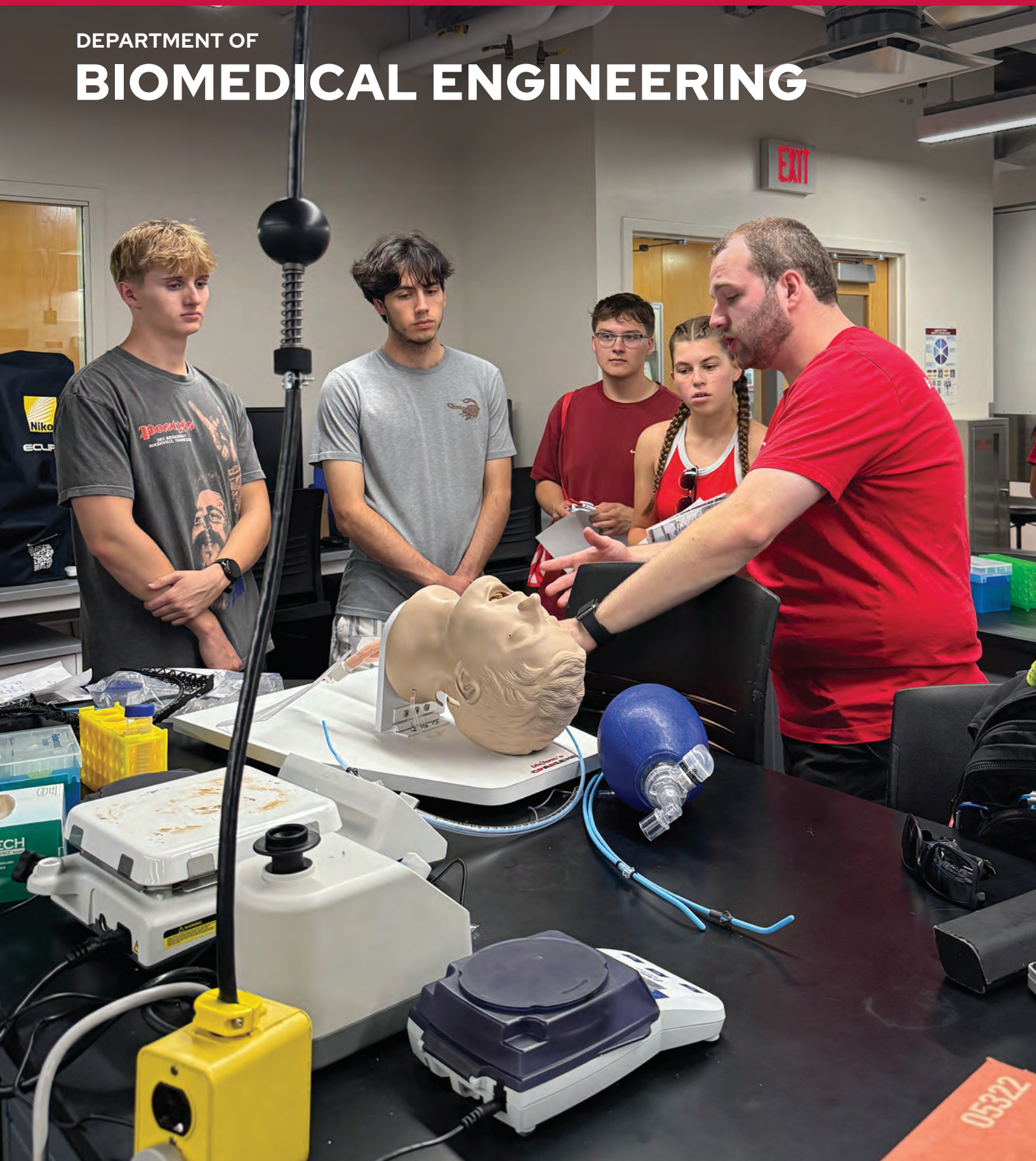
College of Engineering
UNIVERSITY OF WISCONSIN–MADISON

FALL 2026 NEWSLETTER

DEPARTMENT OF

BIOMEDICAL ENGINEERING





Dear friends of Wisconsin Biomedical Engineering,

It is a genuine honor to write to you for the first time as the Peter Tong Chair of the Department of Biomedical Engineering at UW-Madison. Since arriving, I have spent much of my time meeting and listening to faculty, staff, students, alumni and partners. Those conversations have left me truly energized. Wisconsin BME has the people, the culture and the ambition to do something special, and I could not be more excited to be a part of it.

My own path to biomedical engineering began in aerospace engineering at the University of Colorado Boulder, followed by a doctorate in biomedical engineering at Columbia University and postdoctoral training in bioinformatics and computational biology. I then spent over two decades in the Joint Department of Biomedical Engineering at the University of North Carolina-Chapel Hill and NC State, where I most recently served as Associate Chair for Research and helped lead FastTraCS, a MedTech accelerator that worked to move innovations from the lab to patients. My research combines computational systems biology and translational AI, from designing smarter combination cancer therapies to building tools that support clinical decision-making.

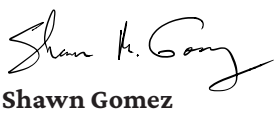
I was drawn to Wisconsin by a reputation I had long admired from afar, both for how it educates engineers and for the impact of its research. Wisconsin BME is known nationally for an education built around hands-on design, where students work on real problems for clinical and industry clients from their first year, and its graduates leave ready to lead, whether in medical device companies, research labs, medical school or startups of their own. Seeing it up close has only deepened my admiration. The same focus on solving real problems drives our research. Our faculty work at every scale, from molecules and cells to imaging and medical devices, and our close partnerships with UW Health, the School of Medicine and Public Health and colleagues across one of the country's great research universities create a rare environment where discoveries can move from the lab to the clinic.

The years ahead are full of opportunity. Artificial intelligence is changing how we discover therapies, understand disease and deliver care, and Wisconsin BME is positioned to help lead that transformation. Building on our longstanding strengths, we will grow our faculty in computational and AI-driven areas, expand collaborative research programs on major health challenges and keep evolving our curriculum for the careers of tomorrow.

To our students and their families: thank you for trusting us with this important stage of life. To our alumni: you are our best ambassadors, and your mentorship and engagement make a lasting difference. To our donors and partners: your support creates opportunities that would not otherwise exist, and I would welcome the chance to talk about where we are headed together. And to our colleagues across the country: I hope we find many opportunities to work together.

I look forward to meeting many of you in the months ahead.

On, Wisconsin!



Shawn Gomez
Peter Tong Department Chair and Professor
shawn.gomez@wisc.edu

Wisconsin Idea in Action

One of the University of Wisconsin's longest and deepest traditions, the Wisconsin Idea is a guiding principle: education should influence people's lives beyond the classroom.

Mechanical forces exerted and outcomes by CAR-T cells

Assistant Professor Joshua Brockman: Chimeric antigen receptor (CAR) T-cell therapy is a personalized immunotherapy that genetically reprograms a patient's own immune cells to seek out and destroy cancer cells. Currently, CAR-T therapies work only for certain leukemias and lymphomas; even in those diseases, not all patients respond to this costly therapy. The Brockman lab discovered that CAR-T cells exert force when they bind to their target protein, much like normal T cells produced by a person's immune system. The lab is working to uncover how important force is to CAR-T cells when targeting cancer cells. Because CAR-T cells are artificial, man-made proteins, they will fight cancer more effectively with better understanding of their mechanics.

Novel instrument for a safer surgical approach

BME design project: BME scholars designed a novel surgical instrument to improve safety and efficiency during procedures such as carpal tunnel and ulnar nerve decompression surgery. The "Nerve Ninja" combines a forceps with a deployable scalpel blade, allowing surgeons to grasp, dissect and cut tissue while protecting surrounding nerves. The innovative design earned the top prize at the 2024 Collegiate Inventors Competition held by the National Inventors Hall of Fame. It addresses the limitations of traditional scissors, which dull quickly, and scalpels, which pose an injury risk. It allows surgeons to operate more efficiently while protecting patients from accidental nerve damage and permanent disability.

Where to find us

engineering.wisc.edu/bme

linkedin.com/company/uwbiomedicalengr

instagram.com/UWMadison_BME

Not just for show and tell, tomorrow's ultrasound tech can treat cancerous tumors, tissue and more

Assistant Professor Aarushi Bhargava's research brings a mechanics perspective to ultrasound therapy. Bhargava leads the SonIMate Mechanics group, which focuses on developing noninvasive therapy, targeted drug delivery methods, and understanding the mechanics of ultrasound interaction with synthetic and biological soft materials. Bhargava, a mechanical engineer by training, also studies how to pair ultrasound with medical robots and how to use ultrasound as a therapy for a variety of injuries and diseases.

In this Q&A, Bhargava discusses how ultrasound works and talks about some of its emerging medical applications.

Q: What is ultrasound?

Ultrasound is, at its core, just sound, but at a frequency far too high for human ears to detect. Most people have encountered ultrasound in a clinic or hospital, where it's used to create images of the inside of the body. The way it works is that a handheld device called a transducer sends out pulses of these high-frequency sound waves into the body. Within the body, the waves pass through different types of tissue—muscle, fat, fluid or bone—and each one interacts with the waves differently.

Soft tissues like fluid or blood let waves pass through fairly easily, while denser structures like organs or bone reflect much more of the wave back toward the transducer. The transducer picks up those returning echoes, and a computer translates the timing and strength of each echo into a picture. Areas that reflected a lot of the wave show up brightly such as organ or tumor, while areas that absorbed or transmitted it appear darker, such as blood or a fluid-filled cyst.



Q: What's the difference between how ultrasound is used for imaging and for therapy?

Ultrasound waves for imaging emit straight, parallel, unfocused waves known as "plane" waves. These waves travel into the body at a very low intensity, so they don't cause injury. They illuminate a large area because of their unfocused nature.

For medical therapy, we focus high-intensity waves on a very small spot. Imagine using a magnifying glass to concentrate the sun's energy into a point where it can burn material. We're applying the same principle with therapeutic ultrasound and applying so much energy that we can actually alter a tissue.

For therapy, we're altering the tissue in one of two ways. One is by heating it up to the point that it burns the tissue and causes tissue death. The other is by causing cavitation. Cavitation often happens on ship turbine blades, where pressure fluctuations cause bubbles to form, collapse and generate shock waves that damage the blades' surface. By altering the ultrasound's properties, we can use those bubbles to cause damage to specific tissue. With this technique, we can actually fragment a tumor and treat it.

Q: How are you learning that ultrasound is effective in treating cancers in fibrotic, or scarred, tissue with ultrasound therapy?

The currently established cavitation technique works well in many cases, but it runs into limitations when a tumor is surrounded by a lot of hardened or scarred tissue. This condition, called fibrosis, is common in high-grade breast cancer, pancreatic cancer and pulmonary fibrosis in the lungs.

My research is focused on understanding why fibrotic tissue resists standard cavitation treatment, and on finding new ways to use ultrasound's mechanical properties to work around that resistance. Rather than simply trying to destroy the tissue outright, I'm exploring whether more nuanced mechanical interventions could make the tumor environment more receptive to treatment: whether that means responding better to the body's own immune response or allowing existing therapies like chemotherapy to work more effectively.

Through her work, Assistant Professor Aarushi Bhargava (right) hopes to expand the range of patients and cancer types that ultrasound therapy can realistically help, particularly those with more advanced or treatment-resistant disease. Photo: Joel Hallberg



Photo: Joel Hallberg

FOCUS ON NEW FACULTY

Shawn Gomez brings computation, collaboration to biomedical engineering

Shawn Gomez's research trajectory had already started to shift during the first few years of graduate school when life forced a more severe change upon him. Gomez's PhD advisor at the University of Colorado Boulder, the accomplished aerospace engineer Marvin Luttges, died suddenly of a heart attack at age 53, leaving Gomez to plot a new path forward.

Rather than persist with his work in aerospace engineering, which had crept from control systems for spacecraft to life support systems for astronauts, Gomez opted to lean into biology and medicine. He finished up formalities for his master's degree and moved across the country from Colorado, where he'd lived since childhood, to New York to attend Columbia University for his doctorate, this time in biomedical engineering.

More than three decades later, he's made another cross-country move—from North Carolina to Madison—where he's joined BME as a professor and the new Peter Tong Department Chair.

"UW-Madison is just a fantastic institution, with a huge number of resources, and it's really collaborative," he says, noting the presence of collocated engineering, medical and veterinary schools and an array of biomedical and biological research centers across campus.

Gomez spent the previous 21 years in the Lampe Joint Department of Biomedical Engineering at the University of North Carolina at Chapel Hill and North Carolina State University.

His research is rooted in computational systems biology, mapping protein interaction and cellular signaling architecture across the human body to better understand disease progression and inform treatment, particularly in regard to solid tumor cancers. In recent years, he's focused more on translational machine learning and artificial intelligence for clinical applications, such as predicting the likelihood of a patient developing drug resistance or an infection.

"The longer-term goal is that those two things will eventually join up, because we want to be able to basically influence the choices of drugs that are used for treating a particular patient," he says. "You're trying to identify the right drug or set of drugs for a set of patients and the right time for them to get it. We're trying to do that from both ends—from the basic science and understanding the principles of how cells work and then also from the clinical side."

At North Carolina, Gomez founded and served as co-executive director of FastTraCS, a medical technology incubator at the Chapel Hill campus. In his new role at UW-Madison, he's excited to build connections among the biomedical engineering department and recently launched entrepreneurial efforts at the campus (Wisconsin Entrepreneurship Hub) and college (Badger Tech Foundry) levels and to leverage existing technology-transfer infrastructure through the Wisconsin Alumni Research Foundation and the Technology Entrepreneurship Office.

Most of all, he plans to deepen the partnership between biomedical engineering and the School of Medicine and Public Health to connect engineering developments with clinical knowledge.

"I think there's just a huge number of opportunities for us," he says. "We should be able to do a lot more joining forces and combining engineering and technologies that are coming out of our college with the practical needs that are happening in the School of Medicine and Public Health."

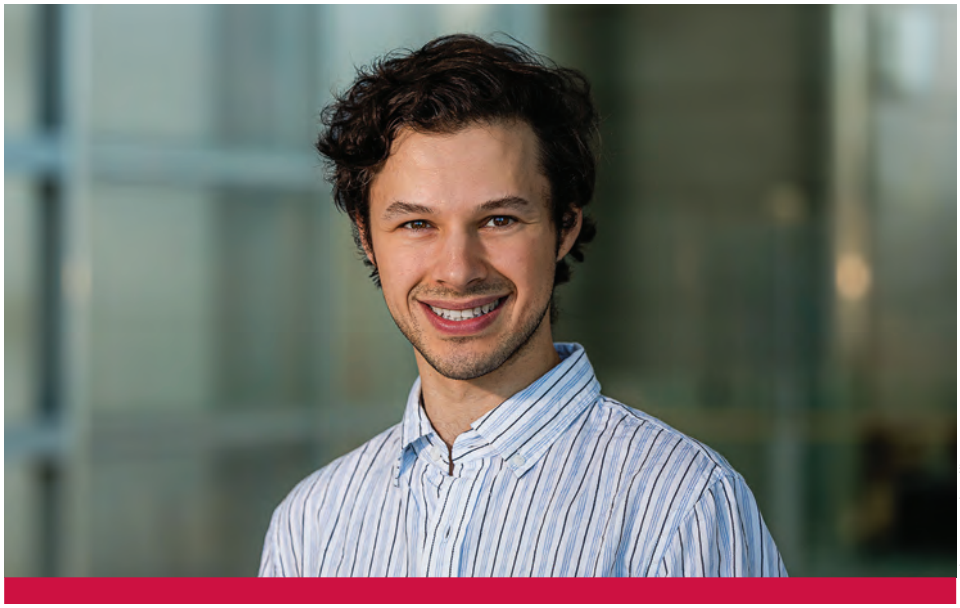


Photo: Joel Hallberg

FOCUS ON NEW FACULTY

Jonathan Soucy eyes new approaches to restore vision

As a young child in Lewiston, Maine, Jonathan Soucy squinted and stumbled until, at age 4, doctors belatedly diagnosed him with a congenital cataract in his left eye. While he underwent surgery shortly thereafter to correct the problem, more than two decades passed before he fully understood the complexities of his unique visual system—a realization that ultimately shaped his scientific career.

That understanding began with a trip to the ophthalmologist as a graduate student—strategically timed before he aged off his parents' health insurance. What he learned that day led him down a research rabbit hole exploring the neural connections between the eye and the brain.

Soucy joined BME as an assistant professor in July 2026, where he is establishing the Neural Engineering for Restoring Vision (NERV) Lab. In the NERV Lab, his team combines stem cell engineering, tissue engineering, and neuroengineering to understand how retinal ganglion cells reconnect with the brain and how those connections might one day be restored.

"Vision has an enormous impact on quality of life, yet many blinding diseases still have no way to restore the lost connections between the eye and the brain," he says. "That's the challenge my lab is trying to solve."

Before arriving in Madison, Soucy spent six years as a postdoctoral researcher at Harvard Medical School and the Schepens Eye Research Institute, where he developed strategies to transplant retinal ganglion cells—the neurons that carry visual information from the eye to the brain—as a potential strategy for restoring vision.

That was a fairly dramatic departure from his PhD work at Northeastern University, which focused on building organ-on-chips of the cardiac nervous system. Then came that fateful visit to the ophthalmologist at a hospital in Boston, where Soucy learned that he had a condition called deprivation amblyopia as a result of his delayed childhood surgery (a congenital cataract is typically removed within the first few months of life). Deprivation amblyopia, the most severe subtype of the condition colloquially called "lazy eye," can include dramatically reduced depth perception.

With a weak visual signal coming from his left eye, Soucy's brain had learned to ignore it and rely almost entirely on information from his right eye. Suddenly, his struggles to snag a disc out of the air while playing competitive ultimate frisbee made sense.

"It clicked for me because it was so similar to what I'd been studying during my PhD," Soucy recalls. "With the cardiac nervous system, you're studying how the brain innervates the heart. Here, it was almost the opposite—the retina innervates the brain. That's when I realized I could bring my engineering perspective into ophthalmology."

He pivoted to ophthalmology, winding up at Harvard and the Schepens Eye Research Institute, which is part of Massachusetts Eye and Ear—the same hospital where he'd undergone surgery at age 4.

There, Soucy worked on culturing, transplanting, and improving the survival and integration of retinal ganglion cells to replace neurons lost in diseases such as glaucoma. In order to reach their therapeutic potential, however, those transplanted cells must not only survive but also integrate into the retina and reconnect with the brain. Soucy is exploring the mechanisms at play, using a combination of stem cell-derived retinal models, mouse models and techniques that include optogenetics (using light to control neural activity) and chemogenetics (controlling neural activity using engineered receptors activated by small molecules).



New tool for researchers makes it easier to analyze individual neurons

The electrical properties of a neuron paint a picture of its development and function. A new user-friendly and accessible tool developed at UW-Madison's Waisman Center, with the help of BME researchers, allows scientists to analyze the electrical activity of individual neurons—rather than clusters—using a process known as spike sorting. The free tool is available online for other researchers to access.

The tool, called Semi-Automated MEA Spike sorting software (SAMS) is designed to separate electrical activity recorded from groups of human stem cell-derived neurons into signals from individual neurons. SAMS is specifically designed for data collected using a multi-electrode array (MEA), a device that uses microscopic electrodes to measure the electrical activity of cells.

SAMS was developed by the lab of Waisman investigator Xinyu Zhao, Jenni & Kyle Professor and Vilas Distinguished Achievement Professor of Neuroscience, and Waisman affiliates Aviad Hai, Vilas Early Career Associate Professor in BME, and Ari Rosenberg, Professor of Computational Neuroscience and Retina Research Foundation Edwin & Dorothy Gamewell Professor.

Neurons communicate by generating and transmitting information using electricity. The electrical pulses they use to communicate are known as action potentials, or spikes. Analyzing the spiking characteristics of neurons through electrophysiology is important to better understand their development, function and dysfunction, and how these processes change in response to diseases, environmental conditions, or therapeutic treatments.

While MEAs allow scientists to record electrical activity from many neurons simultaneously, this approach has limitations. "Some of the characteristics of neurons get disguised if you measure just the average," Zhao says. Resolving the activity of single neurons requires a process called spike sorting.

Current spike sorting methods were not developed for analyzing data from human stem cell-derived neurons. They also involve a complex pipeline and time-consuming manual intervention. Scientist Carissa Sirois and doctoral student Xiaoxuan Ren from the Zhao and Hai labs developed SAMS as a tool to take the recordings and sort them into single spikes in an automated way.

When tested, SAMS produced accurate and consistent results while greatly reducing data-processing time. The software tool also enabled researchers to identify additional neuronal characteristics that they hadn't detected before without spike sorting.



CRISPR roadblocks: Scientists identify genes blocking gene therapy success

Like a delivery driver navigating crowded city streets, a gene-therapy-toting lipid nanoparticle faces a gauntlet of potential detours on its journey toward a cell's nucleus.

First, there's entering the cell's plasma membrane; then navigating around organelles like the Golgi apparatus, mitochondria and endoplasmic reticulum—all destinations that can errantly absorb the particle's payload, rendering it ineffective at best or harmful at worst. And that's all before the particle even enters the nucleus and successfully makes a genetic change.

As part of an effort to improve nonviral genetic editing technologies, with particular interest in treating genetic eye diseases, a group of UW-Madison researchers led by Professor Krishanu Saha developed a platform to screen nearly all genes in the human genome—more than 19,000 genes—linking disruption of individual genes to improved genetic outcomes in human cells. The work was published in the journal *Nature Communications*.

The work could provide a roadmap for identifying potential detours in different cell types when gene editors like CRISPR-Cas9 are applied to cells in the lab or to tissues in the body. Such knowledge could inform the design of new strategies, such as pre-treatments to temporarily mute those genes, to enhance the effectiveness of gene therapies, and even mRNA vaccines and immunotherapies.

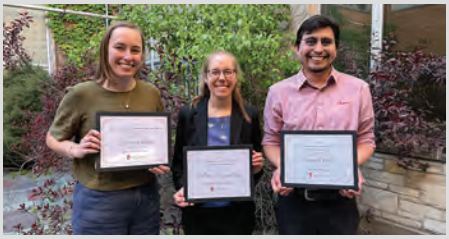
"We essentially knock out each gene one by one in different cells. It's a massive undertaking if you were to try to do that in 19,144 different cell cultures, for instance," says Saha. "Here we do it in essentially a few dishes of cells that have 100 million cells in them. Then we use a precise sequencing strategy to find which genes matter the most, essentially the needles in this genomic haystack."

Over the course of the six-year project, the researchers culled a list of 19,144 genes down to 26 that, when knocked out, increased the editing efficiency by the Cas9 gene editing protein. They further trimmed their list to six, then validated the top two and tested the effects of knocking them out on editing efficiency in human model cell systems. Depleting either of the two genes (GJB2 and BET1L) improved editing efficiency by more than six times using base editors, so called "CRISPR 2.0," which chemically change individual bases in DNA rather than making cuts in the genome like the traditional CRISPR-Cas9 editor does.

FACULTY NEWS

Harvey D. Spangler Professor William Murphy received a named professorship through the Wisconsin Alumni Research Foundation in recognition of major contributions to the advancement of knowledge through his research, teaching and service. Murphy chose the Cathy A. Rasmussen Professorship in remembrance of his late colleague with the UW-Madison-based Forward BIO Institute.

Associate Professor Filiz Yesilköy was elected a senior member of Optica and SPIE.



L to R: Katrina Falk PhDBME '26, Associate Professor Colleen Witzenburg, Samir Rosas PhDBME '25. Anna Tommasi, not pictured.

This year, four outstanding members of the biomedical engineering department were recognized for their dedication to mentorship, serving as a testament to our department-wide commitment to bridging the gap between academic excellence and personal well-being.

Excellence in Graduate Student Mentoring – Assistant Professor: Colleen Witzenburg, now an associate professor, was recognized for her holistic approach to student success.

Post-Doctorate Mentoring and Service – Overall Winner: Samir Rosas (PhD '25) was honored for the outstanding ways he supports students in and out of the lab.

Graduate Student Mentoring and Service – Excellence in Department Support: Anna Tommasi, a PhD student in Professor Kris Saha's lab, was honored for her ability to support individuals while simultaneously demonstrating leadership that benefits the entire Department of Biomedical Engineering.

Graduate Student Mentoring and Service – Honorable Mention: Katrina Falk (PhD '26) was honored for her skill to combine her technical expertise with a welcoming, thoughtful approach.

Congratulations to the following BME professors who received promotions and tenure. These achievements mark important career milestones and recognize contributions to research, teaching and service across the college.

- Megan McClean was promoted from associate professor to full professor.
- Colleen Witzenburg was promoted from assistant professor to associate professor, with tenure.
- Filiz Yesilköy was promoted from assistant professor to associate professor, with tenure.

STUDENT NEWS

PhD students Joshua Alexander and Peyton Lancaster received National Science Foundation Graduate Research Fellowships. Alexander is a member of Professor David Dean's lab, while Lancaster is part of Associate Professor Colleen Witzenburg's lab.



Undergraduate students Noah Kalthoff and Ruffin Bryant, along with computer science and data science student Aadya Ganjigunta, earned double honors at the Endoscopic Vision (EndoVis) Challenge in Strasbourg, France. Competing at MICCAI 2026 against 78 participants from around the globe, the group secured third place in the Surgical Visual Question Answering category and earned the award for Best Methodology Report.

The student-led team developed an advanced AI system capable of answering questions directly from surgical footage. Mentored by BME Assistant Professor Dhananjay Bhaskar and UW Orthopedics and Rehabilitation Assistant Professor Tuo Peter Li, Kalthoff and Bryant originally launched the concept during a BME design project in 2025—a project that has since grown into their startup company, OpScribe-AI.

ALUMNI NEWS

Chris Fernandez (BS '14, MS '15) and Nick Glattard (BS '14, MS '15) are BME's Early Career Award recipients as part of the college's annual Engineers' Day celebration honoring outstanding alumni. Fernandez and Glattard are co-founders and chief research officer and chief technology officer, respectively, of the healthcare tech company EnsoData. The Madison-based company is cleared by the U.S. Food and Drug Administration (FDA) to use artificial intelligence to accelerate diagnosis of sleep disorders such as sleep apnea, grew out of a BME design project. EnsoData's software has helped diagnose more than 3.5 million individuals with sleep disorders to date.

Bin Li (PhD '22) received the George Palade Award from the Microscopy Society of America. This award recognizes "rising stars" who have made distinguished contributions to life science microscopy and microanalysis within six years of graduating.

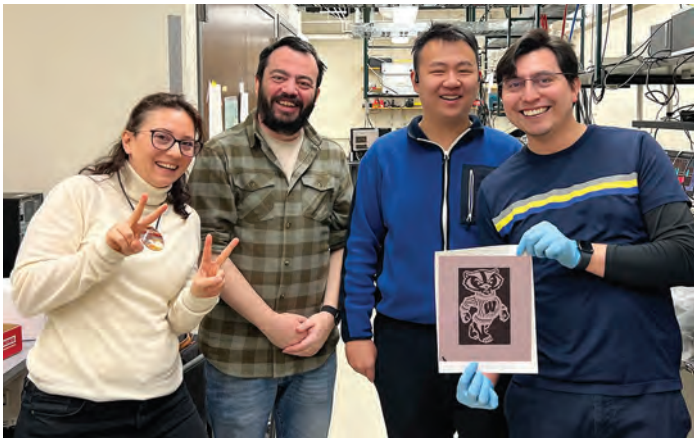


Welcome to our newest alumni!

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Tunable metasurface could bring powerful molecular sensing from the lab to the field

Mid-infrared spectroscopy can identify the molecular composition of unknown samples by their "fingerprints" at different wavelengths, allowing scientists to look beyond visible light's band within the electromagnetic spectrum. The data is valuable for analyzing chemical and biological samples; however, the technology is generally confined to large instruments in research laboratories.

An international team led by Vilas and Grainger Associate Professor Filiz Yesilköy took a step toward miniaturizing biochemical sensors with a new type of tunable metasurface: an ultrathin optical material that can dynamically scan for the molecular "fingerprints" of chemicals using infrared light. The work was published in the journal *Light: Science and Applications*.

Yesilköy and her team had already developed thin silicon membrane metasurfaces they could geometrically pattern to selectively filter specific wavelengths when analyzing samples in solid and gas phase. However, once the team fabricated a metasurface with a particular pattern, it couldn't modify the component to hunt for other molecules at different wavelengths.

Enter Furkan Kuruoglu, who spent a year at UW-Madison as a visiting faculty member from Istanbul University. "Silicon has some features we can tune with temperature," says Kuruoglu. "By switching the metasurface temperature gradually from room temperature to high-temperature range, we can dynamically manipulate the optical resonances of the metasurface."

Moving forward, Yesilköy envisions future portable sensors capable of detecting airborne pathogens or hazardous gases, identifying contaminants in biosamples, or performing rapid biochemical analysis.

From left, Associate Professor Filiz Yesilköy, visiting faculty member Furkan Kuruoglu, electrical and computer engineering PhD student Yihong Chen and postdoctoral researcher Samir Rosas. Submitted photo.