College of Engineering
UNIVERSITY OF WISCONSIN–MADISON

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DEPARTMENT OF

CIVIL & ENVIRONMENTAL ENGINEERING

On the cover: CEE senior Jacknetson Naw shows a scanner used in structural analysis. Naw has learned how to use the scanners

Greetings from Madison!

As alumni and experienced engineers know, the successful design and construction of a building, transportation system, water system, or earthworks requires an integrated community of engineers working together. For example, our forthcoming engineering building relies on the contributions of engineers from many disciplines: construction, structural, geological, hydrologic, hydraulic, environmental, transportation, materials, mechanical, electrical and others. The projects we work on demand that we be as supportive of the overall profession as we are of the disciplines we're so closely connected to. Reinforcing this idea, the final report of the 2025 ASCE Education Summit identifies the fracturing of the profession by discipline as a threat to the profession.

Our department reflects the overall profession. As noted in our last newsletter, we're working to build community by fostering and supporting a vibrant, inclusive departmental culture that unites students, staff, faculty, alumni and industry partners through collaboration, well-being and a shared identity. For over 20 years, our senior capstone design course has introduced our undergraduate students to this shared identity. We've wondered if we can extend this beyond the capstone experience, and I'm happy to report that we are making progress at both the undergraduate and graduate levels.

One of my favorite activities as department chair is meeting with our undergraduate student organizations to learn about what they are doing and how we can support their success. During my first year as department chair, I asked the leaders of these organizations what they thought of creating an undergraduate student council to build a culture in which we focus on the broader department and the profession while also strengthening their work at the organizational level. They liked the idea and, in my second year as chair, they made it happen. In the 15 months since, they've helped organize two town hall meetings with department and college leadership. They've also volunteered to help with department events such as our annual mentor night, golf outing and spring graduation. The president of the undergraduate student council now has a seat on our department's advisory board, known as the CEE Visiting Committee.

We also have a team of graduate students working to develop a shared identity among the seven disciplines of our department and the individual research groups among them. I enjoy meeting with these leaders as much as I enjoy meeting with the undergraduate student council. In the last 15 months, they've helped organize a graduate student town hall with the dean and department chair, a fall orientation event inclusive of current and incoming students, and an end-of-semester bowling and billiards event for graduate students. They also provided critical volunteer support for the golf outing. On May 1, they will host our first ever department-wide graduate student awards and recognition event. The chair of the graduate student council also has a seat on our CEE Visiting Committee.

We are just getting started and it will take a long-term commitment to fully integrate a shared and collaborative identity into the fabric of our department culture. I'm proud of the important work these students, with the wonderful support of staff member Amanda Thuss, are doing. I look forward to seeing them pass it on to the next generation of students. Their contributions will help ensure the strength of our department and the profession in the years to come.

On, Wisconsin!

Gregory W Harrington

Gregory Harrington
Professor and Department Chair

On the cover: CEE senior Jacknetson Naw shows a scanner used in structural analysis. Naw has learned how to use the scanners under Associate Professor Hannah Blum. Photo: Joel Hallberg

Get ready to golf!

Register today for the 29th annual CEE Golf Outing on October 9. This year's event offers new booth sponsorship opportunities and on-the-course entertainment. Register at: go.wisc.edu/cee-golf-outing or use the QR code below.

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As undergrad researcher, civil engineer builds skills, confidence and connections

Jacknetson Naw has spent the last two years learning how to scan structures.

Naw, a CEE senior, has conducted undergraduate research under Associate Professor Hannah Blum, who leads the Steel Systems Innovation Research Lab. She's testing and comparing a variety of measurement methods—ranging from old-fashioned hand tools like calipers to modern 3D scanners and even iPads—to determine whether lower-cost alternatives are up to the task.

Using those methods, Naw and graduate student Richa Rahkee (MSCEE '25) had been working on a project to scan a steel deck, which is a sheet of corrugated metal that is often used in roofing or similar structures. Part of the project includes creating point cloud models using the high-tech Artec Leo, which is a handheld scanner capable of taking 3D scans of objects or parts of a structure up close. Point cloud models are 3D representations of an object or structure that are made of almost countless, precisely arranged individual points.

"Once you've made the model, you can do other things with it," Naw says. "For example, with a steel deck, we exported cross sections at varying locations along the deck span—one in the middle and between the middle and each end—and imported them into AutoCAD. After doing that, we can measure them to look for as-fabricated geometry and imperfections and conduct further structural analysis."

Naw's work is a crucial part of a group effort in Blum's lab to create a workflow that incorporates steps from scanning to creating models. "We can use this tool to measure 'as-built' conditions, which can influence a structure's strength," Blum says. "Jenet has been helping a lot with the scanning, and the team has gotten together to figure out a workflow for the process, and coding for importing the point clouds to help automate the process. This is going to give us very precise results, especially for research purposes."

As another part of the project, Naw has assessed how well an iPad Pro might work as a low-cost alternative for structural scanning. While tools like the Artec Leo can capture incredibly precise scanning data, at tens of thousands of dollars apiece, they're very expensive compared to an iPad.

Scanning a steel deck isn't as simple as just pointing the scanner at it. Because the metal is reflective and the surface is mostly uniform, Naw says, it needs to be painted with a matte finish. Then, she adds markers or characters with sharp edges that she can use to align scans from different orientations during post-processing.

After setting up an iPad to scan the steel deck and then analyzing the results, Naw found the iPad ultimately wasn't up to the task. The scans had rounded edges where there should have been sharp corners—which, she says, is a pretty significant error—and struggled to accurately capture features like embossments.

Blum presented Naw and Rakhee's iPad vs. Artec Leo vs. hand tools scanning analysis at the 2025 International Colloquium on Stability and Ductility of Steel Structures in Barcelona, Spain. "The room was packed," Blum says. "People were really intrigued because, of course, you'd want options using the less expensive method, but the technology isn't there yet."

Naw and Rakhee also scanned the Camp Randall Memorial Arch and the Agricultural Bulletin Building, both on the UW-Madison campus. For scanning those structures, they used the Artec Ray, a larger scanner than the handheld Leo—and Blum says the scanning was practice for a larger ongoing project to monitor historic structures she's conducting with colleague Jesse Hampton.

As she finishes her senior year, Naw, a first-generation college student from Myanmar, says she's learned a lot from being in Blum's lab and is considering pursuing a master's degree in structural engineering.

"I'm really happy that I've had the opportunity to work in a research lab," she says. "It's been a great experience, and not just with my projects, but seeing all of the experimental work going on here has been really cool. Coming in I wasn't really sure what I wanted to do because civil engineers can go into so many areas, but Hannah's lab has really helped me find what I want to do for the future."

Caption: Senior Jacknetson Naw's research on testing handheld scanners for use in structural engineering has also helped to inform her career plans. Photo: Joel Hallberg

With a forecast for the world's most prevalent mosquito-borne disease, countries can better prepare and preserve human health

Year-round warmth and wet climates make Colombia and Puerto Rico natural dengue hotspots.

A mosquito-borne viral disease that causes flu-like symptoms, dengue is prevalent year-round in both countries, with seasonal peaks typically occurring between May and November.

It's the most common mosquito-borne disease worldwide, with more than 14.6 million reported cases in 2024. More than 13 million of those cases were reported in the Americas. Now, in an effort to get ahead of future outbreaks, Professor Paul Block is leading a NASA-funded project to monitor and predict dengue in Colombia and Puerto Rico.

Block specializes in subseasonal-to-seasonal models, which make big-picture predictions for a given season several months in advance. He aims to produce seasonal forecasts that public health and community agencies could use to inform decisions on preventive measures or interventions. Those models will be based on mosquito collections and data from "fever clinics" and broader public health records.

They will also incorporate climatological data gathered from NASA satellites into their models. "The remotely sensed data can give us information about surface conditions, like how green it is and the soil moisture state," Block says. "We'll use that to collect land surface and hydrology parameters to see how well those correlate with dengue burden. Right now, we don't know how different land surface and atmospheric conditions are associated with dengue, specifically, or if at all."

Local stakeholder feedback will shape how the team designs its models and implements them in Colombia and Puerto Rico. That's an essential step, Block says, because every public health decision carries costs.

"We have to tailor the model so that it's applicable to the social context of the local setting," he says. "What that looks like in Puerto Rico could be different from Colombia."

Dengue is the most prevalent mosquito-borne viral infection in the world. Paul Block is leading a NASA-supported project to monitor dengue levels in Colombia and Puerto Rico. iStock photo.

New computer model predicts rising flood threats in Lower Mississippi River Basin

Associate Professor Daniel Wright has published new research in the journal Science Advances on how storm clustering drives flooding in the Lower Mississippi River Basin. Because the lower basin can handle so much water, it usually takes the confluence of several storms to trigger flooding.

"It takes weeks, if not months, for these floods to build. It's hard, especially in the Lower Mississippi River Basin, to figure out the probability of these rare floods because we have, at best, 100 years of data to use," he says. "If we're talking about high-quality rainfall data, much less than 100 years' worth."

So the researchers, led by Wright's former student Yuan Liu (PhD CEE '25), created a model, StormLab, that can simulate thousands of years' worth of flood-causing storm sequences. For this study, they used StormLab to create 7,600 years of high-resolution rainfall predictions across the entire 1.2 million square miles of the Mississippi watershed.

From there, the group analyzed the largest floods in the dataset using a flood-simulation model to determine what type of extreme storm sequences, or "clusters," produced them.

The researchers classified the storm clusters as isolated, which is an individual storm occurring somewhere in the Mississippi River watershed; spatial clustering, which is a single storm with heavy precipitation than can stretch across multiple drainage basins in the watershed; temporal clustering, in which two or more successive storms bring heavy rains to a drainage basin; and compound clustering, which is a mix of temporal and spatial clustering.

Wright says isolated extreme storms are the most common type seen today. However, as weather patterns shift over time, the model predicts that compound clusters will become the most common type of storm clustering.

The record-breaking 2011 Mississippi River floods are an example of the flooding that can follow in the aftermath of extreme storm compounded clustering. The model predicts compound clustering events will become more frequent over the coming century, which has major implications for infrastructure built to protect against flooding.

"You can see a 150-year return period and think that's a long time. But what that really means is that over the average person's lifetime, there's roughly a 50-50 chance that a flood at least that big will occur," Wright says. "The infrastructure we're building today will still be around in 2100. It'll still be around 100 or more years from now, so we've got to consider how we're prepared for the future."

Excellence in civil engineering education: Capstone course wins 10th and 11th NCEES Awards

Our department recently accepted its 10th and 11th Engineering Education Awards from the National Council of Examiners for Engineering and Surveying (NCEES) in recognition of two projects completed in the Senior Capstone Design course.

Now in its 25th year, this award-winning course uses a community-based learning approach that pairs student teams with professional mentors and real-world clients. Over the course of a semester, student teams tackle complex projects that grant them valuable hands-on experience.

In 2025, the award-winning projects focused on revitalizing Frank Lloyed Wright's historic Riverview Terrace in Spring Green, Wisconsin, and modernizing a public transit facility for the city of Wausau, Wisconsin. Each project received a $10,000 prize that will be invested into the program to support hands-on learning experiences, software tools and professional development opportunities for course instructors.

Approximately 2,300 students have taken the capstone course since its inception, completing more than 500 projects for clients across Wisconsin and beyond.

Each project integrates multiple civil engineering aspects to expose students to the profession's multidisciplinary nature. Students collaborate to produce three major deliverables and present their work to a diverse group of stakeholders and industry professionals.

Department Chair and Professor Greg Harrington credits the capstone program's success to its strong network of alumni and industry mentors. More than 200 professionals have volunteered through life of the program , with each mentor contributing an average of 50 to 100 hours of their time per semester.

"Our alumni and industry partners are supportive and eager to give back to help the next generation to launch their careers," he says. "We now have mentors that took the course themselves 10 to 25 years ago, and it's often described as a challenging yet transformative experience."

Caption: Rahel Desalegne, Tunmi Omoloja, Tyler Curtis, Jack Donahue, Isabelle Bierbach, Evelyn Hietpas and Derek Hungness earned the Transit Facility project award. Submitted photo.

Wright leading UW-Madison team in multidisciplinary storm impact research center

Associate Professor Daniel Wright, is adding his expertise in extreme storm prediction research to the new Center for Interdisciplinary Research on Convective Storms (CIRCS).

Wright is the UW-Madison site director for CIRCS, which will be located at Northern Illinois University.

CIRCS will conduct research that aims to make society more resilient and better able to withstand the impacts of "convective" storms—like tornadoes, hail and extreme rainfall. The collaborative center includes nearly two dozen scientists from the fields of atmospheric science, engineering, geography, physics, computer science, actuarial science and risk and insurance.

"There are synergies with people in atmospheric sciences who do field observations or use satellites for observations, while we create models," Wright says. "The idea with this center is that it will bring all of these people together with expertise from across different disciplines to make the research bigger than it would otherwise be."

The National Science Foundation is providing $1.5 million in funds over five years to establish the center, which will be further supported by about a dozen private companies, with each paying an annual membership fee and in return helping to direct the focus of CIRCS research.

Damage from severe convective storms has been on the rise in recent decades, driven by changing weather patterns and shifting geographical populations.

According to the National Oceanic Atmospheric Administration's National Centers for Environmental Information, the United States was buffeted by 190 separate billion-dollar weather and climate disasters from 2015 to 2024. These events, which are often driven by convective storms, killed more than 6,300 people in total and caused roughly $1.4 trillion in damage. CIRCS research thrusts will focus on convective storm risk, prediction, societal impacts, changing weather patterns and data science modeling.

The new Center for Interdisciplinary Research on Convective Storms will focus on way to make society more reslient to extreme weather events. Associate Professor Daniel Wright is serving as the UW-Madison site director for the center. iStock photo.

Professors Hannaha Blum, Aarushi Bhargava and Eric Tervo (front) pose with College of Engineering Dean Devesh Ranjan and Grainger Institute for Engineering Director Oliver Schmitz. Submitted photo.

Grants empower bold thinking and transform vision into momentum

Expanding a consortium that strengthens ties between the college and the steel industry. Commercializing chip-cooling tech. Designing an economical nuclear microreactor.

Through funding and in-kind support, Wisconsin Impact Nexus grants are igniting a ripple effect, enabling College of Engineering faculty and staff to amplify their research in ways that accelerate progress and open doors.

Administered through the college's Grainger Institute for Engineering, the Wisconsin Impact Nexus grant program focuses on entrepreneurship, industry engagement, or large-scale interdisciplinary initiatives. The program is an evolution and reimagining of the institute's seed grant program, which has funded lab equipment and software procurement, precompetitive research projects, seminars and collaborative workshops since its inception in 2015.

"With this model, we can come in and say, 'We can help you with a project plan,'" says Oliver Schmitz, Grainger Institute for Engineering director, College of Engineering associate dean for corporate engagement and entrepreneurship, and a professor of nuclear engineering and engineering physics. "We can help you with engagement with your industry partner, or help you with your technology innovation. We can approach policy-makers to advocate for your idea. Working together, we can do all of these things that can make an idea stronger."

It's a model that amplifies support provided through traditional grants, where faculty receive grants to advance the research laid out in their proposals.

Wisconsin Impact Nexus grants already are resonating with faculty. Take Adelle Wright. An assistant professor of nuclear engineering and engineering physics who is leading a supported project, Wright says the program's multifaceted support can ultimately make her projects more impactful.

"From my perspective, the WIN is really unique, and I wish more projects were run like this," Wright says. "We had a short application to pitch the project, worked with the Grainger Institute for Engineering to get feedback, and they shared ideas on how we could connect to different areas of campus. It really expanded the scope of my initial pitch."

In her work, Wright wants to bring researchers from across UW-Madison together to design a framework for diagnostics innovations for current and future fusion energy systems.

The Wisconsin Impact Nexus supports research through grants issued to annual cohorts. Schmitz says proposal applications are short—half a page or less. In 2025, eight projects earned funding in areas ranging from bicycle design to quantum computing to nuclear fusion. Support typically runs one or two years.

One such project is an initiative by Alain H. Peyrot Associate Professor of Structural Engineering Hannah Blum to expand and strengthen industry partnerships through the Consortium for Holistic Steel Systems.

Blum leads the consortium, which launched in 2024 as an industry-academia partnership focused on improving steel construction. The consortium focuses on advancing steel use in the areas of structural reliability, robustness, and responsible designs. Reliability deals with the long-term integrity of steel structures and systems, while robustness includes their ability to withstand adverse conditions such as earthquakes or storms.

Responsibility looks at steel's environmental impact from raw materials to finished products, including any recycled products that might extend its life cycle. That draws on the work of Associate Professor Andrea Hicks, who is in the consortium and a leader in life cycle analysis.

The Wisconsin Impact Nexus will support the consortium's collaborations with industrial partners on industry-supported research projects. The industry-academia partnership brings together experienced engineers with researchers at UW-Madison, drawing on the strengths of both to tackle challenges facing the steel industry.

As the program continues to grow, Schmitz says he hopes it can support more faculty and position them to succeed in projects that push their research areas forward. "We're learning how to do this strategic integration better," he says. "Another key goal for us is to support more transdisciplinary efforts. We want to help our faculty be truly cross-disciplinary."

Algorithm increases the chance that we're counting nanoplastic concentrations correctly

A growing environmental concern, nanoplastics have been found in water around the world—from the deep oceans to Arctic ice.

New research, published in the August 2025 issue of the journal *Environmental Science and Technology*, could make these tiny plastic particles easier to detect and monitor. That's important, in part, because nanoplastics can easily make their way into our bodies and adversely impact our health.

Assistant Professors Haoran Wei and Mohan Qin developed an algorithm that reduces noise from the membranes used in Raman spectroscopic analysis of nanoplastics. In Raman spectroscopy, researchers shine a laser onto a material and measure shifts in light frequency as photons interact with molecular bonds. Because each molecule scatters light differently, researchers can identify materials by tracking energy gained or lost in those interactions.

However, since nanoplastics measure between 1 and 1,000 nanometers—smaller than a human hair—they're so tiny that they push the limits of Raman detection, Wei says.

"The laser spot size we use is relatively large—about several micrometers in size," Wei says. "If the plastic particle is only a few hundred nanometers across, it generates a small signal. At that point you can get a lot of interference from the membrane itself, because it produces slight signal returns."

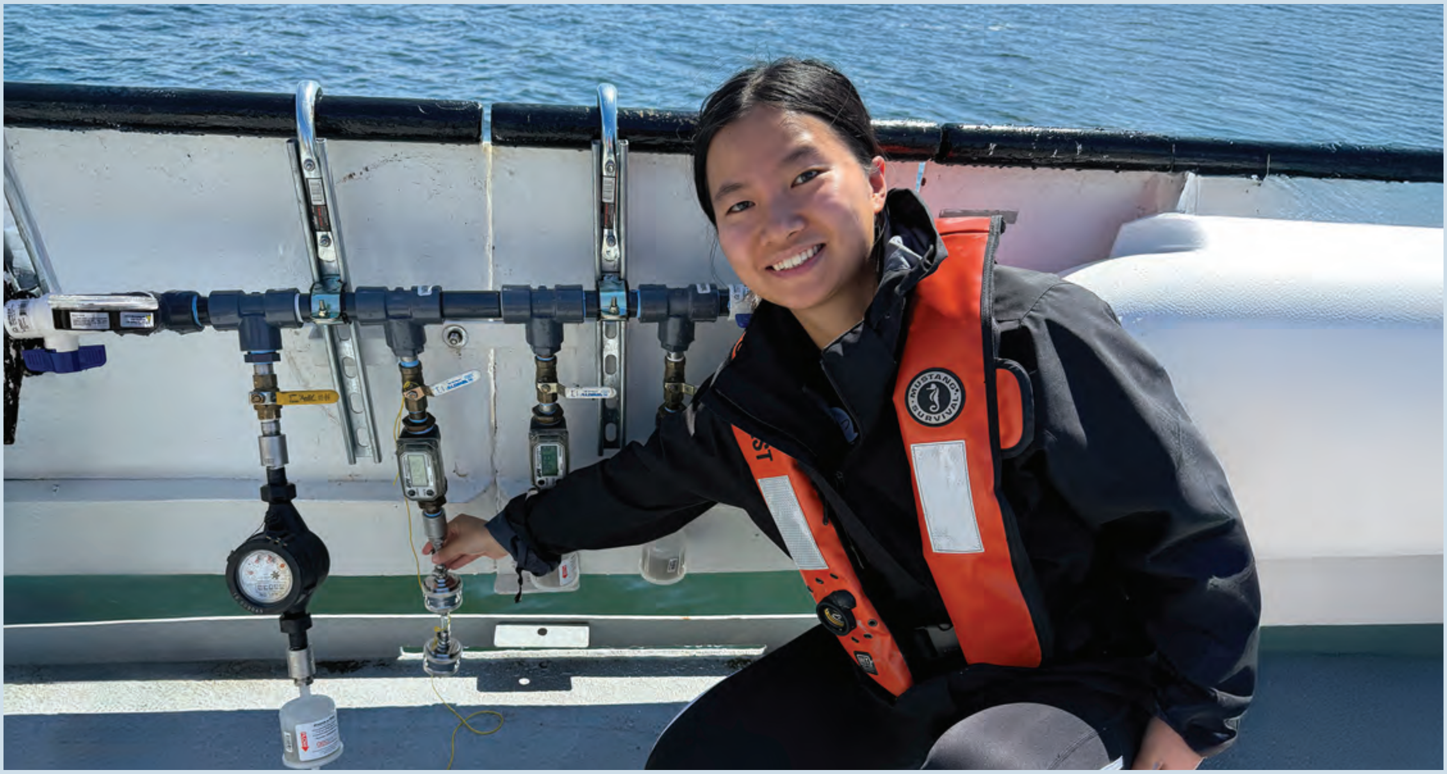
Those signal returns can show up as false positives when researchers are scanning a water sample for nanoplastics. To address this, Wei's and Qin's teams used experimental data sets to determine signal thresholds at different points along the light spectrum. Wei says the thresholds are customizable.

The teams tested the algorithm on water samples from Lake Mendota, in Madison, Wisconsin, and from Lake Michigan. The algorithm was 93.5% accurate in identifying nanoplastics and more than 90% accurate in rejecting non-nanoplastic interference.

With a cleaner picture, the researchers can count the pixels in a scanned image to measure nanoplastic concentrations in a sample. "It works very well for nanoplastic identification," Wei says. "We cleaned up almost all of the interference across the nanoplastics signals. We achieved almost perfect quantification calibration curves because there were no false positives across the membrane surface."

While the algorithm currently only works with single-band Raman spectroscopy, which can be less selective if two polymers share common features, Wei plans to refine the algorithm to work with multi-band Raman spectroscopy, also.

He hopes the method will be a step toward improving how we monitor nanoplastic levels in our water. "We don't have a standard method for measuring nanoplastics in water," Wei says. "But there's been a lot of focus on this emerging contaminant in the last few years, because it's potentially a bio-accumulator and we don't know how toxic it may be. This project was for Great Lakes water, but it could potentially be extended to drinking water, wastewater, or groundwater."



PhD student Ziyan Wu shows a sequential filtration system used to filter water samples from Lake Michigan. The system can help with capturing contaminants like "forever chemicals" or microplastics from lake water. Submitted photo.

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A new digital twins research experience will help undergrads keep an eye on our nation's roads

A new summer research program will give civil engineering undergraduates hands-on exposure to the future of roadway construction.

Associate Professor Zhenhua Zhu says the 10-week program will focus on digital twins in road construction. The program will begin in May 2026. The National Science Foundation is supporting it through its Research Experiences for Undergraduates program.

Digital twins are digital representations of a physical system or asset. They can represent everything from engines to factories. For example, if a digital twin is paired with a bridge, the first step is creating a digital model, then sensors on the bridge collect data that feeds into the model to predict when maintenance is needed.

Zhu says the program is designed to prepare undergraduate students for a field increasingly being shaped by digital infrastructure tools. Digital twin technology could, for example, help transportation agencies better predict deterioration and plan maintenance for aging roads and bridges.

"There are still a lot of questions we need to answer, like what data structures are appropriate for the digital twinning of road infrastructure," he says. "How can we use digital twins of road infrastructure to create meaningful applications for the industry? Much of the road infrastructure across the United States is aging, so deterioration is a major issue. Do we use digital twins to facilitate or assist with asset management of our current infrastructure?"

We're partnering with West Virginia University for the summer research program. Students will spend the first eight weeks of the program at their respective universities. Zhu says that in addition to lectures, the program will introduce students to industry professionals and speakers from transportation departments who can provide real-world insights into efforts to digitize road infrastructure.

Students will spend the program's final two weeks in the United Kingdom at the University of Cambridge. There, Zhu says, they'll get to collaborate with peers who are part of the European Commission-supported Future Roads Fellowship.

"One of the fundamental missions of the Future Roads project is the digital transformation of road infrastructure," Zhu says. "So that's going to be a great opportunity not only for our students to learn from them, but for them to learn from us: to exchange ideas about the current status and challenges of digital road infrastructure."

The summer research program will run for three years. Though this year's application window is closed, applications for the 2027 program should open in fall 2026.