal well-being.

"Animal health and well-being is an important factor for not only the dairy farmer in Wisconsin, but also dairy farming in other states and countries," says Brounts. "Therefore our sensing technology could potentially have a broad impact on animal health and farmers all over the world."

The team will spend the first part of the project developing the sensors and controllers before testing the system at UW-Madison's dairy barns, experimenting with different housing and ventilation systems. If it works with cows, the cyber-physical system may be applicable to poultry and pork production facilities as well.

The new system won't just be good for animals; it will also help farmers save money and provide new jobs in agriculture technology. "Because this proposed system would require builders with specialized knowledge based on the proposed research activities particularly in the areas of advanced IoT-based sensors and corresponding microclimate control, it should create opportunities for Wisconsin's builders specializing in dairy barn design, construction, and operation," says Choi.

Zongfu Yu develops advanced, high-speed angle sensor

Peering through a microscope reveals all sorts of information—the structure, composition and even atomic arrangement of a sample material.

But when researchers want to map and measure the topography—the overall form and features on the surface of a sample—they rely on large benchtop gadgets called white light interferometers, which measure features all the way down to tens of nanometers.

The problem, however, is that these interferometers take up to a minute to produce a single measurement. That's much too slow to record changes over time. A team led by Jack St. Clair Kilby Associate Professor Zongfu Yu has developed a new ultra-compact angle sensor built from flat optics that captures these measurements



says Yu, “but measuring the surface morphology quantitatively gives you a lot more information.”

The new design works by measuring the wavefront of light using a novel type of sensor developed by Yu's team. They modified an off-the-shelf 6.6 millimeter CMOS sensor—the type of flat sensor found in many cell phone cameras—which uses millions of pixels to produce an image. Using photolithography, they deposited

at 30 frames per second, allowing high-resolution video capability.

“You can get an impression of what a material is like from a microscope,”

an extremely thin layer of aluminum over the sensor, producing a grid of tiny square apertures, each made up of just four 5.2-micrometer pixels. Each 4-pixel square acts as an angle sensor, able to determine the incident angle of a wavefront. Combined, the millions of tiny angle sensors on the CMOS chip collectively operate as a wavefront sensor and can create high-resolution surface topography measurements.

The most significant advantage of this wavefront sensor over other technologies is its high resolution, which is two orders of magnitude larger than traditional angle-based sensors. This allows the device to collect images rapidly enough to produce high-resolution video of morphological changes in real time.



Badgerloop transitions to solar vehicle challenge

Badgerloop was formed in 2015 by a group of enterprising students, most from ECE and mechanical engineering, to build electric pods that could compete in SpaceX's hyperloop competition. After four events, however, SpaceX has put the hyperloop on the backburner.

But that hasn't stopped Badgerloop. In 2021-2022 the team has pivoted to building a solar car for the Formula Sun Grand Prix, in which teams race purely solar-powered cars on a closed track. The team with the most total laps around the course over three days wins.

Badgerloop's goal is to get a car ready to compete in the Grand Prix in July 2022 in Topeka, Kansas. Recently, the team recruited new members during college events and now has roughly 50 members with interests in electrical and mechanical engineering, computer science, as well as a suite of operations personnel in charge of marketing, sponsorships and managing the project.

This year's goal isn't necessarily to win the Grand Prix; just getting a car on the track will be a formidable challenge. It has

taken other university teams two to four years to field their first solar cars. But Badgerloop has an advantage: Many of the components of the hyperloop pod translate to the solar car.

In general, the full Badgerloop team meets once every two weeks while the sub teams, including mechanical, electrical and operations, meet weekly. Students also usually put in several hours per week working on building their subsystems, including things like batteries, solar arrays and suspension systems.

“The solar array team is really the only new electrical team this year,” says Lucas Maddox, an ECE junior who serves as Badgerloop's electrical director. “Fundamentally, what we were doing with the hyperloop pod was building an electric vehicle, and the solar car is an electric vehicle.”

While work is progressing well, the team still has one big decision to make: who gets to drive the car.

Faculty News



Professor **Azadeh Davoodi** is a winner of the 2022 UW-Madison Vilas Associates Competition, which recognizes outstanding new and ongoing research. Davoodi researches electronic design automation, machine learning for chip design and using neural networks on IOT devices.



Assistant Professor **Kassem Fawaz** is the recipient of the 2022 Emil H. Stieger Teaching Award, one of UW-Madison's highest

teaching honors. Undergraduate and graduate students cite Fawaz for his student-centric teaching and his ability to present complex topics in a way non-experts can understand.



Philip Dunham Reed Professor and ECE Chair **Susan Hagness** was elected to the 2021 class of fellows of the American Association

for the Advancement of Science for her distinguished contributions to computational and experimental applied electromagnetics, with an emphasis on bioelectromagnetics and the development of diagnostic and therapeutic technologies for biomedical applications. She was also elected to the 2022 class of fellows by the American Institute for Medical and Biological Engineering.



Professor Emeritus **Thomas Jahns** received the 2022 IEEE Medal in Power Engineering, one of the organization's prestigious technical field

awards. Jahns was cited for contributions to the development of high-efficiency permanent magnet machines and drives.



Associate Professor **Umit Ogras** received a 2021 outstanding researcher award from the technology company Intel. The award recognizes exceptional

contributions made through university research in areas including field-programmable gate arrays, artificial intelligence and other technologies. Ogras, along with ECE graduate student Sumit Mandel, also received the 2021 best paper award from the Association for Computing Machinery's journal *Transactions on Design Automation of Electronic Systems*.



Assistant Professor **Line Roald** and ECE graduate student **Noah Rhodes**

received the best paper award in the energy track at the Hawaii International Conference on System Sciences held in January 2022.



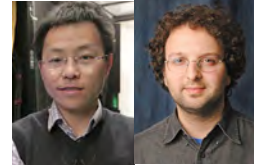
In March 2022, Duane H. and Dorothy M. Bluemke Professor and Vilas Distinguished Achievement Professor **John Booske** was elected a fellow of the

Institute of Physics, the highest grade of membership for the prestigious professional organization.



The National Academy of Inventors selected Jean van Bladel Associate Professor **Bulent Sarlioglu** for its 2021 class of fellows. An NAI fellowship is considered the

highest professional distinction given solely to academic inventors. Sarlioglu has been awarded 20 U.S. patents and 12 international patents with four additional patents currently in preparation. Sarlioglu was also elected a 2022 IEEE fellow for his applications of electrical drives in the aerospace industry.



Jack St. Clair Kilby Associate Professors **Zongfu Yu** and **Mikhail Kats** were both included on

the Web of Science Highly Cited Researchers list for 2021, which honors researchers ranked in the top 1% of cited papers over the last decade.



Patricia and Michael Splinter Professor **Irena Knezevic** is the 2022 recipient of a Vilas

Distinguished Achievement Professorship and Jean van Bladel Associate Professor **Dan Ludois** is the 2022 recipient of a Vilas Early Career Award—both from the UW-Madison.



Projects led by Assistant Professor **Chu Ma** and Jack St. Clair Kilby Associate Professor **Mikhail Kats** were selected as finalists for the 2021 Wisconsin Alumni

Research Foundation Innovation Awards, which recognize some of the most promising technologies developed by researchers at UW-Madison.



The College of Engineering awarded Associate Teaching Professor **Steven Fredette** the 2022 James G. Woodburn

Award for Excellence in Undergraduate Teaching and Professor **Giri Venkataraman** the 2022 Harvey Spangler Award for Innovative Teaching and Learning Practices.



Professor **Daniel van der Weide** was selected as a 2022 IEEE fellow for contributions to ultrafast terahertz electronics and biomedical applications of microwave technologies.

Student News



PhD student **Audrey Evans** was selected to receive an IEEE Antennas and Propagation Society doctoral research grant. The \$2,500 grants are given to up to 10 PhD students each year and are intended to encourage students to pursue a career in the area of electromagnetics.



Rafael Castillo Sierra, a PhD student working with WEMPEC, is the winner of the 2021 EMTP Research Contribution Prize Program in the model category. The \$1,000 prize recognizes Castillo's model which uses a new type of frequency converter to enable low-frequency AC transmission over longer distances.



Recent accelerated master's degree graduate **Matt Henningsen** (BSECE '20) was named a National Football Foundation National Scholar-Athlete and was a finalist for the 2021 William V. Campbell Trophy, often referred to as the "Academic Heisman." The honors recognize the best football players in the nation for combined academic success, on-field performance and exemplary leadership. Henningsen was a defensive end for the Badgers football team through his time at UW-Madison, earning numerous awards for academics and on-field performance.



Undergraduate **Thomas Nguyen** is the recipient of a prestigious National Science Foundation Graduate Research Fellowship, which supports outstanding graduate students in STEM disciplines. He is also the winner of a 2021-2022 IEEE Power & Energy Society (PES) scholarship. The IEEE PES scholarship recognizes students with a high GPA who take a certain number of power engineering courses. This is the third year in a row that Nguyen has received the scholarship.



Quantum Lift

Soon after starting as an ECE PhD student at UW-Madison, Samuel Belling decided to take up some exercise to help deal with stress and get in shape. "I don't like cardio and I don't really enjoy bodybuilding. But I was really drawn to pushing myself and seeing how much weight I could lift."

That led him to powerlifting, a sport in which lifters compete in three disciplines, the squat, the benchpress and the deadlift. Whoever lifts the heaviest loads over the course of three tries in each event wins.

Now, five years later, Belling is one of the top powerlifters in the state, recently benching 458 pounds, a new Wisconsin record.

In between lifts he studies quantum transport theory and simulation in the lab of Patricia and Michael Splinter Professor Irena Knezevic. In particular he researches the transport of excitons in carbon nanotubes and is developing new computational electromagnetics tools that are useful in transport simulations.

Alumni News



Advanced Micro Devices Inc., best known for producing high-end computer processors, has announced the appointment of senior

fellow and server system on chip architect **Kevin Lepak** (BSECE '99, MSECE '00, PhDECE '03) to AMD corporate fellow, in recognition of his critical role in the design of AMD's next-generation processors. Corporate Fellow is one of the company's highest honors, currently held by only eight engineers at the company.

As AMD corporate fellow, Lepak will expand on his leadership in chip design to play a larger role in evolving AMD's processor and systems vision.

"Kevin's technical contributions made undeniable positive impact on AMD over many years," says Mark Papermaster, chief technology officer and executive vice president of technology and engineering at AMD.

Lepak, originally from Stevens Point, Wisconsin, has spent 16 years at AMD, most recently in Austin, Texas, where he is a leading technologist with deep subject matter expertise in system-on-chip design, memory and I/O performance, and CPU architectures.

In Memorium



Richard Marleau, a longtime ECE professor, passed away in August 2021 at the age of 85. Marleau earned his bachelor's and master's degrees at the University of Toledo before beginning his PhD studies at UW-Madison in 1960, where he remained for the rest of his career.

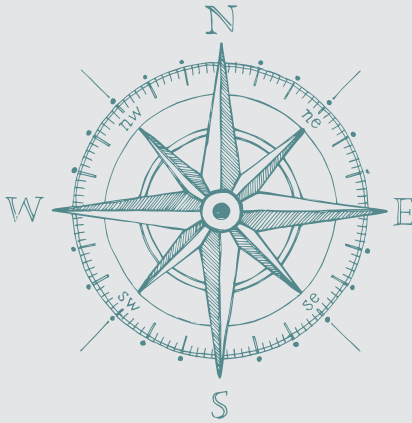
His research focused on non-linear control systems and later he investigated the application of computers in control and instrumentation systems.

Marleau was particularly interested in engineering education. He served as a consultant, helping to develop academic engineering programs worldwide as part of projects supported by the World Bank, Asian Development Bank, the United Nations and the United States Agency for International Development. The work took

him and his wife Sandra around the world, including visits to Indonesia, Singapore, China, Pakistan and other countries. For this effort, the UW-Madison College of Engineering recognized Marleau with its 1994 Ragnar E. Onstad Service to Society Award, which honors faculty and researchers who inspire or demonstrate the use of innovation and engineering principles to benefit humanity.

Marleau served as a research advisor to many graduate students and visiting scholars from China. His teaching honors include a Ford Foundation grant, teaching awards from Standard Oil and Westinghouse as well as the IEEE Student Branch award, recognizing his patience, understanding and thoughtful guidance of his students. He retired from UW-Madison in 2000, after 40 years of service.

ECE alum championing 'ethics in engineering' education



Some of the most heated discussions about technology don't have anything to do with operating systems or RPMs.

Rather, as new technologies change almost every facet of modern life, the big questions center around ethics, addressing topics that include privacy, the social responsibility of media platforms, the role of algorithms in perpetuating bias, and the sustainability of the energy we use or the products we buy.

One of the biggest considerations is the role of engineers in thinking about the downstream effects of their work. That's one reason the College of Engineering charges its students, staff and faculty with keeping ethics at the center of their research and activities. The college aims to make sure students understand and follow ethical guidelines, and have the tools to assess and make ethical choices as they head into the workforce.

The college integrates ethics education into undergraduate education as a matter of course; ethics education is a requirement for college certification and is something the college takes seriously. "Ethics is inherent to our profession," says Ian Robertson, Grainger Dean of the College of Engineering, who considers ethics education one of the college's top priorities. "It's incumbent upon us to actually teach students about what it means to be an ethical engineer and how to put ethics in engineering into practice."

When it comes to research, the college also emphasizes ethical practices, like giving appropriate credit when it is due,

dealing with power dynamics in research groups, and thinking about the broader impacts of research, like its effects on privacy or bias.

The college is advancing its commitment to leadership in ethics as well. The new National Academy of Engineering Grand Challenges Scholars Program, recently adopted by the college, asks undergraduates to achieve competency in five areas, including multicultural understanding and social consciousness. Students undertake practical projects to help them develop and apply these competencies during their engineering education and in their future endeavors.

ECE alumnus David Epstein (BS '76, MS '78), is also helping the College of Engineering to refine its focus on ethics.

He says that when he first began guest lecturing at business schools and reflecting on his experiences in industry about 20 years ago, he realized he had encountered many ethical gray areas and ethical breaches without recognizing them at the time. When the VW emissions scandal—in which regulators discovered the car company had rigged its vehicles to hide their true emissions—began in 2015, Epstein realized that engineers involved in that scandal should have felt empowered to push back.

"In the face of something like that, an engineer should be thinking at a higher level," he says. "Engineers are always taught to solve problems and are given constraints. I want engineers to think about every constraint—not just a temperature range or how much power you have to use, but social, ethical and environmental considerations as well."

To that end, Epstein and his wife Sarah have funded a fellowship in ethics to support engineering graduate students to develop teaching modules about engineering ethics. They have also funded the Ethics in Engineering Distinguished Seminar in the College of Engineering. In 2021, the seminar hosted Tyler Shultz, who worked as an engineer at the biomedical firm Theranos, which promised to create a small machine that could perform hundreds of medical tests in just minutes. When Shultz began to voice doubts about the

machine and detected instances of outright fraud, he was fired and attacked by his former employer.

Despite mounting personal and professional hardships due to his whistleblowing, Shultz persisted, dragging the Theranos fraud into the light. (Company founder Elizabeth Holmes was recently convicted of fraud.)

Epstein says he hopes UW-Madison engineers would have the same grit in calling out an ethical breach. "I want engineers to leave Wisconsin not only with a sense of doing good, being socially aware and environmentally conscious," he says, "but also, as they create solutions, to believe that's a part of who they are."

Robertson agrees, and hopes to increase ethics awareness at all levels. "What these initiatives are doing is elevating the discussions about engineering ethics across the entire spectrum of undergraduates, graduates, faculty and staff," he says. "We want to get even better at ethics education; it's a continual evolution."



David Epstein (BSECE '76, MSECE '78) received a 2021 College of Engineering Distinguished Achievement Award. He has

spent a career in technology as an exemplary entrepreneur and executive in cleantech, semiconductors and healthcare who has demonstrated an unwavering commitment to social responsibility and ethics in engineering and business.

He is currently the executive director of the Susilo Institute for Ethics in a Global Economy at Boston University and a venture advisor, investor and management consultant at Epstein Advisors.

Keith Nosbusch receives honorary degree

ECE alumnus Keith Nosbusch (BSEE '74) received an honorary doctorate of science degree at spring commencement in May 2022 at UW-Madison. Nosbusch is one of only three individuals selected for the honor this year.

"Honorary degrees from UW-Madison recognize individuals who have shown outstanding service to humanity, often on a global scale," says Chancellor Rebecca Blank. "I cannot think of three more worthy individuals. They have used their talent, creativity and generosity to greatly enhance our lives, vividly embodying the Wisconsin Idea."

After graduation, Nosbusch, a Milwaukee native, began his career at the Allen-Bradley Company, later to become Rockwell Automation. He simultaneously pursued a master's degree, earning an MBA from UW-Milwaukee in 1978.

During his 42-year career at Rockwell Automation, Nosbusch held many leadership positions, serving as chairman of the board and CEO of the company between 2004 and 2016.

Under his leadership, Rockwell became the dominant industrial automation company in North America, with business in more than 80 countries. His vision for "The Connected Enterprise" helped spur the smart manufacturing revolution. The approach, consisting of an integrated



control and information architecture, enables the customer's plant floor to be securely and seamlessly connected throughout the enterprise and across facilities located anywhere in the world.

In 2016, Nosbusch was recognized by *Smart Manufacturing* magazine as one of "30 visionaries" who have had the foresight to develop and adopt cutting-edge digital technologies and drive manufacturing into a new era of competitiveness.

Throughout his career, Nosbusch also worked to create an organizational culture

where every employee could perform their best work. In 2017, Catalyst, a nonprofit that promotes inclusivity for women and other people underrepresented in the workplace, honored Rockwell Automation with its prestigious Catalyst Award.

Ethisphere Institute recognized Rockwell Automation as one of the "World's Most Ethical Companies" eight times during Nosbusch's tenure as CEO. He is widely known for his focused philanthropic strategy and advocacy of science, technology, engineering and mathematics (STEM) education. "Keith is an exemplary alumnus, epitomizing both the spirit of innovation and a focus on the greater good that are hallmarks of a UW-Madison education," says Susan Hagness, Philip Dunham Reed professor and chair of the ECE department, which nominated Nosbusch. "With his future-focused mindset and dedication to human values and education, Keith not only improved his company, but is improving the world and the lives of students in Wisconsin and beyond."

Nosbusch's commitment to providing pathways to, and broadening participation in, a STEM education extends to his alma mater. He championed the full-tuition Rockwell Automation Corporate Scholarships at UW-Madison.



Richard G. Baraniuk (MSECE '88) was elected a fellow of the National Academy of Engineering in 2022. He was chosen for the development and broad dissemination of open educational resources and for foundational contributions to compressive sensing.

Baraniuk's research interests lie in new theory, algorithm, and hardware for sensing, signal processing and machine learning. He holds 30 U.S. and six foreign patents, several of which have been licensed to Siemens to radically speed up magnetic resonance imaging (MRI) scans. He is also one of the founders of the open education (OER) movement that aims to unlock education opportunities for all. Baraniuk is a fellow of the American Academy of Arts and Sciences, National Academy of Inventors, American Association for the Advancement of Science and IEEE.

Currently, Baraniuk is the C. Sidney Burrus Professor of Electrical and Computer Engineering at Rice University and the founding director of OpenStax.



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Summer launch gives first-year ECE students a headstart



In winter 2022 a group of first-year ECE students who participated in the Summer Launch program met up in Engineering Hall for a reunion. Except, for most them, it wasn't a reunion at all—many had made lasting friendships during the program which had carried on for their first semesters at UW-Madison.

ECE Summer Launch is a program designed to give admitted College of Engineering students a little headstart on their undergraduate career. The four-week program takes place in July and August and includes enrollment in ECE 210: *Introductory Experience in Electrical Engineering*. The course includes an

introduction to electrical devices and components, circuits and systems and is capped off with a real-world project.

Even more important, the program allows students to start college with confidence, make friends and get their bearings on campus before the start of the fall semester.

Students in the last session, who all stayed in the DeJope Residence Hall, were taught by Professor Giri Venkataramanan. For their final project, they shadowed and helped participants in the Solympics, a hackathon event in the college makerspace in which teams developed innovative solutions for charging devices like phones.

Students in the course were also some of the first to use the new state-of-the-art, hands-on James H. Thompson Electronics Design Studio in Engineering Hall. The lab, generously funded by alumnus Jim Thompson (BSEE '85, MSEE '87, PhD EE '91), chief technical officer of the tech company Qualcomm, is a bright, adaptable space with state-of-the-art design stations and a layout that encourages student collaboration.

But the friends who gathered at the winter Summer Launch reunion say the program was a great way to ease into the academics at UW-Madison. It was equally successful in orienting them to life on campus. "We had time to figure out things like where to eat and where to take walks," says Jordan Scott. "We learned a lot and made a lot of friends. And I'm glad they're still my friends."