College of Engineering
UNIVERSITY OF WISCONSIN–MADISON

FALL 2024 NEWSLETTER

DEPARTMENT OF

# ELECTRICAL AND COMPUTER ENGINEERING

**At 31%, UW-Madison leads all Big Ten Academic Alliance ECE departments in tenure-track and tenured women faculty.**

**Greetings from Engineering Hall!**
With the fall semester of my 7th year as chair of the Department of Electrical and Computer Engineering now well underway, I am reflecting on how much our department has changed over the past six years. We are all tremendously proud of the progress that our ECE department has made in advancing bold research, expanding educational excellence, and cultivating an inclusive and welcoming academic community.

Our development of a five-year (2020-2025) strategic plan laid the foundation for key initiatives, including strategic faculty hiring focused on next-generation electronics and optoelectronics, quantum technologies, autonomous systems, and sustainable electrical energy systems. Faculty recruitment has been a central focus, and I'm excited to report that 25 new tenure-track/tenured faculty members and three new teaching professors have joined us since July 2018, with two more tenure-track assistant professors set to start in January 2025. Since 2018, our total number of tenure-track/tenured faculty has grown by 16%. Additionally, this year we have recruitment efforts underway for four new open-rank faculty positions in ECE through the chancellor's RISE-AI and RISE-EARTH initiatives.

The increase in our faculty size is matched by significant career development and national recognition. Over the past six years:

- Thirteen of our current faculty members have received National Science Foundation CAREER Awards.
- Nine assistant professors have been promoted to associate professor with tenure, and six associate professors have advanced to full professor.
- Fifteen have been recognized as fellows of IEEE, the American Association for the Advancement of Science (AAAS), and other professional societies.

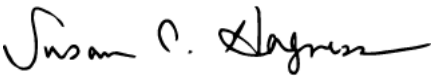
I'm also delighted to welcome a new National Academy of Engineering member to our ECE community, Dorota Grejner-Brzezinska, who now serves as our campus vice chancellor for research. ECE research expenditures have grown by 22% over the past four years, outpacing our faculty growth. Department of Defense research funding has increased by 32% over this period.

We've responded to increased interest in ECE by growing our enrollment and expanding our undergraduate program offerings to best prepare students for our evolving field. Examples include the launch of a new BS named option in machine learning and data science and a new undergraduate certificate in engineering data analytics. Our undergraduate population has now surpassed 1,000 students each year since fall 2022, a major milestone for the department.

Enrollment in our accelerated MS programs has increased from just three students in 2018 to 124 this fall.

We continue to see tangible results of our commitment to cultivating an inclusive environment for all. Notably, we have *doubled* the number of women faculty in ECE since 2018. As of September 2024, we have 16 tenure-track or tenured women faculty. That's 31% of our total, up from 18% in 2018. The percentage of women in our PhD program reached 27% last year, a significant increase from 19% in 2018. Vibrant student organizations such as Women in ECE and the ECE Graduate Student Association offer community-building events supported by our department. Access to our exceptional academic programs has expanded through donor-supported undergraduate scholarships that have increased by 75% since 2018 to more than $500,000 awarded in 2024.

Together, as we celebrate these past six years of growth and accomplishments, we strive for even greater success in the years to come. Thank you for staying connected with ECE and for your continued support of our students, faculty and staff.



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*ECE at UW-Madison: Committed to ethics and diversity in engineering*

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*On the cover:* ECE tenure-track/tenured faculty. 1st row: Jennifer Choy, Azadeh Davoodi, Dorota Grejner-Brzezinska. 2nd row: Susan Hagness, Mahima Gupta, Bhuvana Krishnaswamy, Irena Knezevic. 3rd row: Chu Ma, Shubhra Pasayat, Line Roald. 4th row: Jinia Roy, Haihan Sun, Ramya Korlakai Vinayak. 5th row: Ying Wang, Amy Wendt, Lei Zhou.

FOCUS ON NEW FACULTY

# Mahima Gupta is designing power converters for the electric revolution

Power converters are an essential component of many electrical systems, from a smartphone or electric car to the electric grid. These devices flip current from AC to DC or DC to AC, modulate electric frequency, stabilize voltages, and generally make sure electricity is in a form usable by our electronics.

One of the problems is that the capacitors in the analog versions of these essential components are quite bulky, sometimes taking up 40% to 50% of the converter volume. That's why Thomas A. Lipo Assistant Professor Mahima Gupta, who joined ECE in June 2024, is designing new types of small, high-density, semiconductor-based power converters to more efficiently power the next generation of electric devices. Ranging from just a few kilowatts to many megawatts, the new converters could accelerate integration of solar and wind farms, microgrids, electric cars and other electrified transportation systems.

"My work is mostly theoretical, devising new converter circuits and using advanced modeling approaches, asking what can be done to make power converters really, really small and efficient," she says. "I also work in integration of power semiconductor devices into circuits and look at the modulation and control for new circuit topologies. I've also been doing research in overcoming the challenges of wide bandgap devices due to high electromagnetic noise at the noise source which is the device itself."

During her sophomore year as an undergraduate at the Birla Institute of Technology and Science-Pilani in India, Gupta signed on for a three-month internship at a nuclear power plant. There, she explored the plant's incredibly complex electrical system, with layers of backups, generators and transformers. "Seeing the vastness and the scale of the systems was quite motivating," she says.

She dedicated the rest of her undergraduate career to power systems, electrical machines and power electronics. That interest led her to UW-Madison and the Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC) research group for her graduate work. At UW-Madison, Gupta began her research into power converters.

After earning her PhD, she spent a year at Ford Motor Company, working on electric vehicles as part of the research and advanced engineering group, designing electrified powertrain systems. She then worked at Portland State University as a tenure-track assistant professor before being recruited back to UW-Madison to join the ECE faculty.

UW-Madison, Gupta says, is an ideal place to pursue her research. As the world electrifies, there's a need for power converters that can operate at the gigawatt level. "With the development of clean-energy solutions and the integration of renewable energy applications, there are lots of interesting design challenges coming up for the power electronics community," she says. "What I'm hoping to do at UW-Madison is to look more holistically at addressing the challenges of power electronics, from materials and devices to packaging, thermals, layout circuits, control systems, computing and systems. More like a full-stack approach."

Madison, she says, has the facilities, resources and researchers to support this type of full-stack research. "Obviously, not one person can do this all. Collaboration is the key to what I'm envisioning, and there is an excellent group of researchers at UW-Madison," she says. "I'm very excited and look forward to the next steps in collaborative research."

NSF CAREER AWARD RECIPIENT

# Through his CAREER award, Kangwook Lee is looking for ways to make AI more adaptable

The reason generative artificial intelligence models like ChatGPT or Gemini can fix computer code in just seconds, compose a sonnet in the style of Shakespeare, or explain the physics of a black hole is that the set of data that trained those models was the entire internet. Gulping down and processing that much information, however, is incredibly expensive and time consuming.

That's why Dugald C. Jackson Assistant Professor Kangwook Lee is using a National Science Foundation CAREER Award to develop theory and tools for model adaptation, or tuning these massive pre-trained models to work efficiently on specific tasks. The goal is to create more targeted (and therefore, more useful) AI tools. Lee is one of four ECE faculty to receive an NSF CAREER award in 2024.

In the recent past, machine learning researchers could develop training models from scratch. But as the field advanced, it became more costly to create these models. Machine learning engineers instead began adapting pre-trained models for new applications through a set of model adaptation techniques. However, many of those techniques don't work well with the latest machine learning platforms, including large language models like ChatGPT.

"There are new model adaptation methods being developed almost every week," says Lee. "But we don't have any clear framework that describes them and we don't have a clear theoretical understanding of what's going on with these new methods. So the motivation of this project is to develop a new understanding of these emerging techniques to adapt or transfer knowledge from the pre-trained models to downstream tasks."

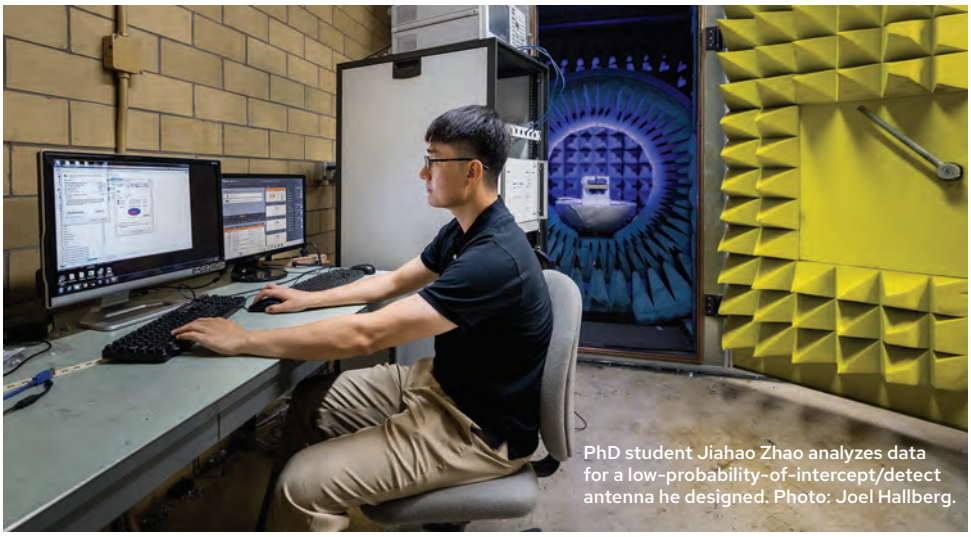
In earlier iterations of model adaptation, Lee says that researchers would take a model that has millions or billions of "tuning knobs" and adjust them little by little to optimize the model for a certain task. But the new machine learning models are so huge that adjusting all those "knobs" is prohibitive.

Instead, the new model adaptation techniques leave the majority of tuning knobs fixed, while adjusting just a small set of knobs. Some newer model adaptation methods don't adjust any tuning knobs. They simply apply a wrapper to the model—in other words, a custom interface geared toward one application.

As part of the outreach portion of his project, Lee and his students are developing a tool that enables people to create their own specialized AI models—no coding or training needed. There are already well-developed AI modules for applications like speech recognition or writing that can be stacked like Lego blocks. "These methods don't require any traditional background in machine learning or data science," says Lee. "All you need is good creativity to come up with new ways of connecting existing AI models."

Assistant Professor Kangwook Lee lecturing in the new *Ethics of Data for Engineers* class. Photo: Jason Daley.

## New antenna design thwarts attempts to sidetrack or steal sensitive information



PhD student Jiahao Zhao analyzes data for a low-probability-of-intercept/detect antenna he designed. Photo: Joel Hallberg.

By blocking "backdoor" access, an antenna developed by McFarland-Bascom Professor Nader Behdad, Keith and Jane Morgan Nosbusch Professor Emeritus John Booske, and PhD student Jiahao Zhao may enable both military personnel and ordinary citizens to keep their communications more private and secure.

Called a "low-probability-of-intercept/detect antenna," the device marries advances in software and hardware and is easy to swap with existing antennas.

The tiny antennas at the heart of cell phones, WiFi base stations, satellites and radar systems are becoming increasingly important. But they have fundamental vulnerabilities. Because their electromagnetic signals radiate in many different directions, these "side lobes" are subject to eavesdropping or jamming and, by following a signal backwards, can pinpoint a transmitter's location. "Someone who wants to eavesdrop can point a very sensitive receiver at an antenna and pick up those little bits and pieces that radiate in other directions," explains Behdad.

The new antenna can reduce all these vulnerabilities: It uses a bank of physical switches, guided by a sophisticated algorithm, to scramble and reduce side lobe signals to nearly undetectable levels. As switches turn on and off hundreds of millions of times per second, they scramble the side lobe signals and send them off in random directions while maintaining the integrity of the main signal.

Under the supervision of Behdad and Booske, Zhao designed and fabricated one of these antennas and showed the technique works very well on a small-scale prototype and for narrowband signals. Now, the team hopes to continue to develop the technology for use with wideband signals and larger antenna arrays, as well as for more specific applications.

Behdad says these antennas are compatible with legacy communications systems, making them commercially attractive. "You can drop these in and upgrade systems that are 20 or 30 years old with our antenna, which brings communications security and jamming resilience capabilities while leaving everything else unchanged."

## Researchers join nuclear security consortium

Two ECE faculty are part of the Consortium for Enabling Technologies and Innovation (ETI) 2.0 which supports the basic science that underlies the U.S. Department of Energy National Nuclear Security Administration's nuclear security and nonproliferation missions.

Dugald C. Jackson Assistant Professor Jennifer Choy will contribute her expertise in quantum sensing technology to support nuclear nonproliferation missions. Associate Professor Andreas Velten will research quantum measurements for novel radiation detection systems.

The consortium, which includes researchers from 12 universities and 12 national laboratories, is led by Georgia Tech and funded by a $25 million award from NNSA.

The technical mission of the ETI 2.0 team is to advance technologies across three core disciplines: data science and digital technologies in nuclear security and nonproliferation, precision environmental analysis for enhanced nuclear nonproliferation vigilance and emergency response, and emerging technologies. They will be advanced by research projects in novel radiation detectors, algorithms, testbeds, and digital twins.

# Popular social media mobile apps extract data from photos on your phone, introducing both bias and errors

Grainger Institute for Engineering Associate Professor Kassem Fawaz and PhD students Shimaa Ahmed and Jack West have found that both TikTok and Instagram extract different levels of personal and demographic data from user images, but can misclassify aspects of the images.

The researchers studied the social media platforms' mobile apps to understand what types of information their machine learning vision models collect about users from their photographs—and importantly, whether the models accurately recognize demographic differences and age.

PhD student Jack West (left) and Associate Professor Kassem Fawaz (right) demonstrate Instagram's vision model in video feeds of their co-authors, Lea Thiemt (top of the screen) and Shimaa Ahmed (bottom). Photo: Joel Hallberg.

West created a custom operating system to track information put into the vision model and to collect the model's output. (The team did not try to extract or reverse-engineer the vision model itself, which would violate the apps' terms of service.)

They found that on TikTok, when users choose a photo from their phone's camera app, the vision model automatically predicted the age and gender of the person or people in that image. Using that understanding, they ran a model data set of more than 40,000 faces through the TikTok vision model and found that the model made more mistakes classifying people under 18 than over 18. For people ages 0 to 2, the model often classified them as being between 12 and 18 years old.

When they did a similar analysis of Instagram, the researchers found that its vision model categorized more than 500 different "concepts," including age and gender, time of day, background images, and even what foods people were eating in the photographs.

To test the Instagram vision model, the researchers showed it a set of AI-generated images of people from four ethnicities, then looked to see if Instagram could correctly determine the 11 face-related characteristics. While Instagram was much better at classifying images by age than TikTok, it had its own set of issues. "It didn't perform as well across all demographics, and seemed biased against one group," says Ahmed.

So what, exactly, are the apps doing with this information? It's not totally clear. "The moment you select a photo on Instagram, regardless of whether you discard it, the app analyzes the photo and grows a local cache of information," says West. "The data is stored locally, on your device—and we have no evidence it was accessed or sent. But it's there."

## Roald part of a major effort to remove carbon from computing

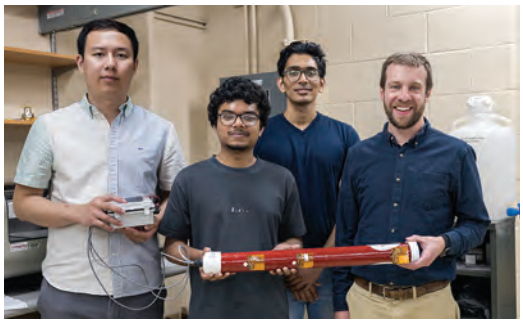
Associate Professor Line Roald is part of a five-year, $12 million National Science Foundation-funded project to develop a new branch of computer science called computational decarbonization. The goal of the project is to apply data-driven approaches to automate decarbonization across the electrical grid, the built environment, transportation and even computing itself.

The multi-institution project is called Computational Decarbonization of Societal Infrastructures at Mesoscales (CoDec) and is led by the University of Massachusetts, Amherst.

CoDec aims to use computer science tools to automate, coordinate and maximize carbon efficiency based on time and location for four domains of infrastructure: computing, electricity, buildings and transportation. The project will then create software interfaces to optimize most carbon-intensive activities with the greenest energy possible.

In her research, Roald is tackling one of the more complicated pieces of infrastructure. "My specific role is as an expert on the decarbonization of the electric power grid, which is both an infrastructure that provides energy and clean energy for computing and an infrastructure that needs computational methods to become more efficient and cleaner," she says.

# Printed sensors in soil could help farmers improve crop yields and save money



ECE PhD students Kuan-Yu Chen, Sharar Muhtasim, Jeneel Kachhadiya and Assistant Professor Joseph Andrews.

A team led by Joseph Andrews, an assistant professor in ECE and mechanical engineering, developed low-cost sensors that allow for real-time, continuous monitoring of nitrate in soil types that are common in Wisconsin. These printed electrochemical sensors could enable farmers to make better informed nutrient management decisions and reap economic benefits.

"Our sensors could give farmers a greater understanding of the nutrient profile of their soil and how much nitrate is available for the plants, helping them to make more precise decisions on how much fertilizer they really need," says Andrews. "If they can buy less fertilizer, the cost savings could be quite significant at large-acreage farms."

Current methods for monitoring nitrate in the soil are laborious, expensive and don't provide real-time data. That's why Andrews, an expert in printed electronics, and his team set out to create a better and less costly solution.

For this project, the researchers used an inkjet printing process to fabricate potentiometric sensors, a type of thin-film electrochemical sensor commonly used to accurately measure nitrate in liquid solutions. However, these sensors aren't suitable for use in soil environments, where coarse soil particles will scratch them and interfere with obtaining accurate measurements.

"The main challenge we were trying to solve is figuring out a way to enable these electrochemical sensors to work well in the harsh environment of soil and accurately sense nitrate ions," Andrews says.

The team's solution was to place a polyvinylidene fluoride layer over the sensor. The team has tested its sensors in two different soil types that are relevant for Wisconsin—sandy soil, which is common in the north-central part of the state, and silt loam soil, which is common in southwest Wisconsin—and found that the sensors produced accurate results.

The researchers are now incorporating their nitrate sensors into a multifunctional sensing system they call a "sensing sticker," in which three different kinds of sensors, including moisture and temperature sensors, are mounted on a flexible plastic substrate with an adhesive on the back.

Bernie Lesieutre

# New tools may help electrical grid operators mitigate major blackouts

A new suite of software tools will allow the nation's electrical grid managers to detect and track instabilities in real time.

Developed by Professor Bernie Lesieutre in collaboration with Washington State University and Electric Power Group, and funded by the U.S. Advanced Research Projects Agency-Energy, these tools can help prevent common disruptions—down wires from storms, or a short in a piece of grid infrastructure, for example—from becoming major catastrophes.

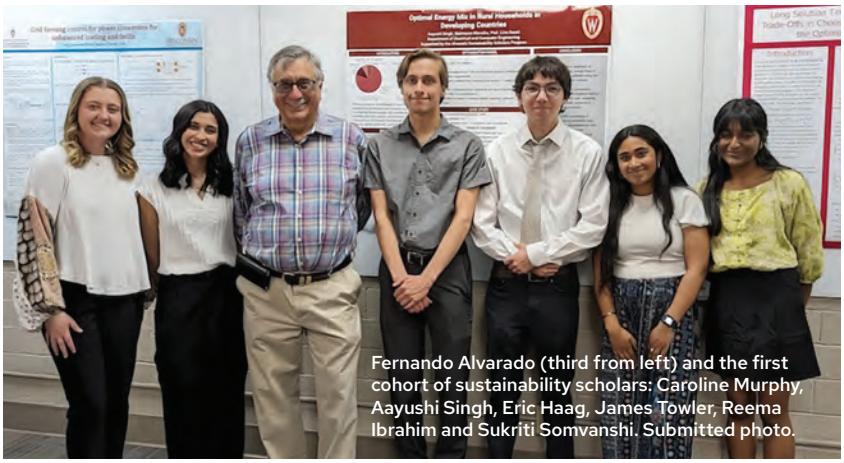
When something goes wrong on the electric grid, the disruption reverberates across the system. This "vibration" jolts the system's normal operating frequency out of whack. Most of the time these vibrations self-correct; occasionally the oscillation amplifies and leads to catastrophic system failures. Grid operators need to detect and monitor these oscillations before they get out of hand.

"When something happens, the grid rings like a bell," says Lesieutre "The risk is, an event could happen where the system vibrates, but it gets bigger and bigger. That doesn't happen too frequently. But it's devastating when it does."

The danger is not theoretical. Major blackouts in 1996 in the western United States and a massive 2003 blackout in the Northeast and Midwest were both caused by persistent oscillations that weren't recognized until it was too late.

Most grid operators can't see these persistent oscillations in real time; they only know these disruptions have occurred by comparing data across various local points on the grid. Lesieutre's software takes advantage of new GPS devices called synchrophasors recently added to many parts of the grid. These devices allow operators to measure voltages, currents, frequency and power. The software aligns the synchrophasors' data from across the grid in real time, provides operators a snapshot of what's happening, and allows them to detect persistent oscillations as they develop and to take action, if needed.

He and his colleagues also developed a second piece of software that can detect "forced oscillations." Caused by a malfunctioning or miscalibrated piece of equipment, these smaller, localized persistent oscillations can lead to later disruptions in the grid. Because the software can provide data at 30 frames per second, it can pinpoint the location of the problem equipment and the persistence of oscillations, which allows grid operators to find and fix or remove the problem.



Fernando Alvarado (third from left) and the first cohort of sustainability scholars: Caroline Murphy, Aayushi Singh, Eric Haag, James Towler, Reema Ibrahim and Sukriti Somvanshi. Submitted photo.

## Sustainability scholars program is a win-win for graduate and undergraduate engineering students

After 30 years in ECE, Professor Emeritus Fernando Alvarado wanted to give back to the department—not just financially, but through a program that would directly serve students and the power engineering industry, while also advancing sustainability in the energy industry.

Finding the right project was difficult. But Associate Professor Line Roald suggested an idea that hit the mark: Support undergraduate research, expose undergraduates to power engineering, and teach them how it can help in sustainability.

The result is the Alvarado Sustainability Scholars, a program hosted by the Wisconsin Power Systems research group and organized by Roald. Principal investigators and graduate students participating in the program come up with well-defined research projects in energy and sustainability that also blend in skills from optimization, control and data science. Interested undergraduates apply for the projects and conduct their research with the guidance of graduate student mentors. In spring 2024, an inaugural class of six undergraduates participated in mentored research projects.

Roald says it actually flips the traditional path to undergraduate research. In most cases, an interested undergraduate must reach out to a professor to inquire about doing research. By instead offering a well-defined program with a clear application process, the program demystifies the pathway to undergraduate research for students and allows them to get up and running on a meaningful research project much more quickly.

The program also gives graduate students valuable experience as mentors. Joe Gorka, a fourth-year PhD student, mentored Reema Ibrahim, a rising junior, on a project to calculate carbon emissions. “It was my first time mentoring an undergrad, and it was helpful in developing skills in how to frame things and balance things,” he says.

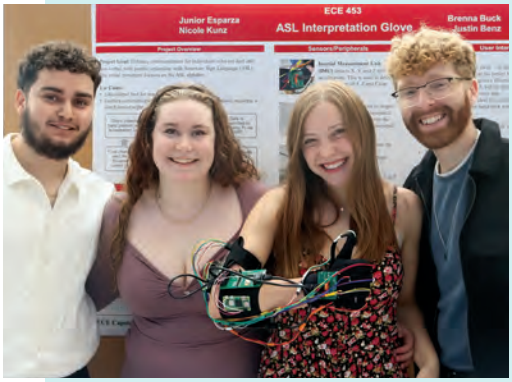
Gorka and the other mentors seem to have found a good middle ground. The program’s first semester concluded with a poster session in which the six undergrads presented their research to Alvarado and others. Alvarado says he was impressed by the work, and hopes the program continues to generate enthusiasm. “Everyone in ECE really got behind the idea. I was fascinated by the amount of interest generated among students. We’re going to have some really good power engineers coming out of this, and some people who would have never considered power engineering, which is really what we need,” he says.

## Inaugural ECE capstone design event highlights student innovation

ECE hosted its first capstone design open house in May 2024. Twenty-two student teams from three senior design courses created projects of their own invention throughout the semester and presented them at the event in Engineering Hall. In addition to having the opportunity to explain their work to event participants, teams were eligible to win best poster and project awards.

The three design courses focused on embedded microprocessor system design, mobile computing, and digital engineering. Nine ECE alumni—whose experience ranged from software engineer to patent attorney to CEO of mobile gaming or electric utility companies—served as guest judges. Students presented their projects, explaining the inspiration for their ideas as well as the process and technology used to create a finished product.

“There is so much work that goes into capstone projects—many hours and late nights spent in the lab with your teammates. An event like this was a great way for students to be able to show off all of their hard work,” says judge Forrest Woolworth, COO of PerBlue Entertainment Inc.




ECE undergraduate students Juan Esparza, Brenna Buck, Nicole Kunz and Justin Benz from Team StickyKeys. Submitted photo.

Watch and learn more about the ECE capstone student experience.

Colin Peck (left) and Brian Peck (right). Submitted photo.

# ECE student inspired to follow brother's path after loss

Colin Peck, a senior studying computer engineering and computer science, found inspiration to help others from the loss of his brother. When Brian Peck, a UW-Madison biomedical engineering junior, passed away from cardiac arrest at age 20, he was planning to begin an internship at healthcare technology company Medtronic. Colin carried forward his brother's legacy as an intern with the same company.

"At the start, losing my brother invoked a loss of identity. It forced me to grow up very fast, as I was 16 at the time. It was just before the outbreak of COVID-19, so the isolation was inconveniently timed with my grief. However, I was able to take a lot of time to reflect and work on myself; to determine what I could be and rediscover my purpose," says Colin, about his brother's passing in 2019.

While still in high school, the Orland Park, Illinois, native organized EKG drives to perform screenings used to detect potentially harmful cardiac conditions in his classmates. "Brian's passing gave me a new perspective of mortality, and how fragile life can be. It motivated me to advocate for the prevention of sudden cardiac death," says Colin.

He fell in love with the UW-Madison campus during visits to see Brian. "I chose UW-Madison for its wonderful engineering school as well as seeing it prior to my application," says Colin. "I chose computer engineering and computer science because I have always been very drawn to technology and consider myself to be a problem solver. Me and Brian would talk about technology all the time. It was a very shared interest between us."

As an undergraduate student at UW-Madison, Colin sought to apply his classroom knowledge to enhance the quality of life for others. "During Brian's interview process, I heard great things about Medtronic," Colin says, prompting him to reach out to the company. "They were very kind and supportive after hearing about Brian. I worked in the same operating unit as Brian would have (the cardiac rhythm management operating unit)."

In his role as a post-market quality engineering intern, Colin felt the impact he made through his work. "Connecting with others here has put into perspective how much of a difference each individual role and person makes at Medtronic," he says. "Even little impressions made as an intern go a long way. It is an honor to be able to contribute to such an important cause."

Colin plans to continue helping people through his work in cardiac healthcare. "I wish to pursue a career that allows me to contribute to the bettering of lives truthfully, especially cardiac health," he says. "It is a strong passion of mine to apply my work to that field. Witnessing the impact and the background of cardiac health firsthand has only strengthened my passion for it. I know that I am exactly where I should be."

## Yu-Hen Hu retires

Professor Yu Hen Hu served ECE for 37 years. Hu, known for his wide-ranging curiosity, dedicated mentorship, and service to the department, has transitioned to emeritus status.

Hu earned his PhD at the University of Southern California. In 1987, he joined UW-Madison, where his broad research interests have included VLSI physical design automation, image and video compression algorithms, wireless sensor network signal processing, statistical filtering and tracking, computer vision and deep learning algorithms applied to biomedical applications and ergonomics.

Over his career, Hu has published more than 170 journal articles and 240 conference papers. He has edited four books and holds 9 U.S. patents. Hu is a life fellow of IEEE, and served on many technical committees.

He has advised 37 graduate students, with several more in the pipeline, and developed two ECE courses, including the popular *Introduction to Artificial Neural Networks*. Over the years he has contributed much to the department, serving on many committees and in advisory roles.

"Yu-Hen's unwavering commitment to ECE over all these years (37!) has been remarkable. We thank him for the expert advice, mentoring, instruction and guidance he has provided to countless students in computer engineering," says Chair Susan Hagness.

## Mikko Lipasti retires

Professor Mikko Lipasti retired in July 2024 after a distinguished career in academia and industry.

Lipasti earned his PhD degree at Carnegie Mellon, and before and after his PhD work, he spent years at IBM where he developed software and hardware for PowerPC servers. He joined ECE in 1999.

His research focuses on the design of high-performance, low-power, and reliable processor cores; networks-on-chip for many-core processors; and fundamentally new, biologically-inspired models of computation.

In 2005, Lipasti led the restructuring of ECE's introductory computer engineering curriculum, introducing a new freshman course and developing a course in mobile systems programming. He also developed the department's first course on ethics, which is still in use.

During his career, he has published more than 100 peer-reviewed papers, advised 27 PhD students and founded two startup companies. He is an IEEE fellow and a charter member of the ISCA, MICRO, and HPCA Halls of Fame.

"We thank Mikko for his research leadership as one of the pillars of UW-Madison computer architecture, and for his countless tangible contributions to the education of so many ECE students over the past 25 years," says Chair Susan Hagness.

## 2024 Engineers' Day Honorees

**2024 DISTINGUISHED ACHIEVEMENT AWARD**

Aref Chowdhury (PhDEE '01) is a distinguished researcher in nonlinear optics and optical communications and a guiding force in developing and implementing new network technologies at Bell Labs/network infrastructure at Nokia, where he has worked for the last quarter century.

He spent seven years conducting basic research, earning an *MIT Technology Review* young innovator award in 2004. In 2008, he shifted gears, becoming a senior manager in intellectual property and standards at Nokia. Over time, he took on increasingly important roles, including chief technology officer of optics, and CTO and head of strategy, network infrastructure IP and optical. He is currently vice president of strategy and CTO of network infrastructure and has served as a member of the ECE advisory board since 2020 and served as board chair in 2022.

**2024 EARLY CAREER AWARD**

Laura Balzano (PhDECE '12) is an associate professor at the University of Michigan focusing on statistical signal processing, optimization and deep learning. She is internationally recognized for her work in modeling and applying real-world "messy" big data, or data that is incomplete, corrupted or uncalibrated, to a wide array of scientific problems.

She has earned many accolades, including a rare trifecta of early-career awards, including a 2019 National Science Foundation CAREER Award, a 2018 Air Force Office Scientific Research Young Investigator Award and a 2018 Army Research Office Young Investigator Program award.

"It was the culture at Wisconsin that allowed me to excel at being a professor because it was so collaborative," she says. "It built a community that let us learn and figure out how to decide which ideas are exciting."

## Faculty news

Grainger Institute for Engineering Associate Professor Kassem Fawaz is one of the founding faculty members of the N+1 Institute, with a mission to foster university-industry collaborations, speed development of innovative technologies and provide hands-on learning for students.


Assistant Professors Shubhra Pasayat and Chirag Gupta each received a 2024 Early Career Innovator Award from the UW-Madison Office of the Vice Chancellor for Research. The awards recognize early-career faculty for engaging in technology transfer and commercialization activities.

Philip D. Reed Professor Susan Hagness received a UW-Madison Wisconsin Alumni Research Foundation (WARF) named professorship and chose to name the professorship after the late Maria Stuchly, an IEEE fellow who was an early pioneer in the field of bioelectromagnetics. Hagness studies electromagnetic interactions with tissue for medical applications.

Charles Ringrose Assistant Professor Bhuvana Krishnaswamy received a plant sciences challenge grant from WARF and Bayer for a project using wireless sensors for soil moisture sensing.

Dugald C. Jackson Assistant Professor Kangwook Lee received an Amazon research award, which includes funding and access to Amazon datasets and AI/ML services.

Thomas A. Lipo Assistant Professor Jinia Roy was selected as regional distinguished lecturer by the IEEE Power Electronics Society.

Assistant Professor Tsung-Wei Huang received the ICCAD 10 Year Retrospective Most Influential Paper Award. This is the highest honor given to papers published in this premier ACM/IEEE conference.

Professor Bulent Sarlioglu received the 2024 IEEE-PELS Outstanding Achievement Award in Aerospace Power for contributions to the research and development of high-performance electric drives for aerospace applications.

Assistant Professor Manish Singh received the IEEE Power and Energy Society Outstanding Doctoral Dissertation Award at the IEEE-PES general meeting in July 2024.

A paper by Associate Professor Andreas Velten received the SIGGRAPH 2024 conference's Test-of-Time Award.


Professor Luke Mawst; Assistant Professors Shubhra Pasayat, Chirag Gupta and Joseph Andrews; and Associate Professor Andreas Velten are investigators on three Research Forward projects funded by the UW-Madison Office of the Vice Chancellor for Research.

## College awards

Associate Professor Line Roald received the College of Engineering's Inclusion, Equity and Diversity Award for her work in recruiting and retaining women in ECE.

Assistant Teaching Professor Eduardo Arvelo received the College of Engineering's James G. Woodburn Award for Excellence in Undergraduate Teaching.

Keith and Jane Morgan Nosbusch Professor Giri Venkataramanan received the College of Engineering's Ragnar E. Onstad Service to Society Award for his work on sustainable energy around the world.

## Student news

ECE undergraduate Eric Dubberstein, who graduated in May 2024, received a prestigious NSF Graduate Research Fellowship for his future graduate studies.

ECE graduate student Unmesh Raskar was a poster award recipient at the 2024 Midwest Machine Learning Symposium held in Minneapolis.

Chi Wang and Ari Graupe both received IEEE Antennas and Propagation Society undergraduate summer research scholarships.

## In memoriam

Professor Emeritus William "Bill" Zarnstorff passed away in June 2024. He was a member of the faculty for nearly 25 years, focusing on advancing engineering applications in medicine, in particular cardiovascular physiology and pathophysiology. He made substantial contributions to the study of heart function, vascular biology, and the effects of medical interventions on cardiovascular health. He is also remembered as a dedicated educator, taking great pride in the accomplishments of his students.

Professor Emeritus Nigel Boston passed away in March 2024. A mathematician by training, Boston developed an interest in electrical engineering. He joined UW-Madison in 2002 with a split appointment in mathematics. He applied algebra to engineering and computer science, working on coding theory, cryptography, face recognition and was founding director of the Wisconsin Wireless and Sensor Networks Consortium.

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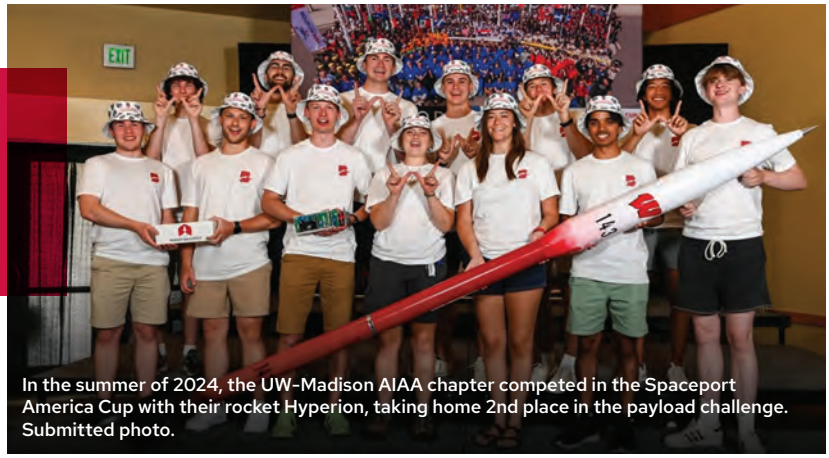
## Rocketeers' quantum magnetometer payload runner-up at Spaceport America Cup



In the summer of 2024, the UW-Madison AIAA chapter competed in the Spaceport America Cup with their rocket Hyperion, taking home 2nd place in the payload challenge. Submitted photo.

In their second year competing in the Spaceport America Cup, the UW-Madison chapter of the American Institute of Aeronautics and Astronautics (AIAA) soared to new heights, taking 2nd place in the space dynamics laboratory payload challenge during the competition in June 2024 in New Mexico. The Badger Ballistics team members' success comes after a year of hard work designing and building a new rocket based on modifications and feedback from last year's competition. Their rocket, *Hyperion*, stood 11 feet, 6 inches tall, weighed 45.5 pounds, and reached an altitude of 11,470 feet—1,470 feet higher than the team's goal of 10,000.

The students' payload was a quantum photonic system inspired by their advisor, Dugald C. Jackson Assistant Professor Jennifer Choy. It was designed by team members John Krueger, Isaac Becker, Kaden Reybrock, Cam Schultz and Andy Rivedal. The objective of the payload was to measure a changing magnetic field using quantum photonics in the environment of a sounding rocket. The system acts as a magnetometer by using an engineered diamond with a nitrogen-vacancy center, a green light-emitting diode, a photodiode sensitive specifically to wavelengths of red light, and a Helmholtz coil. The device was sophisticated enough to earn Badger Ballistics second place for the payload.

Unfortunately, during the competition, an eyebolt came loose during the rocket's descent and a booster section fell from 1,000 feet, costing the team points in the overall competition. But members still consider the event a tremendous success, and have learned enough, they hope, to make next year's space shot even better.