

ELECTRICAL & COMPUTER ENGINEERING



BETTER TOGETHER

ECE excels at multidisciplinary research



Warm greetings From Madison!

I can't begin to describe how energized our engineering campus is right now. Our campus has exceeded a 90% vaccination rate, and our students and faculty are fully in person in our classrooms and labs.

We are delighted to be welcoming all of our first-year undergraduate students in ECE 210 (*Introductory Experience in Electrical Engineering*) into the brand-new James H. Thompson Electronics Design Studio. Every student in ECE 210 also received our "Welcome to ECE" gift: a lab kit with a handheld USB-powered multi-function instrument and electronics supplies that they will use in their systems-level project work their first year and in subsequent lab courses—all made possible through generous alumni support. This is also the inaugural year for our new machine learning and data science named option for our electrical engineering BS and computer engineering BS degrees. The creation of this option is a direct response to growing demand for electrical and computer engineers with expertise in AI. Speaking of demand, our ECE undergraduate enrollment this fall is just a few students shy of 1000—a 20-year high for us!

Our graduate enrollments across our five MS and PhD degree programs have bounced back to pre-pandemic numbers. Last month, I was thrilled to welcome our newest class of graduate students to campus. These bright future leaders are joining an exceptional group of forward-thinking, high-achieving MS and PhD students like Sofia Taylor who just received a National Science Foundation (NSF) Graduate Research Fellowship to pursue research in renewable electric energy systems, and Maitreyee Marathe who helped make our summer Solympics a reality while juggling her own PhD research on DC microgrids. I continue to be impressed by the creativity, innovation, and collaborative leadership these students display.

We have been extremely successful with recent faculty hiring and have broadened and strengthened our expertise across critical research areas. Our two most recent additions are Assistant Professors Shubhra Pasayat and Chirag Gupta, who are developing new wideband and ultrawideband semiconductor materials and devices for applications in high-frequency communications,

efficient power electronics, optoelectronics—including micro-LEDs for displays and biophotonics—and next-generation computing technology. They join our exceptional cohort of faculty who include eight NSF CAREER award recipients over the past three years! We've also been successful in diversifying our faculty and have emerged as a national leader in this regard. I am proud to head an inclusive department that includes 10 tenure-track or tenured women—more than 20% of our faculty. UW-Madison ECE will continue to lead by example as we promote research excellence, impact and growth in areas of vital importance to society.

I look forward to welcoming three of our ECE alumni back to campus this fall to receive College of Engineering distinguished honors: Todd Kelsey (BSEE '87, MSEE '89), president and CEO of Plexus Corporation; Subbu Rama (MSECE '05), founder of Accio Ventures and co-founder of Bitfusion, which was acquired by VMWare in 2019; and David Epstein (BSEE '76, MSEE '78), executive director, Susilo Institute for Ethics in the Global Economy at Boston University. It's thrilling to see the stellar accomplishments of our more than 12,000 ECE alumni across the globe.

So, yes, it is an exciting time to be a Badger engineer. Thank you for staying connected with the department through our newsletter and other outlets, and please feel free to reach out to me anytime. I always enjoy connecting with our alums and partners.

On, Wisconsin!

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Focus on new faculty

Shubhra Pasayat shines a new light on semiconductors and LEDs



While most people are impressed by their smartphone's speed or fancy camera, new ECE Assistant Professor Shubhra Pasayat thinks one of the most promising bits of the cell phone is one that's often overlooked: the flashlight.

She believes the material that powers the flashlight has the potential to transform the world. Pasayat is interested in the design and growth of gallium nitride and related materials, which are wide- and ultra-wide-bandgap semiconductors. These materials are more energy efficient than silicon and could replace that common semiconductor in the next generation of electronics. When fabricated into high-electron-mobility transistors, these materials could help convert power for electric cars, improve high-frequency communications like 5G and 6G and improve many other applications.

Gallium nitride is also one of the few materials that produces true blue light in LEDs, which makes it useful in microscopy, lasers, fiber-optic communications and in lighting, such as in a smartphone flashlight.

The issue is that gallium nitride is fairly expensive to grow and fabricate. Through her work, Pasayat hopes to make it and other materials industry-ready.

"If we take a look at our society's technological requirements, gallium nitride serves them quite well. Moving forward, I want to work on not just this wide-bandgap semiconductor but also ultra-wide-bandgap semiconductors such as gallium oxide," says Pasayat. "My goal is to use these new and novel materials to take them from an emerging phase to a commercially viable phase—so that after a decade or so, we can also rely on these as we rely on silicon semiconductors today."

Pasayat earned her bachelor's degree from the Indian Institute of Technology in Kharagpur before working as a senior hardware engineer at the Samsung R&D Institute in Bangalore. In 2015, she began graduate study at the University of California, Santa Barbara, where she worked on various projects including the development of micron-sized red LEDs based on indium gallium nitride, a step toward producing highly efficient, long-lasting micro-LED-based displays.



Pasayat says Madison is an ideal place to continue her work since it has great facilities for growing and characterizing these new materials. The College of Engineering's state-of-the-art clean rooms will aid her research and the metal-organic chemical vapor deposition reactor in the

Engineering Centers Building, equipment normally found in high-throughput industrial facilities, is unique for a university and offers a great advantage in materials development.

She is stocking her laboratory with unique equipment as well, including a state of the art nano/micro electroluminescence measurement tool. Most importantly, she plans to recruit energetic students to her lab. Pasayat is teaching a course on integrated optics and optoelectronics in fall 2021, which she hopes will stimulate upper-level undergraduates and graduate students to join the field.

"My lab will have a diverse set of people really motivated to show up every day to work on next-generation problems," Pasayat says. "These are not the types of problems you can solve with a piece of code; you need to be really motivated, have very strong fundamentals and knowledge of physics and need to think outside the box."

It won't just be students aiding her research. Pasayat is also excited by the culture of collaboration among researchers at UW-Madison. In particular, she is impressed by the willingness of colleagues to share specialized lab equipment and for the interdisciplinary cooperation she's seen. "I was struck pretty early on by the warmth of the faculty," she says. "At Madison, there is an open channel of communication and transparency. That's something that's hard to find in a competitive research environment."

Focus on new faculty

Chirag Gupta is bringing the lessons of the tech industry to the lab



After completing his PhD at the University of California, Santa Barbara, Chirag Gupta decided to take a break from academic research to try his hand in the tech industry. As a device engineer with component maker Maxim Integrated, he got a crash course in just how versatile, reliable and cheap the ubiquitous semiconductor silicon is. "There are many technologies out there

better than silicon. But the important part is they need to be cost-effective," he says. "People never buy something which is better but is twice as expensive. Most of time they say, 'You know what, I'm happy with the cheaper thing I'm using.'"

Now that he's returning to academic research as an ECE assistant professor, that experience colors his understanding of the new materials and devices he studies. Gupta plans to help make

another semiconductor, gallium nitride, easier and cheaper to fabricate into transistors and other devices to power the next generation of electronics.

Gupta earned his bachelor's degree at the Indian Institute of Technology Kanpur before coming to UC-Santa Barbara, where he studied gallium nitride transistors. At UW-Madison, he will be fabricating new gallium nitride devices, and potentially gallium oxide devices, making heavy use of the College of Engineering's state-of-the-art Nanoscale Fabrication Center.

Gupta says it's not just the facilities that drew him to Madison, but also the university's breadth and depth of research.

"UW-Madison is a great place to be a device engineer. You have the full assembly here. There's a great materials department and all the facilities to support their work. Then there are the people working on devices, which I will be helping out with. Then you have circuits and systems faculty," he says. "There's a whole pipeline going from materials to full systems. We can generate very unique intellectual property and unique solutions for challenging problems."

UW-Madison is hiring the next generation of great electrical and computer engineering faculty

Over the last four years, ECE has hired 12 diverse and outstanding new faculty members including Shubhra Pasayat and Chirag Gupta, above. During the same period, young tenure-track faculty have earned an impressive 13 National Science Foundation Faculty Early Career Development Program (CAREER) awards.

With a smart, motivated class of new researchers, educators and mentors, UW-Madison's storied electrical and computer engineering department is at the forefront of many fields, including applied electromagnetics and acoustics; communications, networks, privacy, and security; computer systems and architecture; plasma science and fusion energy; machine learning, signal processing, and information theory; solid-state electronics and quantum technologies; optics and photonics; energy systems; and optimization and control.



From upper left: Assistant Professors Ying Wang; Ramya Vinayak; Joshua San Miguel; Line Roald; Associate Professor Umit Ogras; Assistant Professors Chu Ma; Kangwook Lee; Bhuvana Krishnaswamy; Dominic Gross; Kassem Fawaz

Roald to use NSF CAREER Award to optimize risk mitigation in electric distribution grids

The resilience of the power grid has been in the news a lot in recent years: Transmission equipment, for example, sparked some of the largest fires in California history in 2018, leading to rolling blackouts, and the February 2021 cold snap in Texas shut off power to millions for days on end.

While those incidents were high-profile, they repeat across the nation on a smaller scale hundreds of times per year. In fact, it's estimated that severe weather alone causes about \$44 billion in power outage costs annually in the United States. As climate change alters weather patterns, it's likely weather-related outages will increase. That's why Assistant Professor Line Roald (right) is studying ways to mitigate these problems through a research project funded by a National Science Foundation CAREER Award.

Managers of transmission lines (the large electric lines that carry energy from power-generating sources to transmission stations) have a long history of proactively mitigating risk to make sure there is no disruption in the energy supply. However, because of the different structure and instrumentation of electric distribution grids (the lines that bring power directly into homes and

businesses), local utilities or co-ops that operate these grids usually manage risk differently.

In her project, Roald is using data to develop new methods to help utilities optimize a new generation of devices that can control power flows using technologies such as remote switching. That will allow them to turn off or reroute power to mitigate risks—for instance, shutting off power to lines with overhanging vegetation on extremely windy days. Her second thrust is developing mathematical models and solution methods to mitigate risks associated with different failure scenarios, like wildfire risks or severe weather.

"I'm essentially trying to develop a framework that allows utilities to assess risks and use that knowledge to come up with better solutions across a number of future scenarios," Roald says.

Eventually, she hopes utilities will be able to adopt her framework through open-source models they can integrate into systems to mitigate risks.



CAREER Award will help Joshua San Miguel build hardware and software tools to make the smart future a reality

Almost any vision of the near future includes the proliferation of smart devices; smart sensors and processors will be enmeshed in our clothes, hidden in jewelry and even in body implants. To work, however, these gadgets will have to sip tiny amounts of energy, in the range of tens of milliwatts. By comparison, a typical smartphone uses tens of watts, while desktop computers can use hundreds to run their processors.

"Even if it becomes possible to make the processor hardware ultra-low-power, these devices would be unusable if software developers are not able to write efficient programs that can run on these devices," explains Assistant Professor Joshua San Miguel (right).

That's why he is developing hardware and software tools for a new type of

computing on ultra-low-power devices in a project funded through a National Science Foundation CAREER award.

The project focuses on a type of computing called approximate or stochastic computing. Most computer processors read and write in binary, which performs calculations using just two-wide digits. Still, that type of processing requires thousands upon thousands of logic gates and a degree of processing power that likely can't fit in a next-gen smart device.

But stochastic computing reads and writes in unary, in which data is encoded as probabilities instead of digital numbers. This computing style allows circuits that are orders of magnitude smaller than those needed for binary.



There are tradeoffs; stochastic computing can return some inaccurate results. But in many cases, the accuracy of these processors is good enough for the tasks they will carry out.

"Actually, stochastic computing fits very well with the kinds of computations that you'd be doing on these smart devices, which is usually machine learning or analytics," he says.

San Miguel plans to develop an open-source framework he's calling UnarySim, which will allow programmers to design and evaluate stochastic computing systems. Eventually, he hopes his work will lead to the first general-purpose, programmable stochastic computing processor which can be used in all sorts of applications.

Engineering success

UW football player tackles the gridiron and a graduate education



At training camp in August 2021, Badgers football player Matt Henningsen was officially declared a freak by Bruce Feldman at *The Athletic*: the defensive end is incredibly strong (he can squat 675 pounds) and abnormally fast (he can accelerate his 291-pound body more than 19 miles per hour).

But there's something even freakier about Henningsen. It's his mind: He's a gifted student finishing up an accelerated master's degree in electrical engineering, focusing on machine learning and signal processing.

While many players on the Badgers football team have been recognized for academic achievement, few have the time or bandwidth to take on an academically rigorous curriculum, much less excel at it. But Henningsen has accomplished so much by approaching both football and school like an engineer: He has a system, a schedule and the self-discipline to fit everything in.

His daily routine each fall semester is grueling. Up at 6 a.m. Daily practice between 6:30 and 10:30 a.m. Classes from 11 a.m. until 5 p.m., then back to the stadium for meetings, film study and other game-day preparations until 7 p.m. Homework between 7 and 10 p.m. "And then I try to get some sleep. I try to stick to that routine every day," he says.

"Guys would laugh at me because they'd see me on the plane, and I'd be working on my physics homework," he says. "Everyone else would just be watching a movie or something."

That discipline has paid off on both fronts. Henningsen has been named an Academic All-Big Ten athlete each of the last three years and a Big Ten Distinguished Scholar, an honor that recognizes student athletes with exceptional GPAs, for the last two years. He's also participated in two research projects involving medical imaging and signals processing.

Henningsen's work on the field is equally impressive. Though a torn bicep in the second game of 2020 cut his season short, he's been a starter since 2018. As of the end of the 2020 season, he had 58 tackles, five sacks, three recovered fumbles, two touchdowns and has played in the Rose Bowl.

In December, he will add another impressive stat when he completes his accelerated master's degree.

This season, Henningsen is likely to spend even more time working on the team plane. "As we get into quantum mechanics and some of the more difficult machine learning classes, it's starting to get tougher," he says.



Photo by David Stluka

Currently, Henningsen doesn't have any post-graduation employment plans, but he's intent on giving the NFL a shot. Regardless of what happens next, he's glad to have his degrees from UW-Madison. "The NFL only lasts so long. It's a tough league and it's a grind," he says. "We'll see where I end up. If I do go into industry, I'd like to get into something with signal processing. My capstone research was with medical imaging like MRIs and brain waves. So, I'm leaning in that direction."

Right now, however, Henningsen doesn't have much time in his schedule to ruminate on the future. He's got books to crack and sacks to make. "There are guys who take football extremely seriously and school kind of comes in behind it," he says. "I try to take both of them seriously and do everything I can to be as good as I can in both."

PhD student Audrey Evans hopes a buddy system will help incoming graduate students



When Audrey Evans caught the research bug while an undergraduate at the University of Kansas, the idea of going to graduate school didn't seem

plausible. "I thought, 'Oh, I can't afford to go to grad school,' which I think is a misconception that a lot of people have," she says.

But one brief conversation with an academic advisor changed her mind. "They told me that the vast majority of PhD students in engineering fields have funding, which I never realized before," she says.

That simple conversation was an ah-ha moment for Evans, who is now a PhD

student researching imaging for microwave ablation. Evans also mentors a junior ECE undergraduate researcher. "I had this exact same conversation with her, and I saw this click go off in her head, too," she says.

Evans has seen firsthand the power of mentoring. So when the ECE Graduate Student Association, of which Evans is president, started brainstorming ways to support first-year graduate students, mentoring was something Evans and others brought up. Now, the organization is matching first-years with more experienced graduate students in an effort called the Buddy Program.

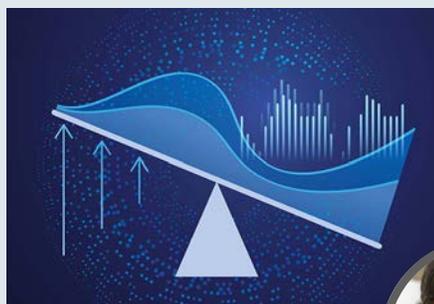
The idea is that the experienced students can answer all the basic questions new students have about classes, moving to Madison and navigating their first semester.

So far, 29 first-year graduate students have been paired with more senior graduate students in the program.

"When you're a first-year graduate student, you have a lot of random questions and misconceptions about what grad school is going to be like," says Evans. "Having the opportunity to hang out with more senior grad students can help ground you and give you some perspective."

Evans says that she's hopeful the mentoring project will help build community in ECE. She's interested in increasing other mentorship opportunities in the department as well, including projects to support women and underrepresented groups.

Taking a crack at the glass ceiling and other biases perpetuated by big data



Predictive algorithms are an influential part of daily life, even though most people aren't aware they exist. The formulas, derived from massive collections of information often referred to as "big data," are used to determine things like insurance rates or mortgage and credit worthiness.

While relying on just the facts might seem like a great way to make unbiased, equitable decisions, one major issue with

big data is that the information used to develop predictive algorithms often reflects the assumptions and biases of those who collected it.

As a result, predictive algorithms can transmit historical prejudices or perpetuate existing gender and racial inequalities.



That's why Assistant Professor Kangwook Lee (left) and Sociology Assistant Professor Eunsil Oh are examining the reproduction of social inequality in big data-derived predictive algorithms.

Lee, who studies machine learning, has researched the societal implications of big data from a computer science perspective. "Businesses have been using these predictive algorithms for more than 10 years now. Even though they have realized the issues, many are still employing predictions or decision-

making that is biased," says Lee. "The question we want to answer is how much impact this has made on society and how we can measure these impacts."

Their interdisciplinary approach incorporates both sociology and computer science perspectives on bias in big data. In their research, Lee and Oh will draw on the limited number of research papers published on the issue before beginning to collect and analyze datasets. In particular they will look at the gender wage gap in the labor market and racial disparities in determining bail in the criminal justice system.

Eventually, they hope to develop recommendations for removing or mitigating bias in data-driven decision making that they can disseminate to the data scientists developing predictive algorithms.

A visit from a tech legend amps up capstone class for ECE accelerated master's program

Jim Thompson is a big deal in the tech world; the chief technology officer of Qualcomm Technologies—the multinational mobile chip, semiconductor and software company—is the type of speaker who delivers keynotes at IEEE conferences and advises the National Science Foundation on engineering issues.

But in July 2021, Thompson (BSEE '85, MSEE '87, PhD EE '91), took time to digitally drop by a session of ECE 697, the capstone course of the accelerated master's degree in machine learning and signal processing. For an hour, Thompson discussed his journey through academia, his time in the technology sector, and how he managed to stay on the cutting edge through decades of rapid change.

The interaction was one of many career-building experiences students in the program received. Unlike a traditional master's degree, which focuses on academic research and culminates in a

research-based thesis, the accelerated master's degree program is a course-based curriculum that takes 12 to 16 months to complete. The program is designed for students hoping to get a jump start on a career in data science or who are returning to school to improve their skills.

Thompson was one of several speakers who visited with the class, including engineers from GE Healthcare, American Family Insurance, Google and Amazon. "The goal is to get a broad perspective from engineers that are at different points in their career," says Matt Malloy, an assistant teaching professor in ECE who led the class.

But students in ECE 697, the capstone design course in machine learning and signal processing, do much more than listen. They pursue final projects that tie together their previous year of coursework. In summer 2021, students took on projects with real-life applications,



including a convolutional neural network that monitors the quality of spot welds and an artificial neural network that can translate MRI scans into CT scans.

That learning-by-doing approach helps the students drill down to exactly where they want to take their career—and most importantly, shows them how to be adaptable. That's something Thompson emphasized in his talk. "It's those fundamental, base kind of skills that will allow you to move between different types of signal processing that are really important," he told them.

New condenser makes water from air, even in the hot sun



Access to clean water is a huge issue across the globe. Even in areas with water resources, a lack of infrastructure or reliable energy means purifying that water is sometimes extremely difficult. That's why a water vapor condenser designed by Jack St. Clair Kilby Associate Professor Zongfu Yu could be revolutionary. Unlike other radiative vapor condensers which can only operate at night, the new design works in direct sunlight and requires no energy input.

"Water sustainability is a global issue," he says "You can't set out to solve the water problem without addressing energy."

Over the last few decades, researchers have designed dew collectors based on the principle of radiative cooling, using specific materials that efficiently shed heat in the mid-infrared range, also known as the atmospheric-transparency window. That heat naturally radiates toward the cool upper atmosphere of Earth and the chilly void of space. The problem is that those collectors only work at night since sunlight produces more heat than the materials can give off.

In this project, the team, led by postdoctoral researcher Ming Zhou, constructed a small vapor condenser using a thin film of material called polydimethylsiloxane, which is very efficient at releasing thermal radiation in the atmospheric-transparency window. They layered that over silver, which reflects sunlight. The combination of the

two is able to cool the condenser below the dew point, leading to condensation.

Zhou tested the device by placing it inside a box-like condensation chamber alongside chambers containing a commercially available dew-collecting material as well as a simple black body. The team pumped humidified air into the three chambers, which they positioned on top of a UW-Madison building and, during another test, a parking garage. The polydimethylsiloxane was the only material that condensed water vapor while in direct sunlight.

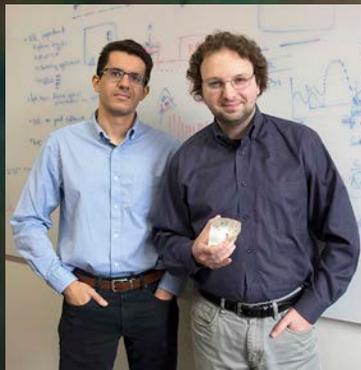
Eventually, the team hopes that the system will be efficient enough to produce water directly from the air, a process they are working to optimize. "This experiment was done using some controlled water vapor," says Yu. "Now, the next step is to pull the water directly out of the air. That's very, very exciting to us—to get water from the air for free using no energy."

A rainbow connection

New nondestructive optical technique reveals the structure of mother of pearl

Most people know mother of pearl, an iridescent biomineral also called nacre, from buttons, jewelry, instrument inlays and other decorative flourishes. Scientists, too, have admired and marveled at nacre for decades since the material is 3,000 times more fracture resistant than aragonite, the mineral from which it's made. "It has piqued the interest of materials scientists because making materials better than the sum of their parts is extremely attractive," says Physics Professor Pupa Gilbert, who has studied nacre for more than a decade.

Gilbert has learned how nacre forms, orders, resists fracture and how its layered structure records the temperature at which it formed. This layered structure of nacre reflects light and generates different colors depending on layer thickness. That led to an interest in finding a way to assess the thickness of the nacre layers that doesn't involve destroying the mollusk shell in which it is deposited.



That's why Gilbert teamed up with Jack St. Clair Kilby Associate Professor Mikhail Kats (left) and PhD student Jad Salman (far left), experts in advanced optical phenomena, to use a nondestructive optical technique called hyperspectral interference tomography (HIT) to unlock even more knowledge about nacre.

Salman imaged red and rainbow abalone shells, using a hyperspectral camera. He then used sophisticated modeling software he developed to determine the thickness of the nacre layers pixel by pixel using the data, allowing him to determine the thickness of the shell at any given point.

The team anticipates that the nondestructive technique is applicable to measuring other transparent, layered structures found in plants, animals, geological samples or synthetic materials.

"The power of this research is that we brought all of this experimental and theoretical expertise, and were able to model not only engineered, well-behaved layered structures, but messy, disordered biological structures," says Kats. "And we were able to get useful information out of it in a way that a biologist or paleoclimatologist can use."

Panoramic 3D visualization system aims to revolutionize laparoscopic surgery

Modern medicine radically changed with the introduction of laparoscopic surgery several decades ago, which allows surgeons to operate through a small incision instead of cutting a patient open, reducing potential complications.

The technique has improved greatly over the years, but there is one problematic element: The camera used for the technique needs to be inserted through a second incision and is prone to smudging and fogging.

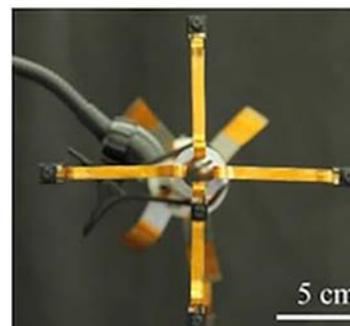


That's why Lynn H. Matthias Professor Hongrui Jiang (left), along with Professor Yu Hen Hu, is leading the development of a new visualization system called EasyVis that could significantly improve the efficiency of laparoscopic surgery.

Recently, the National Institutes of Health renewed funding for this work, giving Jiang and his team \$1.6 million

over the next four years to improve the system. "Our idea is really a paradigm shift to using multiple cameras mounted on the surgical port," says Jiang. "There are lots of potential benefits including 3D rendition and much more flexible visualization of the surgical field."

The EasyVis system consists of multiple 5-millimeter-diameter microcameras with liquid miniature lenses, tiny LED light sources, and miniature optical devices used to create 3D images. It's deployed into the abdominal cavity on a device called a trocar, inserted through the same port that the surgical



instruments use. Once the trocar enters the abdomen, it unfolds tiny mechanical arms that hold the imaging devices. After surgery, the arms fold up and the trocar is removed.

The system can be completely controlled by the operating surgeon, who wears a pair of virtual reality or augmented reality goggles and can zoom in, pan out, change viewing angles and get close-up 3D images of specific areas via voice control, eliminating the need for a second surgeon.

By the end of this grant period, Jiang says he expects EasyVis will be operational and ready for UW-Madison surgeons to validate through animal testing.

FACULTY NEWS



Jean van Bladel Associate Professor **Bulent Sarlioglu** is the recipient of the 2021 Cyril Veinott Electromechanical Energy Conversion

Award from the IEEE Power & Energy Society for contributions to the design, development, and manufacturing of electric motors and drives for industrial and aerospace applications.



Professor **Amy Wendt** has joined the Office of the Vice Chancellor for Research and Graduate Education as a divisional associate vice chancellor for research.

Wendt had been serving as the interim associate vice chancellor for research in the physical sciences since August 2019.



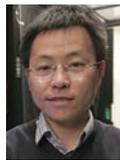
Assistant Professor **Dimitris Papailiopoulos** recently earned the prestigious Mac Van Valkenburg Early Career Teaching Award from the IEEE Education Society

recognizing his student-centered learning success and active learning strategies.



Assistant Professors **Ramya Vinayak** and **Dimitris Papailiopoulos** are both recipients of UW-Madison data science research grants from the American

Family Funding Initiative. Vinayak is studying how the human ability to learn affects crowdsourced data. Papailiopoulos is investigating tools that can automate and accelerate the training of machine learning models.



Jack St. Clair Kilby Associate Professor **Zongfu Yu** recently received a UW-Madison H.I. Romnes Faculty Fellowship, which

recognizes outstanding faculty members across the university within the first six years of receiving tenure.



Keith and Jane Morgan Nosbusch Professor **Robert Nowak** was recently invited to present an Institute of Mathematical Statistics

Medallion Lecture at the 2021 Joint Statistical Meeting.



ECE faculty are part of two new AI institutes funded by the National Science Foundation. Assistant Professors **Bhuvana Krishnaswamy** and **Younghyun Kim** are part of Athena, an initiative to transform the design, operation and service of future mobile systems and

networks. Professor Robert Nowak is part of AI-EDGE, which will develop new AI tools to ensure wireless networks are self-healing and self-optimized.



Philip Dunham Reed Professor and ECE Department Chair **Susan Hagness** is serving as the 2021-22 president of ECEDHA, the nationwide Electrical and Computer Engineering

Department Heads Association.



Professor **Tom Jahns**, co-director of the Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC) and the Grainger Professor of Power Electronics and Electric

Machines, retired from his active faculty position in June. Jahns joined UW-Madison in 1998, and during his 23-year career made pivotal contributions to power engineering both as a researcher and through his work with WEMPEC, the largest academic/industry partnership in its field.

An expert in power electronics, electric machines, drives and power conversion, Jahns has conducted research in a wide variety of areas ranging from the development of high-performance permanent magnet machines used in nearly all hybrid- and battery-electric vehicles to the integration of distributed renewable energy sources and energy storage into the utility grid system using microgrids. During recent years, he has focused his research in the areas of integrated motor drives and electrified transportation, merging them together in the development of high-power-density megawatt-class motor drives for future aircraft electric propulsion systems.

Jahns has been honored with numerous prestigious awards throughout his career in both academia and industry, including election to the U.S. National Academy of Engineering in 2015 and a prestigious Hilldale Award in Physical Sciences from UW-Madison in 2020 honoring his lifetime achievements.

STUDENT AND ALUMNI NEWS

PhD students **Wei Zeng** and **Tianen Chen** along with Professor Azadeh Davoodi and Assistant Professor Younghyun Kim recently won the programming contest held as part of the International Workshop on Logic and Synthesis 2021.

PhD student **Joshua Tabor** was recognized with an Innovation in Teaching Award from the 2020 Campus-Wide Teaching Assistant Awards, noting his work developing new ways to teach students about robotics.

Chenhao Wan, a PhD student, received the 2021 Dorothy M. and Earl S. Hoffman Scholarship from AVS, a materials science, interfaces and processing professional society.

PhD student **Audrey Evans** received a 2021 Doctoral Research Grant from the IEEE Antennas and Propagation Society.

Earlier this year, PhD student **Hanyang He** received recognition as an outstanding university graduate in Sichuan Province and also an award for excellent master's thesis at Sichuan University.

Voxelgrids, a company that produces, lightweight, easy-to-install MRI scanners founded by alumnus **Arjun Arunachalam** (PhD '06) recently received a \$5 million investment from Indian software firm Zoho Corporation.

Alumnus **Ruyu Ma** (PhD '20) recently won the 2021 Harold A. Wheeler Applications Prize Paper Award from the IEEE Antennas and Propagation Society.

Alumnus **Kevin Lepak** (BSECE '99, MSECE '00, PhDECE '03) was recently named a corporate fellow by chip maker AMD, one of the company's highest honors.

IN MEMORIAM

Remembering Bill Long

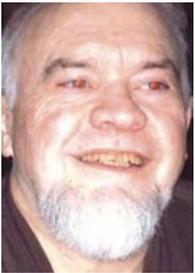


ECE emeritus professor Willis "Bill" Long passed away in July 2021. Long earned a PhD in electrical engineering from UW-Madison, joining the faculty in 1973. Over his career, he taught courses and conducted high-voltage direct current research for the Department of Energy, the Electric Power Research Institute and other agencies.

As a faculty member of the UW Engineering Extension, he traveled to Brazil, China and other parts of the world teaching about power systems. He also helped develop and teach many popular continuing education courses for professional engineers. That work earned him the IEEE Educational Activities Board Meritorious Achievement Award in Continuing Education in 1992.

In 1996, the UW-Madison College of Engineering recognized Long with its Ragnar E. Onstad Award for Service to Society. Long volunteered with many organizations during his life including the Community of Hope United Church of Christ, the Sierra Club, Madison Festival Choir, Madison Youth Soccer League, the Boy Scouts of America and the Harvest of Hope Fund for farm families. Most significantly, he held many volunteer positions with Madison Urban Ministry, recently renamed JustDane, a social justice and social service organization that serves families with incarcerated members and helps formerly incarcerated people re-enter society.

Remembering Richard Casper



Richard Casper, who worked as a research engineer in the College of Engineering from 1974 until 2002, passed away in May. Casper graduated as valedictorian from Fennimore High School in 1965 and earned bachelor's and master's degrees in electrical engineering from UW-Madison before beginning work at the University. Over his career, he mentored thousands of engineering students.

FACULTY NEWS

Ma receives two DARPA grants



The Defense Advanced Research Projects Agency recently awarded two grants to Lynn H. Matthias Professor Zhenqiang "Jack" Ma.

The first is a \$1 million grant to develop novel diamond heterostructures based on the quantum tunneling effect. The goal of the project is to demonstrate two-dimensional electron gases and show the quantum anomalous Hall effect in diamond. This could pave the way toward the development of next-generation radio-frequency devices.

The second grant, also for \$1 million, focuses on the development of vertical aluminum gallium arsenide and aluminum scandium nitride quantum tunneling heterostructures using a semiconductor grafting approach first developed by Ma's group. The research will pave the way toward development of next-generation radio-frequency bipolar transistors.

Behdad, Van Veen, Booske receive grants from Office of Naval Research

McFarland-Bascom Professor Nader Behdad and Lynn H. Matthias Professor Barry Van Veen received a \$1.1 million grant from the Office of Naval Research to investigate advances in full-duplex, high-frequency antenna systems. High-frequency radio communication covers frequencies in the 3-to-30-megahertz range, which bounce between the surface of the Earth and the ionosphere, allowing communication over hundreds and sometimes thousands of miles without the use of cables, satellites or cell towers. In this project, the researchers are developing ways to establish "full duplex" communications, in which the wireless system sends and receives information at the same time. They hope to use predictive algorithms that allow the electronics to compensate for changes in the environment, improving the efficiency of the systems.

Behdad and Duane H. and Dorothy M. Bluemke Professor and Vilas Distinguished Achievement Professor John Booske are working on a second \$1.1 million project improving troposcatter communications

systems, which scatter signals off the Earth's troposphere, allowing secure over-the-horizon communications without satellites or relay stations. The team is investigating phased array antennas that conduct rapid beam scanning, which allows them to stabilize, maintain and maximize the quality of the connection, especially on platforms like ships at sea.



Nader Behdad



Barry Van Veen



John Booske



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ECE alumni give College of Engineering an industry perspective

To make sure students receive the best and most useful education, the College of Engineering consults with an industrial advisory board made up of leaders with deep academic, business and engineering experience.

The current board of 35 impressive individuals includes four women who earned degrees from the department: Kathy Howard (MSEE '81), an integrated circuit engineer and patent attorney with CyberOptics; Cynthia Bachmann (BSEE '83), a retired vice president for engineering and product development at Kohler Kitchen & Bath; Dawn Harms (BSEE '84) a veteran aerospace executive currently serving as chief revenue officer for Momentus, a space infrastructure company; and Wendy Harris (BSECE '90, MBA '99), general manager for product operations at GE Healthcare.

Insights from the board help college administrators set priorities to advance the college's commitments to research and education and to strengthen connections with alumni and industry. That's a broad

mandate, but board members have a wide range of experience. "I think having the breadth of design and management experiences I had with a multinational company allows me to help problem solve the myriad issues presented to COE management," says Howard, who says the board advises on many issues, including funding, enrollment, faculty hiring and ways for the college to reach its goals.



Photo by ThisIsEngineering from Pexels

"Many of these issues are specific to a university, so perhaps there's no specific experience on the part of a board member, but the ability to problem-solve in a group is something that engineers do well!"

Bachmann says having outside eyes on the college offers a valuable perspective. "Academia does not operate like a business," she says. "Many of us on the Industrial Advisory Board try to bring the mindset of a business to help tackle the issues and opportunities of the college."

Having the perspective of women who graduated from the college also adds unique insights, especially as the college and ECE focus on recruiting and retaining women faculty and students. Howard can see how things have changed for the better—when she graduated with her master's degree in 1981, there was just one other woman graduate she can remember. "Now, there are significantly increased percentages of minority representation in the college," she says, as well as policies and pathways for women and minority students and faculty. "All those policies and recognitions make it a little bit easier, year after year, for those minority students to feel respected and highly valued within their chosen fields."

Three other ECE alumni also serve on the IAB, including Craig Palmer (BSECE '82), a veteran Silicon Valley executive, Mike Running (BSEE '99) a senior vice president of Appleton, Wisconsin-based Plexus Corporation; and Roy Thiele-Sardina (BSECE '82), founder of the technology investment firm HighBar Partners.