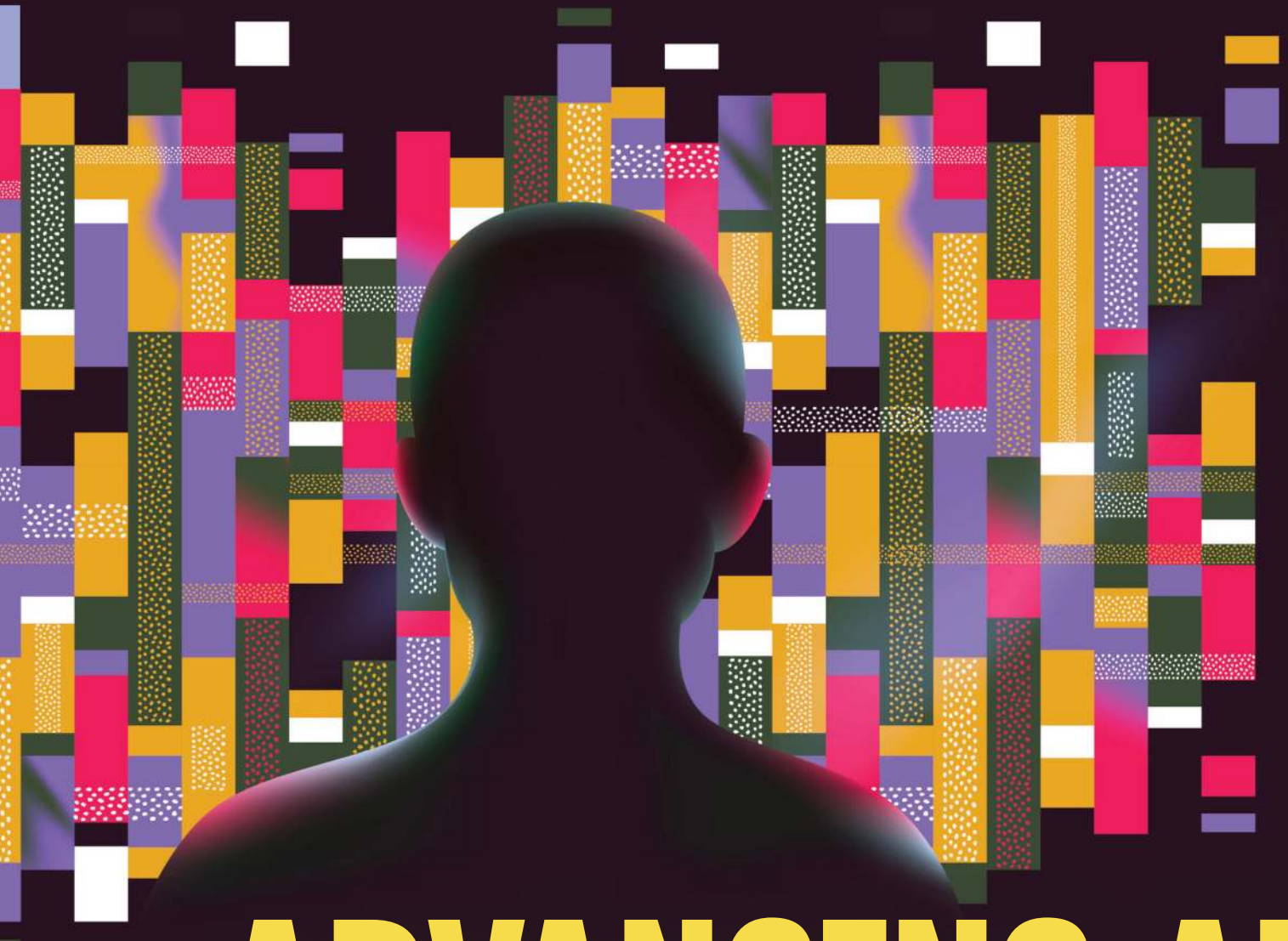
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Engineering Innovation at Lehigh



ADVANCING AI

Lehigh engineers are improving **artificial intelligence** and using it to turn complex data into insight and discovery

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P.C. Rossin College of Engineering & Applied Science
LEHIGH UNIVERSITY



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COLLEGE DEANS
Stephen P. DeWeerth
Professor and Lew and Sherry Hay Dean

Derick Brown
Professor and Associate Dean
for Undergraduate Education

Megan Casey
Associate Dean for Development
and Alumni Affairs

Kristen Jellison
Professor and Associate Dean
for Faculty Development

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for Research

Anand Ramamurthi
Professor and Associate Dean for
Global Engineering Initiatives

Mark Snyder
Professor and Associate Dean
for Graduate Education

Susan Perry
Professor of Practice and Assistant Dean
for Academic Affairs

PUBLICATION DIRECTOR | Chris Larkin

EDITOR | Katie Kackenmeister

SENIOR WRITER AND MULTIMEDIA CREATOR
Christine Fennessy

DIGITAL DIRECTOR | Marc Rosenberg

DIGITAL MARKETING SPECIALIST
Maegan Anderson

DESIGN | Gipson Studio LLC

CONTRIBUTING WRITERS
Katie Clarke, Stephen Gross

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P.C. ROSSIN COLLEGE OF ENGINEERING AND APPLIED SCIENCE
Lehigh University
19 Memorial Drive West
Bethlehem, PA 18015
610-758-4025
engineering.lehigh.edu

SUBSCRIBE OR SEND COMMENTS
engineering@lehigh.edu

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COVER: IVAN HAIDUTSKI/ISTOCKSY; BACK COVER AND OPPOSITE PAGE: CHRISTA NEU

Turning ideas into action

Welcome to the Fall 2026 edition of *Resolve*—a magazine dedicated to research and educational innovation in the P.C. Rossin College of Engineering and Applied Science at Lehigh University.

This fall marks an important step forward for First Year Rossin Engineering. In its second year, FYRE has grown from three pilot modules to eight, giving first-year students more ways to tackle real-world engineering challenges from the moment they arrive at Lehigh.

The expanded lineup spans topics such as natural disasters, plastic remediation, sensing, energy storage, agentic AI, and sustainable energy for AI and microgrids. Through these seven-week modules, students begin connecting concepts across disciplines while gaining experience with the tools, teamwork, and persistence that engineering requires.

I have seen that process firsthand this semester as a co-instructor in the Human-Machine Interface module, led by bioengineering professor Juan Aceros. Students are learning how electrical signals from the human body can be translated into commands for a robotic arm. Watching first-year students wrestle with an unfamiliar interdisciplinary problem and persist as they build new knowledge and skills has been particularly rewarding. You can read more about FYRE's expansion on page 20.

That learning-by-doing approach continues well beyond the first year. "Engineering on Tap" (page 22) takes readers into a course on brewing, winemaking, and distilling, where upper-level students apply chemical engineering principles through hands-on work in process design and product development. It is a distinctive class, but the larger idea—giving students the chance to put what they are learning into practice—is fundamental to the Lehigh engineering experience.

Keeping that experience relevant also requires us to respond to change, and few areas are changing as quickly as artificial intelligence. The pace of advancement is already affecting how we teach computing, how AI is incorporated into programs such as FYRE, and how we think about the curriculum more broadly. Our new bachelor's degree in Artificial Intelligence, Machine Learning, and Data Science (see page 17) is another example of that evolution.

What feels current today can quickly become a new baseline. That reality makes adaptability especially important for our students and for the faculty and programs preparing them.

for interdisciplinary faculty teams pursuing promising ideas. That backing allows researchers to generate preliminary results, establish collaborations, and become more competitive for external funding.

Over the past two fiscal years, the Rossin College has received nearly $34 million in philanthropic commitments. That generosity is helping us strengthen academic programs, advance faculty research, and invest in the student experience. A new $1 million matching challenge from an anonymous alumnus is the latest example, creating the potential for eight new endowed scholarships for undergraduate engineers. See the inside back cover of this issue for more.



GIVING STUDENTS THE CHANCE TO PUT WHAT THEY ARE LEARNING INTO PRACTICE IS FUNDAMENTAL TO THE LEHIGH ENGINEERING EXPERIENCE.

Our cover feature, "Making AI Work" (page 14), reflects that same dynamic in research. Rossin College teams are striving to improve AI itself while applying the technology to complex problems. Their projects aim to make AI reasoning more reliable, streamline scientific research, and uncover patterns in data that might otherwise be difficult to see.

In the Q&A (page 8), Lumen CEO Kate McConnell Johnson '89 adds an industry perspective. Johnson discusses both the networks required to support the AI economy and the mindset needed to navigate rapid technological change.

On page 10, we also explore the Rossin Research Innovation Grant program, which is funded by alumni donors and provides early support

Taken together, these efforts reflect the kind of environment we continue to build: one that can respond to change while giving students and faculty the support and experiences they need to grow, adapt, and make an impact.

I hope you enjoy this edition of *Resolve*; thank you, as always, for your interest in Lehigh Engineering!



Stephen P. DeWeerth, *Lew and Sherry Hay Dean*
P.C. Rossin College of Engineering and Applied Science
steve.deweerth@lehigh.edu

When tiny swimmers reverse course

Researchers find that robots slide backward in fluids that mimic blood and mucus, offering new insight for targeted drug delivery

One day, tiny swimming robots may travel through the human body to deliver drugs. The medication would target only areas of need—chemotherapy drugs for a tumor, for example—avoiding healthy tissue and minimizing side effects.

A research team led by Ebru Demir, assistant professor of mechanical engineering and mechanics, with collaborators On Shun Pak (Santa Clara University) and Roberto Zenit (Brown University), is studying how tiny robots move through bodily fluids. They recently published a paper in the journal *Applied Physics Letters* detailing new foundational insights.

The challenge is that bodily fluids are difficult to navigate. Blood and mucus are non-Newtonian fluids, meaning their viscosity changes under shear stress, which occurs when layers of fluid slide past one another or along a solid surface like a blood vessel wall.



Demir demonstrates an experimental setup used to study how tiny swimmers move through complex fluids.

A surprising shift in motion

"We found that the rheology, or properties of the fluid, affected the locomotion of the swimmers," says the paper's lead author, Amin Balazadeh Koucheh, a second-year PhD student in Demir's research group. "Specifically, we found that the swimmer reversed its direction of motion when we increased the actuation frequency in a non-Newtonian fluid. This phenomenon has been shown numerically by our research group, but this was the first time it's been shown experimentally."

The team used two types of tiny swimmers, a sphere and a helix modeled after the corkscrew shape of certain bacteria. They embedded a magnet within each and tested them first in Newtonian fluid. (The viscosity of Newtonian fluids, such as water or alcohol, never changes, no matter how much the fluid is shaken or stirred.) They used millimeter-scale swimmers (see inset) but matched the physics of microswimming by increasing the viscosity of the test fluids.

By magnetically actuating the swimmers, the researchers caused them to rotate and move forward. As they increased the frequency of the rotation, the swimmers continued to move forward at a higher rate of speed, as expected.

At the same time, the way the swimmers pushed against the surrounding fluid near the wall also caused them to move sideways while moving forward, resulting in a diagonal trajectory. But when they placed the swimmers in a synthetic non-Newtonian fluid meant to simulate mucus or blood, the researchers observed an unexpected behavior: Under the same magnetic actuation, the swimmers moved sideways in the opposite direction from what they did in a Newtonian fluid.

"They start to slide backward, in a sense," says study co-first-author Ben Ratner MS'26. "It's almost like changing the fluid changes where the finish line is for each swimmer."

Toward better control

The significance of such unexpected movement lies in the team's ultimate objective: successfully manipulating the swimmers. To do that, they need to first understand how the swimmers react to different environments.

"Both types of swimmers showed this backward sliding motion," says Balazadeh Koucheh. "So we now understand that rheology alone is enough to affect this phenomenon rather than shape. It's a very nice finding since our aim is to control these swimmers inside shear-thinning fluids like mucus and blood."



The next step for the research is to explore the effects of rheology on swimmers designed at the microscale and with different shapes.

Although targeted drug delivery remains many years away, findings like this represent the incremental advances that will bring the concept from theory to practice.

"The same swimmer behaves completely differently depending on what it's swimming through and that's a powerful handle for control," says Demir. "We used to think of the fluid as just the medium. Now we're starting to see it as part of the machine."

TOP: DEMIR LAB; LEFT: CHRISTA NEU; BOTTOM: STARLAB/NASA

TOP: RYAN HULVAT/MERIS

Gold-palladium interaction reveals unexpected catalytic behavior

The building-block chemicals behind everyday items like shampoo bottles and kitchen spatulas are largely derived from oil. Researchers are now working to replace those fossil-fuel-based inputs with materials sourced from renewable biological systems.

These biosourced molecules begin as renewable feedstocks such as plants and algae.

"Through a series of chemical steps, these molecules can be transformed into platform chemicals that industry uses to make a wide range of products," says Steven McIntosh, Zisman Family Professor and Chair of the Department of Chemical and Biomolecular Engineering.

> "WE'VE EFFECTIVELY ENABLED AN ENTIRELY NEW REACTION MECHANISM."
>
> —Steven McIntosh

But many of those reactions remain poorly understood. In a paper published in *Nature Catalysis*, McIntosh and his collaborators shed light on how these transformations occur and how they might be made more efficient.

At the center of the project is a newly observed interaction between two common catalyst metals: gold and palladium.

Building on earlier work, the team examined how gold and palladium interact when used together as catalyst particles. They found that the two metals couple through an electrochemical mechanism, altering each other's behavior in ways that change how reactions proceed.

"Every reaction consists of two half-reactions, oxidation and reduction," says McIntosh. "In conventional catalytic reactions, both occur on the same catalytic particle. But in our design we couple separate gold and palladium nanoparticles, forcing those reactions separate, and making the overall system more efficient."

In effect, the pairing creates a nanoscale electrochemical reactor, increasing reactivity so that more molecules can react per second at a given temperature.

The team also showed that this coupling stabilizes the palladium. Under typical reaction conditions, palladium would dissolve. In the presence of gold, however, it remains in a metallic state.

"Through this electrochemical crosstalk between the metals, we're not only increasing reaction rates but also stabilizing the system," he says.



The team includes McIntosh (right) and PhD student Bohyeon Kim (center), as well as collaborators from Cardiff University (UK).

"That allows the catalysts to operate under conditions they normally couldn't, and it's the first time this has been shown."

The researchers also found that this stability breaks down under highly alkaline conditions. While gold continues to drive the oxidation reaction, palladium begins cycling between dissolved and metallic states, a process called homogeneous and heterogeneous coupling.

"This cycling becomes part of the reaction itself," he says. "We've effectively enabled an entirely new reaction mechanism that hasn't been previously observed."

The work points toward the development of more effective catalysts and, in time, more practical approaches for producing bio-based chemicals at scale. For now, the findings offer something more foundational: a new framework that could reshape how catalysis researchers think about these reactions.



SPACE FOR COLLABORATION

Lehigh has joined a newly formed international research consortium aimed at advancing research and technology for the growing commercial space sector.

Spearheaded by The Ohio State University, the consortium brings together academic and research institutions from around the world to pursue collaborative research, facilitate faculty and student exchanges, and develop foundational technologies for future commercial low-Earth orbit (LEO) platforms. Those include the planned Starlab space station (artist's rendering, at left) and VISTA, the George Washington Carver Science Park based at Ohio State.

The effort comes as public and private entities prepare for the eventual transition from the International Space Station to commercial platforms, increasing the need for scientific research and a skilled workforce to support in-space research, manufacturing, and services.

"Space is no longer the domain of a handful of national agencies," says Nathan Urban, Lehigh provost and senior vice president for academic affairs. "It is quickly becoming a commercial sector with its own supply chains, infrastructure needs, and workforce demands. By joining this network, we're positioning Lehigh faculty and students to help define that future rather than simply react to it."

This effort builds on recent growth in aerospace and space systems engineering across the Rossin College, including new faculty expertise and an interdisciplinary master's program.

"Our engagement in this consortium is a direct extension of the strategic investments we've been making in these areas," says Stephen P. DeWeerth, professor and the Lew and Sherry Hay Dean of Engineering. "A partnership like this helps to turn that foundation into real opportunities for our students and researchers."

Thinking bigger about computing

Lehigh computer scientist joins researchers from across the field to make the case for ambitious, measurable challenges that could help shape the future of artificial intelligence

As artificial intelligence races ahead—reshaping nearly every aspect of modern life—Daniel P. Lopresti is among a group of researchers asking a deceptively simple question: What would it look like if the field of computing rallied around a shared, long-term goal?

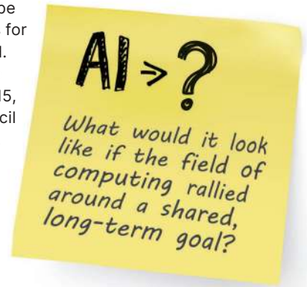
Lopresti, professor of computer science and engineering, and his peers argue that while computing underpins many modern scientific breakthroughs, it has never defined a unifying "grand challenge," nor produced a coordinated, large-scale effort comparable to the Moonshot or the Human Genome Project. That absence, he says, has become increasingly consequential as AI systems are rapidly deployed across society.



Lopresti (left) has long helped shape national conversations on computing research.

"You could argue that if the push toward AI had grown out of a grand challenge—one that baked in the concerns about ethics, societal impact, and resources from the very beginning—we might be in a better place now," says Lopresti, whose research spans machine learning, pattern recognition, AI for social good, and systems-level algorithm design.

Lopresti is a co-author of a white paper, "The Imperative for Grand Challenges in Computing," developed through the Computing Community Consortium (CCC), an NSF-funded committee (under the umbrella of the nonprofit Computing Research Association) that convenes leading researchers to shape long-term priorities for the computing field. He has been active with CCC since 2015, serving on its council and, most recently, as vice chair and council chair, before transitioning to chair emeritus—roles in which he has helped guide community-wide visioning efforts and national research road maps.



Defining the challenge

The new paper examines the history of grand challenges across science and engineering, considers what such efforts could look like in computing, and outlines a set of prototype challenges. To qualify, they must address a critical societal need, be ambitious enough to drive progress in the field, be barely feasible with current techniques, require interdisciplinary collaboration, and offer a clear way to measure success.

"A grand challenge can't be something like, 'We want to build better AI,'" Lopresti says. "What does that even mean? Does that mean more fair AI or more ethical AI? You have to be able to measure success. It has to be something you either accomplish—or you don't."

Lopresti contributed a prototype challenge that focuses on net-zero computing—rethinking how algorithms, hardware, and systems are designed to dramatically reduce energy and resource consumption. Right now, he says, the field tends to reward research that delivers faster results, even if those algorithms burn an enormous amount of energy.

For Lopresti, net-zero computing reframes what progress looks like in AI and high-performance computing. "There's an optimization problem to solve if we shift focus from speed to how we use resources," he says. "When computing is applied to real energy-use problems, the savings achieved through more efficient algorithms can outweigh the energy required to run them in the first place. That's what makes the idea net zero. Let's reward—and publish—the researchers who can say, 'I achieved this incredible result using a tiny fraction of the resources others used.' I'm fond of this idea because it's measurable."

Shaping the field's future

Beyond any single proposal, the paper is ultimately a call to action. Its authors are urging the broader computing community—universities, professional societies, industry leaders, and funding agencies—to critique, refine, and build upon these ideas, with the aim of fostering long-term thinking in a field often driven by short-term incentives.

While it may seem as though the moment to shape AI through grand challenges has long since passed, Lopresti disagrees. It's not too late, he says, but the window is narrowing.

"We've seen amazing things with AI, and we've also seen troubling ones," he says. "But if we don't step back and take a more encompassing view—one that considers all the implications—we risk missing the chance to shape where this technology goes."

LEFT: COURTESY OF THE COMPUTING RESEARCH ASSOCIATION

BOTTOM: COURTESY OF LICHAO SUN; RIGHT: CHRISTA NEU

MEET DR. CLAW

Open-source AI assistant helps researchers streamline tasks across the full scientific workflow

Lehigh researchers have built the first "AI for Science" software tool designed to support an entire project from start to finish.

Dr. Claw is an open-source, full-stack AI research assistant that helps users refine ideas, conduct literature reviews, run experiments, draft and review papers, write grant proposals, and build presentations. It eliminates the need to toggle between specialized AI tools—such as deep research agents for source evaluation or code generators for data analysis—by unifying these capabilities within a single interface.

"Everything an investigator, professor, or student needs to complete a project is within this ecosystem," says Lichao Sun, assistant professor of computer science and engineering and head of the team that developed Dr. Claw. "It's meant to accelerate the ability to conduct scientific research."

Sun and his team built Dr. Claw as an Integrated Development Environment (IDE), providing a single, unified workspace where a researcher can code, write, and analyze without switching tools. It's supported by three of the most powerful large language models (LLMs): Anthropic's Claude Code, Google's Gemini CLI, and OpenAI's Codex.

The advent of OpenAI's ChatGPT in late 2022 sparked Sun's vision for Dr. Claw.

"Our group was the first to publish a paper discussing ChatGPT's potential to change the world," says Sun. "And it has."

This evolution led to "auto-research," where AI acts as an active researcher rather than a passive content generator. These systems operate in autonomous loops of generating, testing, measuring, and learning to improve their results.

"There are elements of the research process that are extremely time-consuming and could be more efficiently conducted by AI, under the direction and guidance of a human," he says. "Replacing these processes with algorithms would not only accelerate the process, but it could reduce the cost of doing research as well."

Researchers can trust Dr. Claw because it prioritizes data privacy by allowing sensitive information to be processed locally or on secure academic servers, ensuring proprietary data never leaves the user's control, says Sun, whose background is deeply rooted in AI safety.

"To prevent hallucinations and guarantee accuracy, the system doesn't just guess," he says. "It actively grounds its outputs by cross-referencing verified, peer-reviewed databases and relies on human-in-the-loop checkpoints to validate critical steps."

At the time, Sun had noticed that his students were constantly cycling through disparate AI tools in their own research.

"I said to them, 'Why are we switching back and forth? Why don't we consolidate these tools into one system?'" he says.

Dr. Claw's rapid development is a testament to this technological revolution: Sun and five of his PhD students built the software in just three months.

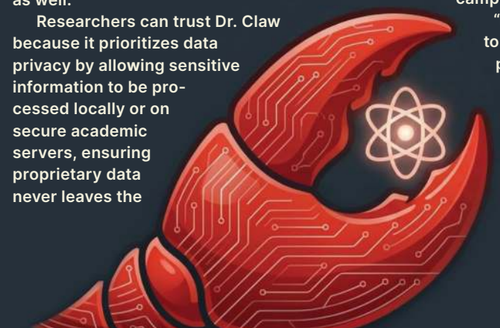
"In the past, this would have required 20 to 30 people working for a year or two," he says. "One of my students used the tool to finish a paper for a top-tier conference in just two weeks, a task that previously would have taken two to three months."

Since its public release in March, Dr. Claw has gained significant traction on GitHub (having earned more than 1200 stars on the developer platform to date). Sun's work also earned him an invitation to the advisory board of the 2026 AI Scientists Conference at the University of Toronto.

"The market space for tools and bots to support research is crowded," says Mayuresh Kothare, Lehigh's R.L. McCann Professor of Chemical and Biomolecular Engineering and the Rossin College's associate dean for research. "Every major corporate entity, such as Microsoft, Google, and Apple, is developing a competitive product. It is truly remarkable that within such a short time, Dr. Sun's lab has been able to develop Dr. Claw as an open-source tool with the potential to play a major role in supporting the next generation of scientific discoveries."

Sun's immediate goal is to scale the adoption of Dr. Claw (named as such in a nod to the AI assistant OpenClaw) and transform research timelines globally. He envisions it as a staple tool supported by Lehigh's Information Technology Services for the campus-wide research community.

"Lehigh students could use this tool to pursue impactful research that previously felt out of reach," he says. "They could take risks on projects with long time horizons and see those ideas become reality in months, not years. With Dr. Claw, we're changing the game."



OPTIMIZING WHAT'S NEXT

Frank E. Curtis, professor of industrial and systems engineering and an expert in large-scale nonlinear optimization, has received two federal grants to advance mathematical optimization research.

One project, supported by the National Science Foundation, will develop new algorithms for solving large-scale optimization problems that involve noisy or incomplete data. The work aims to improve computational methods used in applications such as image processing, statistical learning, and robust control.



The second project, funded by the Air Force Office of Scientific Research, focuses on optimization under uncertainty and informed machine learning. Curtis' team will develop algorithms with strong theoretical guarantees while improving techniques for solving constrained optimization problems.

Together, the research projects aim to advance optimization theory while producing practical computational tools for applications in data science, energy systems, machine learning, and other engineering fields.

"What is most meaningful to me is that these projects will support incredibly talented doctoral students who inspire me every day," Curtis says.



Streamlining smart grid control

NSF CAREER Award recipient Javad Khazaei is developing faster, data-driven models to help prevent power grid failures

The modern power grid is no longer a straightforward, one-way system.

Just 20 years ago, demand strictly dictated generation. Today, the grid is a massive, nonlinear web driven by distributed energy resources (DERs), such as solar arrays, wind farms, and battery storage. These resources rely on power electronics to interface with the grid, creating bidirectional flows where customers (including communities and even individual households) can both consume and supply electricity.

"So the question we are asking now is, how do we control these millions of devices?" says Javad Khazaei, associate professor of electrical and computer engineering.

Khazaei recently received funding through the National Science Foundation's Faculty Early Career Development (CAREER) Program for his proposal to develop a geometry-based control paradigm for DERs in smart grids.

The prestigious NSF CAREER award supports junior faculty members across the U.S. who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research. Each award provides approximately $500,000 over a five-year period.

The shift to data-driven control

Currently, grid control relies on a centralized optimization problem known as optimal power flow: Data is collected from every generation/demand unit and sent to a single controller that optimizes the demand and generation balance on minute-based or hourly time frames.

> "OUR APPROACH WILL MAKE CONTROL OF LARGE-SCALE SYSTEMS MORE EFFICIENT, ACCURATE, AND ROBUST."
>
> —Javad Khazaei

That main controller, says Khazaei, decides exactly how much power should come from a specific power plant or resource without considering the grid conditions.

As the power grid scales and becomes more sophisticated, the centralized approach is becoming impractical, as traditional control decisions cannot account for the complexity of a grid populated by millions of DERs. Khazaei and his team are pursuing a fundamentally different strategy to incorporate dynamic models into grid control, also known as predictive control, through a two-step process.

First, rather than relying on the precise physics of every individual device, which is computationally expensive and difficult to determine, they use systems behavioral theories to learn the behavior of complex nonlinear DERs directly from data. They then identify the geometric "shape" of that behavior—mapping its boundaries to ignore computational noise and focus only on the most critical variables. This allows them to simplify the system using reduced-order modeling.

"Rather than capturing every variable in a high-dimensional system, can we represent each DER with just a few simple differential equations?" he asks. "In theory, this is possible."

Simplifying the smart grid

This emphasis on simplicity—mapping the geometric boundaries of a system's behavior—is what makes Khazaei's work novel.

By minimizing data requirements and reducing the computational burden of modeling the "full order" system, the team aims to slash the number of equations and data required to efficiently model large-scale power grids without sacrificing accuracy.

While the project centers on microgrids, these simplified models could one day be applied to predictive control across the entire national grid, meaning systems could anticipate and prevent failures before they occur. Controlling the whole grid, he says, is nearly impossible because millions of nodes translate into millions of equations.

"With this new model, we will be able to predict what's going to happen in the next few seconds or minutes given the current condition, and fix issues in real time," he says. "Right now, we don't have that ability. We have to take corrective action after the fact."

The AI advantage

Preliminary results are promising, and the ongoing surge in data-driven methods and artificial intelligence is providing researchers with higher resolution data than ever before.

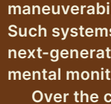
"We can use AI to our advantage," he says. "It used to take months or years to develop control designs. I'm optimistic that our approach will eventually make control of large-scale systems more efficient, accurate, and robust."

CLOCKWISE FROM TOP LEFT: CHRISTA NEU; COURTESY OF SPANISH RESEARCH COUNCIL; DOUGLAS BENEDICT/ACADEMIC IMAGE

FACULTY EARN FULBRIGHT HONORS

Three Rossin College faculty members have been selected for 2026–27 Fulbright U.S. Scholar awards, contributing to a record-setting year for Lehigh. All nine Lehigh faculty members who applied were selected—a university record for a single award cycle. Sponsored by the U.S. Department of State, the Fulbright Program is the nation's flagship international academic exchange program, supporting teaching, research, and professional collaboration to foster mutual understanding between the United States and countries around the world.

MUHANNAD T. SULEIMAN Professor of civil and environmental engineering; deputy director of ATLSS Engineering Research Center



Suleiman's work in Amman and Irbid, Jordan, addresses the soil-structure interaction of solar and wind energy infrastructure, an area of growing importance as the country expands renewable energy and infrastructure projects. The project combines research with teaching and professional development, including a new course on soil-structure interaction at Jordan University of Science and Technology, a graduate research methods course, and workshops on proposal writing, graduate scholarships, and professional development for students and early-career faculty. The goal is to strengthen engineering education while preparing future civil engineers to address the challenges of renewable energy infrastructure.

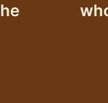
HIMANSHU JAIN Diamond Distinguished Chair in Engineering and Applied Science; professor of materials science and engineering



Jain (left) learns about CSIC scientist Juan Rubio's research on glass fertilizers.

Jain's project at the Instituto de Cerámica y Vidrio–CSIC in Madrid, Spain, focuses on engineering education at the pre-college and doctoral levels. The work includes developing hands-on demonstrations using glass and ceramic materials to spark student interest in engineering, while also examining how Spain's national labs, universities, and industry partner to train doctoral students in use-inspired research. The aim is to highlight the role engineering plays in everyday life.

ALBERTO J. LAMADRID Professor of industrial and systems engineering; professor of economics, College of Business; director of the Institute for Cyber Physical Infrastructure and Energy



Lamadrid's research at Universidad Nacional de Colombia Sede Medellín examines how renewable energy and artificial intelligence are reshaping modern electricity systems. The project develops dynamic models that capture the interactions among renewable energy resources, electricity demand, markets, and public policy to better understand how those factors influence system reliability, resilience, investment decisions, and the transition to more sustainable energy systems. It also strengthens international research partnerships and student collaboration.

ENGINEERING MEETS NATIONAL SECURITY CHALLENGES

Keith Moored, professor of mechanical engineering and mechanics, has joined the Defense Science Study Group (DSSG), a highly selective program that connects leading academic researchers with U.S. national security challenges.

Moored is one of just 15 academics chosen from more than 150 nominated by universities across the country. Established in 1986, the DSSG is run by the Institute for Defense Analyses and sponsored by the assistant secretary of defense for science and technology.



Moored's research focuses on fluid dynamics and bio-inspired underwater propulsion systems, including technologies inspired by aquatic animals that could improve the performance and maneuverability of underwater drones. Such systems could eventually inform next-generation autonomous underwater vehicles used for environmental monitoring, exploration, and maritime security applications.

Over the course of the two-year program, participants visit the Pentagon, military bases, intelligence agencies, national laboratories, and defense offices, where they engage with researchers, policymakers, and military personnel working directly on national security operations.

"I'm looking forward to going to these bases and talking to the people who work on them," he says. "I'll get a much better understanding of the problems our military members are facing and what they need. I think that will ultimately help inform my own research to more directly address those challenges."

With only a small cohort selected every two years, inclusion in the DSSG is considered a significant professional distinction. For Moored, however, the opportunity is most meaningful because of its potential impact.

"It's an honor," he says. "I'm grateful to have this opportunity to help solve some of these challenges and assist the people who serve our country."



WIRED FOR CHANGE

Lumen CEO Kate McConnell Johnson '89 on building the networks—and mindset—the AI era demands

Kate McConnell Johnson '89 has spent her career helping technology companies navigate change. Now, as CEO of Lumen Technologies, the electrical engineering alum is leading one of her most consequential transformations yet: reshaping a legacy telecommunications company around the digital networking demands of the AI era.

Johnson joined Lumen in 2022 after holding leadership roles at Microsoft, GE Digital, Oracle, and Red Hat, experiences that have given her a broad view of how technology reshapes industries and how organizations adapt along with it. In 2025, she returned to Lehigh as the university's undergraduate Commencement speaker, urging graduates to embrace change with a "play to win" mindset.

For Johnson, the challenges posed by AI are not abstract. They are playing out in real time as she leads Lumen through its own transformation—and as the technology reshapes the work of engineers and the organizations they will lead.

Q: Why did you study engineering?

A: I was drawn to the concept of solving problems with technology. I did my senior research project on fiber optics, which is kind of funny, because I run a company where that's kind of important! Lehigh gave me the basic toolkit and the confidence to adapt and persevere through complex problem-solving and uncertainty.

Q: This issue is focused on the advancement of AI. What's your outlook on the technology?

A: AI is an extraordinary accelerant of productivity. But just like with every major technology shift, it will require profound human adaptation. As we adjust, we have to think about how we collaborate with it. We must consider which cognitive tasks we will keep and which we should augment with AI. That's very different than any other adaptation curve. Think about the personal computer revolution in the '80s and '90s. We used PCs to automate tasks, but there were still people printing out emails to read them. Then came the internet and instantaneous access to information. That adjustment went beyond individual work habits to how an entire company could benefit from connection—think supply chains, customer experiences, and so on. But we weren't really sharing cognition in either one of those shifts. AI is much bigger. It's more than adapting to a tool. It's figuring out how we collaborate with it and share cognition to be more productive.

The precise impact of AI is, frankly, unknowable. Yet I see a lot of CEOs making broad declarations that it's going to take over the human role in the workplace—or that it's not a cause for concern and we shouldn't worry about a thing. I am somewhere in the middle. We're going to adapt, but adaptation introduces friction. There is heat and pain and loss. Some of us will adapt quickly, and others won't. I see maybe a decade or more of tectonic shifts in the workforce, so it does make me wonder about the support systems needed to help individuals adjust.

"The biggest risk in this market, which is moving so fast, is standing still," says Johnson.

Q: You often say that AI is a network story. Why is the physical backend so critical to the AI economy?

A: Across the AI industry, we talk a lot about models and constraints around computing power and energy. What gets less attention is the network that connects it all. That's where Lumen comes in.

In the late '90s and early 2000s, Lumen built one of the largest fiber networks in North America, which today puts us in a strong position to connect the next generation of AI infrastructure. For decades, the network operated in the background. It was like plumbing. You didn't think much about it because it was designed for relatively fixed and predictable traffic patterns.

AI changes that. It's not enough to simply connect data centers. You need to move massive amounts of data between data centers, clouds, applications, and users in real time. As AI workloads become more distributed and dynamic, the network becomes increasingly critical to the AI stack.

Think about data centers as the new corporate office buildings for AI. That's where AI agents live. And there are millions of agents being built every day—that's why there is a huge data center explosion. I may be working in Bellevue, Washington, while my AI agents are running in a cloud in Northern Virginia and in two dozen other data centers around the country. These agents need to communicate with each other, with applications, and with people. AI is constantly ingesting data, creating new data, and sending insights somewhere else. You can't build a network in legacy fashion to accommodate that. It would be far too expensive.

That's where the idea of a digital network comes in. We're bringing the network into the same business model as compute and storage. In a consumption model, as with a cloud service, companies subscribe to network services so they can connect virtually from anywhere to anywhere and pay only for what they use. AI is a network story because intelligence is only useful if the data can move to the right place at the right time. And for that, you need a digital platform that enables the network to move and adapt as fast as AI does.

Q: As technology changes so quickly, how does a "play to win" mindset shape the way you lead?

A: That mindset is essential for any company that's trying to transform itself in a world with AI. Standing still is not an option. You can't take a pass on this technology wave. You need to figure it out. That requires an open mind, a willingness to keep learning, and the courage to be vulnerable and ask for help.

As a leader, you need to be comfortable not knowing the answers and bringing together experts who can fill in the gaps. And you need to be comfortable with formulating hypotheses, testing, getting feedback quickly, and pivoting. And all of that happens in collaboration with a lot of people. That takes a certain amount of courage, too, because it's not fun to be wrong and have everybody watching. It also requires the ability to forgive each other and ourselves when we make mistakes or fail. At Lumen, we've instilled this notion that we're here to get it right, not to be right.

Q: What skills and outlooks will the next generation of Lehigh engineers need to thrive in a world being reshaped by generative AI?

A: I don't think it matters what discipline you're in. It's not even just engineering. It's pretty much everybody. Get as close to the technology as possible and learn its capabilities. You have to get in the game. The winners in the AI era will be the people who know how to keep learning—unlearning and relearning. Students nearing the end of college will be entering a marketplace that's changing profoundly week over week. They must demonstrate the courage to try things. They need to show a completely open mind, AI fluency, and an eagerness to reinvent the future.





CLOCKWISE FROM TOP LEFT: COURTESY OF LUMEN (2); CHRISTA NEU



INVESTING IN DISCOVERY

Rossin Research Innovation Grants give faculty the time, resources, and interdisciplinary partnerships needed to transform bold ideas into competitive research proposals

Story by Christine Fennessy | Photos by Christa Neu

IT'S NEVER BEEN EASY TO SECURE FUNDING FOR RESEARCH.

Grant proposals often run to double-digit page counts and require extensive literature reviews and a meticulously detailed research design that can take months to write. Reviewers tend to favor investigators and teams with proven track records, meaningful preliminary data, and compelling evidence that a proposed project is likely to succeed.

For faculty pursuing entirely new research directions or interdisciplinary collaborations, those expectations can create a difficult catch-22: The preliminary results and evidence of successful collaboration needed to win external funding often require funding to generate in the first place. Add to that recent reductions in federal research spending and greater competition for available dollars—and the bar for securing major grants only continues to rise.

This reality helped spawn the Rossin Research Innovation Grant (RRIG) program. The initiative is funded by alumni donors and encourages engineering faculty to submit brief proposals to a multidisciplinary review panel. Selected projects receive $50,000 and a graduate student tuition waiver to support one year of research into a potentially high-risk, high-reward idea.

"There are various internal mechanisms at the university level, but there has never been seed funding provided at the college level," says Mayuresh Kothare, R.L. McCann professor of chemical and biomolecular engineering and the college's associate dean for research. "As an R1 research university, we're constantly looking for ways to help faculty compete successfully for external funding. We wanted to create an avenue that would inspire faculty to brainstorm futuristic ideas without requiring the workload of a typical grant. And after a year, if they've made some interesting findings, they could use those results to develop a proper research proposal targeted at one of the big funding agencies, such as the National Science Foundation, National Institutes of Health, or Department of Energy."

AN EASIER FIRST STEP

RRIG kicked off in late 2024 with a call for two-page proposals summarizing a research problem and outlining the proposers' relevant expertise. Teams spelled out the potential impact of their work and the competitive advantage it could yield for Lehigh. They also identified the external funding agencies they eventually planned to target.

"These were essentially elevator-pitch white papers," says Kothare. "We didn't want faculty to spend a lot of time writing them. So we made it very clear up front: Capture the idea and describe how it will grow. That's it."

In early 2025, a multidisciplinary panel of Rossin College faculty members reviewed nine proposals. Projects were evaluated on the strength of the research idea, the potential for new interdisciplinary collaborations, the strategic value to Lehigh, and the likelihood that the work would lead to a competitive proposal for external funding.

"The review process is very rigorous," says Kothare. "We are systematically assessing the potential of each project. Our key criterion, however, was: Can this idea lead to a funded proposal after one year?"

The answer, it turns out, is yes. Of the three projects selected for the 2025–26 funding cycle, two have produced results that led to proposals, with the third team targeting a submission by year's end. Two groups have produced either a journal article or conference paper.

"They're doing exactly what we wanted them to do," he says. "As a pilot program, it worked well. We're now in year two and have additional funding to support even more projects."

FUELING BOLD IDEAS

The RRIG grant funds one PhD student for a year, plus lab expenses, and is accompanied by a tuition waiver.

"It's effectively equal to one year of NSF funding," says Kothare, "so from a faculty perspective, it's enough to do a deep dive into an area of research."

Building the program required more than faculty enthusiasm. It also depended on institutional support and philanthropy from Lehigh alumni. Kothare believes RRIG appeals to them because the program embraces an entrepreneurial model—early-stage ideas that need angel investors willing to accept uncertainty for the potential payoff of a future proposal.

"It's not a startup in the sense of launching a company, but rather in the sense of starting an idea and growing it into a full-fledged research project," he says. "Many of our alums are savvy businesspeople, and they appreciate the similarities between the two endeavors."

According to Stephen P. DeWeerth, professor and the Lew and Sherry Hay Dean of Engineering, how a college supports research can be just as important as the research itself. "With RRIG," he says, "we're taking a more entrepreneurial approach to managing our research enterprise, investing early in bold ideas and clearing the barriers that too often keep promising work from ever reaching the funding stage. We are tremendously fortunate to have donors who immediately saw the value in a program like this and wanted to be a part of it. They're enabling the kind of ambitious, creative thinking that has helped make Lehigh an R1 research institution."

As with all startups, the potential for failure among RRIG's selected teams is real. But pursuing ideas that don't pan out can still be valuable, says Kothare. Academic research builds on both success and failure, and unsuccessful attempts can more clearly mark the path forward.

"We're creating an ecosystem and a culture of thinking outside the box, and giving faculty the means to develop those ideas," he says. "We're seeing faculty come together from across departments in ways they hadn't previously considered," he says. "That's what we were trying to cultivate, that spirit of boldness when it comes to trying something new."

GAINING MOMENTUM

The 2026–27 Rossin Research Innovation Grant funding cycle sparked 14 proposals and five were funded (see "Five New Research Teams," page 13). The long-term goal, Kothare says, is to expand to supporting 10 projects annually.

Top-tier research institutions are judged both by the quality of their scholarship and their ability to attract competitive external funding. By helping faculty launch new collaborations and yield the preliminary data needed for major grant proposals, RRIG strengthens the pipeline that ultimately fuels Lehigh's research enterprise.

Every major research grant begins with an idea, but ideas alone rarely attract external funding. Those ideas must first be tested, refined, and backed by preliminary evidence and strong collaborative teams. RRIG was created to accelerate that earliest stage of discovery, helping faculty transform promising concepts into competitive research programs.

"Ideas are the root of all research," says Kothare. "RRIG allows those ideas to germinate."

With two review cycles under his belt, Kothare is most impressed by the creativity showcased in each proposal as faculty extend beyond their comfort zones.

"We're seeing faculty come together from across departments in ways they hadn't previously considered," he says. "That's what we were trying to cultivate, that spirit of boldness when it comes to trying something new."

THE ALUMNI INVESTMENT PIPELINE

Like angel investors backing an early-stage venture, Lehigh alumni fund seed grants that give faculty the freedom to pursue high-risk, high-reward research before its potential is fully known.



In this three-minute video, the teams explain their projects—and where they could lead.

SMARTER WOUND MONITORING

Mixed conduction polymers are uniquely suited for biological applications because they conduct both electronic charges and ions—the chemical signals the body uses to communicate.

Elsa Reichmanis, professor and Carl Robert Anderson Chair in Chemical Engineering, has spent decades designing and studying these materials. Together with Thomas E. Gartner, assistant professor of chemical and biomolecular engineering, she has explored how their structure changes as ions move through them, combining laboratory experiments with Gartner's molecular dynamics simulations.

In 2024, conversations with Xuanhong Cheng, professor of bioengineering and materials science and engineering, opened the door to a new possibility.



An organic electrochemical transistor measures how the polymer responds to changes in pH.

"Xuanhong has a bioengineering background and a track record of research related to biosensors," says Reichmanis. "We talked about creating a credible biosensing application that could validate that these polymers are, in fact, useful in that capacity. We landed on the question: Can we monitor stem cell differentiation and tissue growth? And that led to the RRIG proposal."

The Rossin Research Innovation Grant allowed the team to gather the preliminary data needed to determine whether the concept was viable. Their early results showed the material was biocompatible; cells cultured on the polymer grew normally and maintained typical behavior. But they also uncovered an unexpected finding: the polymer was extremely sensitive to changes in pH.

Rather than viewing that result as a detour, the researchers recognized an opportunity.

"In wound healing, pH sensing is very important," says Cheng, who now chairs the bioengineering department. "Successful healing is characterized by a gradual shift from alkaline to acidic pH. Persistent alkaline pH, however, can indicate a chronic wound or infection. Sudden drops or fluctuations in pH can signal tissue ischemia, changes in blood flow, or excessive wound drainage."

The team is now investigating what ion movement through the polymer reveals about the health of surrounding tissue. One potential application is a sensor that could be embedded in wound dressings, which would provide an early warning of infection, particularly for burn patients who face a high risk of complications.

The preliminary findings have already positioned the researchers to compete for external funding. They submitted a proposal to NSF that is currently under review and published a review article in *npj Biosensing*.

RRIG support also helped establish a collaborative foundation that Reichmanis says will extend well beyond this initial project. The grant created the time and space for researchers with expertise in chemistry, molecular simulation, and bioengineering to learn one another's approaches and build a common scientific language.

"Every discipline and subdiscipline has its own language and that can be a challenge," she says. "We have learned to communicate and work seamlessly together. Our different backgrounds, experiences, and perspectives have helped us move in innovative new directions."



AI FOR BETTER BONE HEALING

For more than a decade, Hannah Dailey has been working to improve care for patients recovering from broken bones. Her lab creates digital twins from CT scans that allow researchers to measure how well a fracture is healing—information that could help physicians decide whether a patient needs additional surgery or simply more time to recover.

Dailey, associate professor of mechanical engineering and mechanics and associate department chair, envisioned making that technology far more practical by using standard X-rays instead of CT scans. The idea was to use artificial intelligence to reconstruct three-dimensional information from two-dimensional images, dramatically expanding the technology's clinical potential.

There was just one problem.

"I'm not an algorithm developer," Dailey says.

So she found someone who is: Lifang He, associate professor of computer science and engineering. Together, they submitted a proposal to the National Institutes of Health.

"It wasn't successful," says Dailey. "It's a really good idea, but we didn't have enough preliminary data, and we had no record of collaboration. The idea was dead in the water until we received the Rossin Research Innovation Grant."

The RRIG enabled them to generate the proof-of-concept data reviewers wanted while demonstrating their ability to work together as they prepared to compete for external funding. He's role in the project is to work with their graduate student to develop and train the AI algorithm, while Dailey has assembled a network of orthopedic surgeons eager to contribute clinical data and help move the research forward.

Today, the team is preparing a new NIH proposal built on that foundation.

The long-term vision extends beyond a single grant. One day, physicians might upload routine X-rays and receive objective measurements showing how a fracture is healing, helping guide treatment without requiring costly CT scans. The same technology could also unlock decades of archived medical images, allowing researchers to study how factors such as smoking, occupation, and other patient characteristics influence bone healing over time.

"There are profound amounts of medical imaging data just sitting in servers right now," says Dailey. "And because X-rays are done periodically, there's a treasure trove of time-based data that reveals how bones heal."

For Dailey, the project illustrates why seed funding matters.

"The funding environment is so competitive right now that you can't have any weaknesses," she says. "Lehigh is using these seed grants to invest in building the credibility of new teams like ours that are pursuing novel, risky ideas. I am very grateful for the support."

PROTECTING AI MODELS

Training today's AI models requires enormous investments of time, computing power, and expertise. Protecting the intellectual property and preventing unauthorized copies from being distributed or misused has become an increasingly important challenge.

Zhiyuan Yan, professor of electrical and computer engineering and associate department chair, and Yuntao Liu, assistant professor of electrical and computer engineering, believed they could address that problem by giving AI models something akin to a digital fingerprint. Their approach builds on a microchip security technology known as a physical unclonable function, or PUF, which has long been used to verify the authenticity of electronic devices.

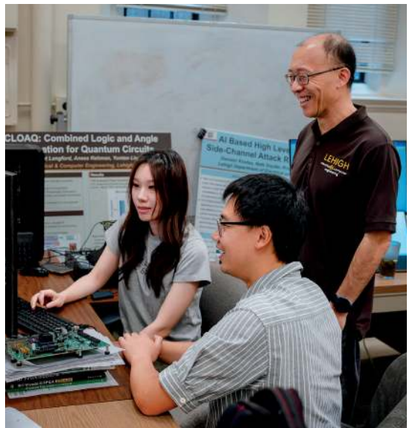
The Rossin Research Innovation Grant gave the researchers the opportunity to combine their complementary expertise—Yan's background in PUF technology and Liu's work in hardware security—to test whether the same concept could be applied directly to AI models.

Rather than adding security after a model is created, the team developed a proof-of-concept method that embeds a unique fingerprint into the model as it is being trained. If one of the smaller versions distributed to users is copied or leaked, that fingerprint can identify exactly which version was compromised.

"We successfully proposed the scheme to embed these digital fingerprints in the model distillation process," says Yan. If a student model (a streamlined version that can be run on smartphones and laptops) is leaked, "using the embedded fingerprints, we can accurately identify it and whoever violated the IP contract."

The team is now preparing an NSF proposal while finalizing a journal manuscript describing the work. Their next step is to further refine the technology and explore how it could eventually be incorporated into AI systems.

"We couldn't have reached this point without the RRIG," says Yan. "This grant gave us the chance to combine our unique, complementary experiences to try a creative approach to solving a widespread problem."



FIVE NEW RESEARCH TEAMS

The next round of Rossin Research Innovation Grants supports projects spanning AI, healthcare, robotics, energy, and advanced materials.

1 ARTIFICIAL INTELLIGENCE FOR CYBER-PHYSICAL SYSTEMS

Parv Venkitasubramaniam and Rick Blum (Electrical and Computer Engineering); Yue Yu (Mathematics/College of Arts and Sciences)

2 AI-DRIVEN CARTILAGE REGENERATION

Tomas Gonzalez-Fernandez (Bioengineering), Lifang He (Computer Science and Engineering), and Dr. Gregory Carolan (Saint Luke's University Health Network)

3 ROBOTIC REHABILITATION BLIMPS

Juan Aceros (Bioengineering) and David Saldaña (CSE) with Good Shepherd Rehabilitation

4 ADVANCING GEOTHERMAL ENERGY

Carlos Romero and Arindam Banerjee (Mechanical Engineering and Mechanics); Frank J. Pazzaglia (Earth and Environmental Sciences/CAS); Muhannad Suleiman (Civil and Environmental Engineering)

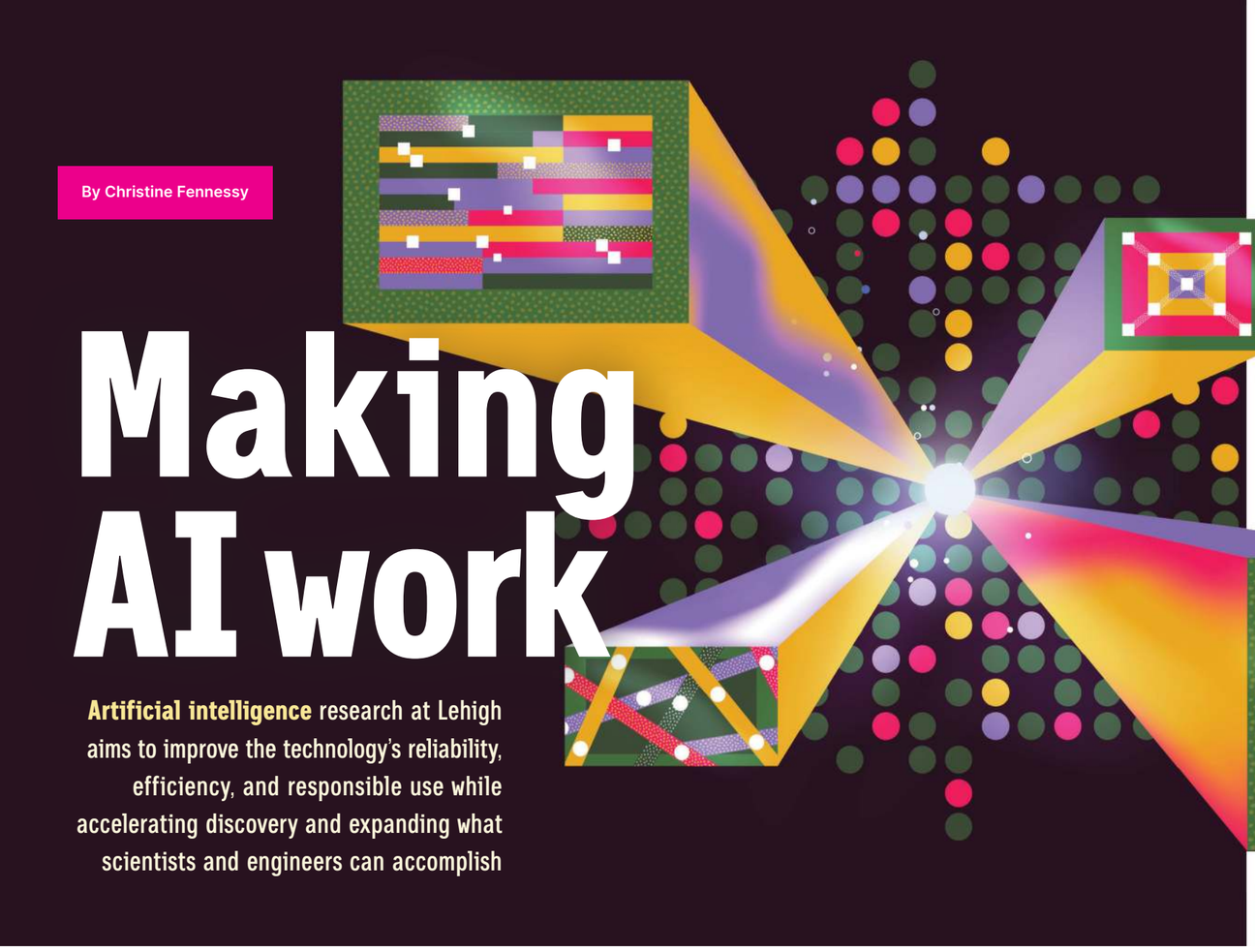
5 RECOVERING CRITICAL MINERALS

Thomas Gartner, Mark Snyder, Steve McIntosh, and Elsa Reichmanis (Chemical and Biomolecular Engineering); Christopher Kiely (Materials Science and Engineering)

By Christine Fennessy

Making AI work

Artificial intelligence research at Lehigh aims to improve the technology's reliability, efficiency, and responsible use while accelerating discovery and expanding what scientists and engineers can accomplish



In only a few years, artificial intelligence has become a pervasive presence in everyday life. It has accelerated scientific discovery, reshaped industries, and prompted universities to rethink how they conduct research and educate students. Yet for all that AI can already do, we are still in the early stages of understanding its potential—and its limitations.

"AI is happening so fast, it brings to mind the image of building the bridge as you're walking across it, or constructing the airplane as you're trying to fly it," says Larry Snyder, Harvey E. Wagner Professor in Industrial and Systems Engineering and Lehigh's deputy provost for faculty affairs. "There is still so much of the technical, ethical, economic, and legal foundation of this technology that the world has not really thought through."

Those gaps in the foundation are what make this such an important moment for universities. While some researchers are harnessing today's AI tools to tackle problems in healthcare, manufacturing, and infrastructure, others are working to improve the algorithms that underpin the technology itself—making AI more accurate, efficient, and useful.

Lehigh is contributing to both efforts.

"We have people who are making contributions that are both useful and valuable," says Brian Davison, Daniel E. '39 and Patricia M. Smith Professor and chair of the Department of Computer Science and Engineering. "And we're constantly adjusting and learning from our experiences, and from each other, on how to maximize the value of AI."

Across the Rossin College, research teams are developing new methods to make AI models more reliable, uncovering patterns in biomedical data, streamlining scientific research, and tackling complicated engineering problems with the technology. Their work is aimed at both improving artificial intelligence itself and expanding what engineers and scientists can accomplish with it.

STORY ILLUSTRATIONS BY IVAN HAIDUTSKI/STOCKSY

CHRISTA NEU

Reasoning under pressure

For decades, artificial intelligence researchers have pursued the goal of creating machines capable of reasoning through difficult problems. The emergence of large language models (LLMs) has brought remarkable advances, but also new challenges. Today's AI systems are highly capable, yet they still make mistakes, misunderstand human intentions, and reason inconsistently when faced with complex, multistep problems.

These problems define the work of Hector Muñoz-Avila, professor of computer science and engineering and director of I-DISC, Lehigh's Institute for Data, AI, Society, and Computation (which was recently renamed to bring artificial intelligence to the forefront of the institute's identity). His research currently centers on three projects aimed at ensuring that AI systems produce results that are correct, reliable, and consistent with human expectations.

"LLMs like ChatGPT, Claude, and Gemini work really well, and I'm an avid user of generative AI," he says. "But I also know that their reasoning is not always reliable, particularly on complex problems, and they can produce incorrect solutions."

The first of his projects addresses a persistent challenge in AI: planning.

"While today's LLMs excel at generating text, they still struggle at planning," he says. "Especially long-horizon planning, when they have to plot multiple steps that result in something happening in the future."

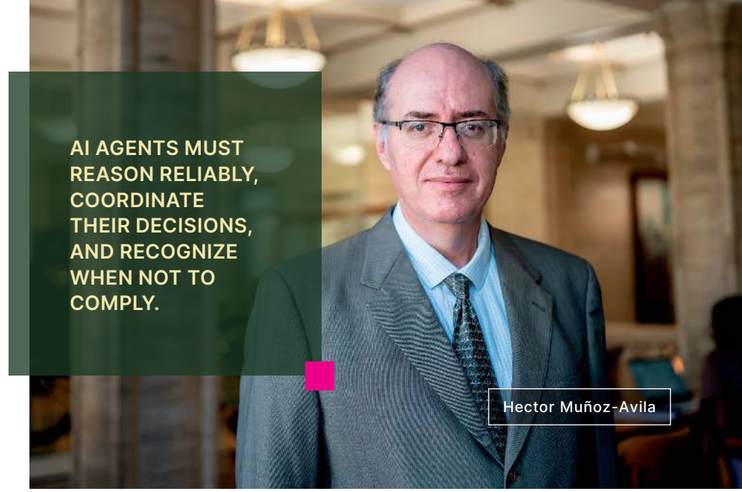
Instead of asking an AI system to solve a complicated problem all at once—planning a route from New York City's Port Authority Bus Terminal to San Francisco, for example—Muñoz-Avila's team uses an AI agent to break the task into smaller tasks through a process called a hierarchical decomposition. The agent might first ask the language model how to get from the bus terminal to the New Jersey Turnpike before moving on to the next leg of the journey. The model handles the smaller tasks individually, reducing the margin for error, while the results are combined into a complete plan.

The approach combines modern neural-network-based language models with decades of symbolic AI built on logical reasoning. By blending the two, the team hopes to produce systems that are both scalable and dependable.

A second project, conducted in collaboration with the U.S. Naval Research Laboratory (NRL), explores what Muñoz-Avila calls "moral agents."

"For the longest time, researchers thought agents should do what we tell them to do," he says. "But now, with generative AI, they're so capable that sometimes we don't want the agent to comply because the user may be asking it to do things that have unintended consequences."

As a hypothetical example, an instruction to deliver a package as quickly as possible might cause an autonomous drone to choose a route through restricted airport airspace. The request isn't malicious, but blindly complying with it could create a dangerous situation.



Muñoz-Avila's team is developing AI agents that combine reasoning with symbolic rules about safety, privacy, and other ethical constraints. As it carries out a task, the agent evaluates alternatives and can reroute, replan, or even deviate from the request if necessary. (For a broader look at how researchers are thinking about the long-term direction and responsible development of AI, see "Thinking Bigger About Computing," page 4.)

His third project, also in collaboration with NRL, addresses the orchestration of multiple AI agents working together to complete a task. If a user is planning a trip, for example, one agent might book the flights, another the hotel, and another the activities. Each might perform its assigned task correctly, but without effective coordination, the pieces may not fit together.

Muñoz-Avila's research explores ways for these agents to communicate, synchronize their decisions, and work together toward the user's overall goal safely and effectively. A botched vacation is one thing; the stakes are considerably higher when multi-agent systems are deployed in the defense, transportation, or energy sectors.

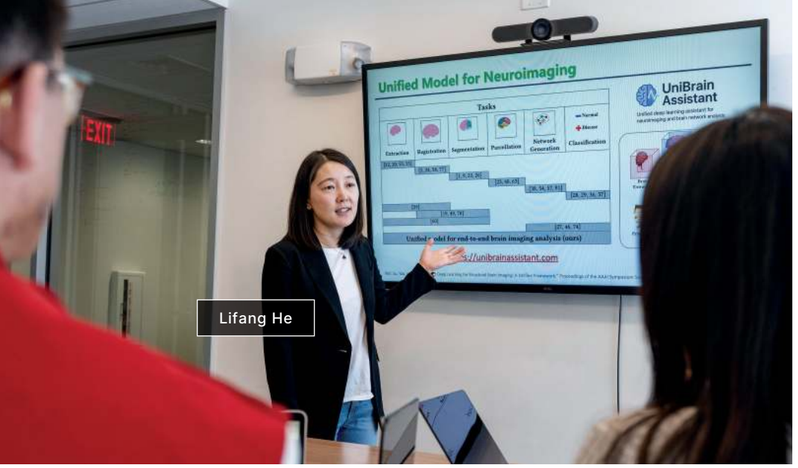
Still, Muñoz-Avila sees plenty of reason for optimism.

"I find it very empowering," he says. "Yes, there are big, important problems that need to be solved, but those problems also open up new worlds of fascinating research. It's an exciting time to be pursuing these ideas, and I actually think this is the best time to work in computing and engineering."

A unified view of the brain

Brain imaging has become an important tool for detecting and studying brain changes associated with neurological diseases such as Alzheimer's and Parkinson's. In many conventional workflows, however, researchers must prepare the data through a lengthy series of preprocessing steps that often require multiple software packages and programming languages as well as specialized expertise.

Continued



Lifang He

To streamline the process, Lifang He, associate professor of computer science and engineering, and her team are developing UniBrain, an AI-native platform designed to unify the neuroimaging analysis pipeline within a single system.

"We're not just applying existing AI tools to do the analysis," says He. "With UniBrain, we're developing and deploying new ones while rethinking the entire neuroimaging analysis process from start to finish within a unified platform."

> From raw brain scans to scientific insight—in one unified system.

Many conventional brain imaging workflows handle each task—such as image registration, segmentation, feature extraction, and disease prediction—as a separate step, often requiring researchers to move data among multiple specialized software packages. That process can take weeks or even months for large datasets and creates a significant barrier for clinicians and scientists without advanced computational training. Her team's preliminary results indicate that a unified deep learning model can make the process more efficient while matching or improving the performance of conventional workflows.

The team is also developing an agentic AI version of UniBrain that would provide a ChatGPT-like interface for brain imaging analysis. Researchers or physicians could upload raw MRI data, ask questions in plain language, and receive automated preprocessing and analysis, along with interpretable results and AI-generated reports highlighting imaging biomarkers potentially associated with disease.

Such a system could accelerate research while making sophisticated AI tools accessible to physicians and scientists without requiring advanced programming expertise. It could also help researchers identify subtle imaging biomarkers associated with neurological disorders that might otherwise be overlooked.

UniBrain requires expertise well beyond computer science. The team behind it includes radiologists at Massachusetts General Hospital and Harvard Medical School, as well as neuroscientists, bioengineers, and AI researchers from Emory University and the University of Pittsburgh. Together, they contribute expertise in brain imaging, data harmonization, and clinical validation.

"This is a very ambitious project," she says. "We need experts in many fields working together to solve problems of this scale."

For He, that collaborative approach points toward a broader direction for AI research. Rather than building models designed for a single task, she envisions platforms like UniBrain that can integrate diverse data, support multiple functions, and expand to new tasks over time. Her goal is to take researchers seamlessly from raw brain scans to interpretable insights and scientific discovery—all within a unified AI system.

"This represents the next generation of AI for scientific discovery," she says, "and it could help scientists make discoveries that weren't possible with earlier tools."

Faster paths through chemistry

Many of the chemical reactions that underpin modern manufacturing—whether producing everyday chemicals, recycling plastics, or converting waste into useful products—involve thousands of possible molecular interactions. Understanding what happens during those reactions is essential to designing cleaner, more efficient industrial processes, but modeling the chemistry has traditionally required enormous computing power and months or even years of calculation.


Srinivas Rangarajan

TOP: CHRISTA NEU; BOTTOM: DOUGLAS BENEDICT/ACADEMIC IMAGE

"We need a method that can do things faster so we can look at much more complicated chemistries, but with the same level of accuracy we have with our current methods," says Srinivas Rangarajan, associate professor of chemical and biomolecular engineering.

Rangarajan and his team are combining scientific foundation models—AI systems trained on massive amounts of quantum chemistry data—with physics-based simulations to model catalytic reactions at the molecular level more efficiently than conventional approaches.

The goal isn't to replace the underlying science, he says, but to make it possible to explore chemical systems that were previously too large and complex to study. His group has built AI-enhanced computational workflows that can analyze thousands of possible reaction pathways, helping researchers understand how valuable products are formed and why unwanted byproducts appear. That knowledge can guide the design of better catalysts and more efficient industrial processes.

The team has begun developing agentic AI workflows that can automate much of the repetitive work involved in building and running these sophisticated models. By allowing AI to handle routine computational tasks, researchers can spend more time asking scientific questions instead of managing calculations.

More accurate and efficient models could support conventional applications, such as hydrocarbon upgrading, as well as emerging applications involving plastics upcycling, breaking down PFAS "forever chemicals," and bio-derived aviation fuel.

"The ability to get so far so quickly using these tools," he says, "has made me very excited about AI and its future."

> AI-ENHANCED COMPUTATIONAL WORKFLOWS CAN GUIDE THE DESIGN OF MORE EFFICIENT INDUSTRIAL PROCESSES.

Simulating the user

Cyber-physical systems that act as personal assistants are making our lives easier. Smart home assistants can anticipate an owner's arrival and adjust temperature and lighting. Driver-assistance systems can monitor the surrounding environment and help drivers safely navigate. Wearable fitness devices can track movement and personal goals to help users meet daily targets.

But designing these systems for real-world use is challenging and time-consuming.

"When you're developing those systems, you want to know how people interact with them so you can identify problems and refine the design," says Yu Yang, assistant professor of computer science and engineering. "You have to develop a prototype, recruit people to use it, observe those interactions, collect the data, and then use the data to improve the system."

For now, that's the typical development pipeline. But Yang and his team are using a two-pronged approach that combines human studies with AI-based simulation to streamline it. They're building a wearable, always-on personal assistant prototype to improve people's daily lives, while using foundation models to create simulated users that can interact with the system across different scenarios.

"We want to use those models to simulate how people interact with the system and then use that interaction behavior data to improve our personal assistant," he says.

The team is working with existing models to represent a diverse range of human behaviors and individual differences, drawing on data from participants in previous studies. They incorporate details such as physical

Continued

LEARNING AI FROM THE GROUND UP

AS ARTIFICIAL INTELLIGENCE RESHAPES INDUSTRIES, Lehigh will soon prepare students to not only use AI tools, but to understand how they work—and how to improve them.

Officially approved this spring, the new Bachelor of Science in Artificial Intelligence, Machine Learning, and Data Science will launch next year and give undergraduates a technical foundation in mathematics, computing, machine learning, data science, and AI, with an emphasis on the ethical and responsible development of intelligent systems. Coursework includes deep learning, big data, AI theory and practice, natural language processing, computer vision, and a two-semester AI capstone project.

The degree is designed to go beyond applying existing technologies by teaching students how AI systems are built.

"Students will learn not just how to use those algorithms, but how they were created so they can improve upon them, extend them, or create a replacement," says Brian Davison, professor and chair of computer science and engineering.

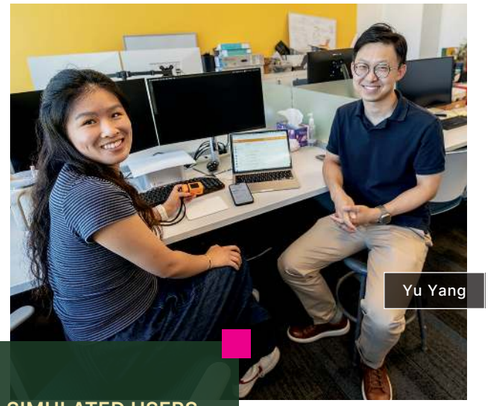
Graduates will be prepared for technical roles such as AI engineer and machine learning engineer, developing and improving intelligent systems.



characteristics, daily routines, and preferences for feedback, and then fine-tune the models to reduce bias. In their most recent published study, approximately 1000 simulated users interacted with the prototype in settings such as the home and office.

"We found that the simulated users reproduced several interaction patterns that had previously been observed across 10 human studies," says Yang. "That gave us evidence that these models can capture meaningful aspects of human-system interaction."

A recently accepted paper takes the next step: examining whether simulated interaction data can actually help improve the system. In that study, the team used the simulated interaction data to refine the prototype and then tested it with 34 human participants. Participants evaluated the personal assistant before and after the changes and found that the version informed by the simulated users performed better.


Yu Yang

SIMULATED USERS CAN STREAMLINE THE DESIGN OF SYSTEMS MEANT TO AUGMENT DAILY LIFE.

"Our results show that simulated user interactions can provide useful signals for improving real-world systems," he says. "Human evaluation is still essential, but simulation can help us decide what to test, which scenarios deserve more attention, and where problems may emerge before conducting human studies."

In the future, development pipelines that once relied on dozens of human participants could first explore hundreds or thousands of simulated users across many different scenarios. Researchers could then use human studies to validate the most important findings and test situations where real-world evidence is especially important.

"Simulation allows us to explore a larger space of users and situations," Yang says. "That can help us make better use of human data, speed up the design process, and build systems that are safer, more personalized, and better prepared for situations they will encounter in the real world."


Meng Zhao

Finding the right fit

For academics, publishing is paramount. Yet in some fields, the distinctions among closely related journals may be murky, and submitting a paper to the wrong one can dramatically slow the dissemination of new research.

"It's against the rules of academia to submit the same paper to multiple journals at the same time," says Meng Zhao, assistant professor of industrial and systems engineering. "If you submit your paper to an unsuitable publication, it can take months to hear back that it's been rejected—not because of the quality of the work, but because the topic didn't align with the journal's content. By the time you resubmit it elsewhere, your work might be outdated."

To minimize time lost to mismatched submissions, Zhao and her team created an algorithm to help researchers find the journal that best fits their work. For the study, they focused on six transportation journals with enough overlap in subject matter that distinguishing among their specific areas of coverage could prove difficult even for seasoned authors.

The algorithm analyzed topics covered by each journal over the previous 10 years. The results revealed how the publications differed from one another and how their areas of coverage had shifted over time.

"We found that even the journal editors weren't aware of how much their topical coverage had evolved," says Zhao. "Knowing about that evolution helps them refine their review process. And it's important for the researcher because they're able to monitor new topics in transportation."

She and her team built a website where transportation researchers can submit an abstract and receive a recommendation for which of the six journals best fits their work. Zhao herself used the AI system to identify the journal that ultimately published her paper on the algorithm, *Transportation Research Part A*.

The algorithm may not fortify infrastructure or improve health directly, but it can save researchers' time and help them do their jobs more effectively. And the approach could extend to fields such as healthcare and manufacturing, helping new findings reach the teams most likely to build on them. (For more on how Lehigh researchers are using AI to streamline their workflows, see "Meet Dr. Claw," page 5.)

"I think it's amazing that you can use AI tools to solve a problem and make a contribution to your field," she says. "What's so useful about these tools is that we can use them to actually change the way we do research."

PHOTOS BY CHRISTA NEU

AI can help researchers get new findings to the right audience faster.

Connecting the models

When radiologists use AI to interpret imaging scans, they typically rely on models designed for specific tasks. One may excel at detecting a lesion, while another generates a report summarizing the scan. That narrow focus stems in part from the data used to train the models.

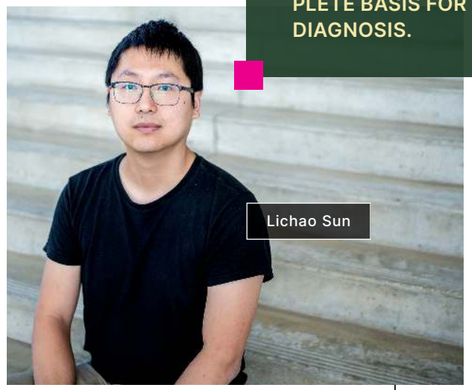
"Each of these models does its job very well, but they don't work together to give the radiologist a complete understanding of the scan," says Lichao Sun, assistant professor of computer science and engineering. "We realized that a single agentic system could take advantage of the strengths of these different models."

In an agentic AI system, multiple agents work together toward a common goal, coordinating models rather than relying on one to perform every task.

Sun and his team built an agentic AI system called RadFabric as a research framework for combining specialized imaging models. The long-term goal is a tool that could help doctors determine both the presence of disease and the reasoning behind that conclusion. Their results were recently published in *npj Digital Medicine*.

When the researchers tested RadFabric on chest X-rays, the system outperformed other leading AI models at identifying a range of abnormalities, achieving an overall accuracy score of about 85 percent. It was particularly effective at recognizing less common conditions—cases that can be challenging for AI models trained on limited datasets. RadFabric could also explain how it arrived at its conclusions, combining information from multiple specialized models to produce a step-by-step rationale for its findings.

COMBINING SPECIALIZED IMAGING MODELS COULD PROVIDE A MORE COMPLETE BASIS FOR DIAGNOSIS.


Lichao Sun

"We're encouraged by this research," says Sun. "The idea is that eventually hospitals could have an AI solution to the problem of disparate models based on this strategy, providing better information for doctors and patients."

AI AT THE EXTREMES

Two projects led by Rossin College researchers have received funding through the U.S. Department of Energy's Genesis Mission, an initiative designed to accelerate breakthroughs in energy, scientific discovery, and national security by supporting work that combines AI, supercomputing, quantum systems, and advanced scientific instruments.

Mechanical engineering and mechanics faculty members Eugenio Schuster and Tariq Rafiq are leading a project focused on one of the central challenges in making nuclear fusion energy safe and viable.

Fusion seeks to generate energy by combining light atomic isotopes under extreme temperatures. At reactor scale, scientists must control ultrahot plasma while managing extreme heat and particle exhaust at the reactor walls. Conventional physics simulations of these boundary dynamics can take weeks or months to run, making real-time control impossible.

The team, in collaboration with Oak Ridge National Laboratory (ORNL) and Columbia University, will replace those computationally intensive simulations with ultrafast AI surrogate models integrated into a digital twin of the reactor. The models are designed to calculate plasma states in milliseconds, allowing a control system to respond quickly enough to protect reactor surfaces while maintaining peak energy performance.

A second project, led by Hong-Yi Li, associate professor of civil and environmental engineering, tackles another complex system: the movement of water through rivers, reservoirs, and underground aquifers. Li is joined by fellow faculty researchers in Lehigh's Center for Catastrophe Modeling and Resilience, Brian Davison and Ethan Yang, along with collaborators from the Pacific Northwest National Laboratory, ORNL, the University of Texas at Austin, and the City College of New York.

The project will combine AI with physics-based modeling to improve predictions of water availability, floods, and droughts. The work will begin in the Delaware River Basin, with the goal of developing approaches that can be applied nationwide.

One challenge is accounting for how people manage water systems. Information contained in operating manuals, policies, and institutional practices is essential to practical decision-making but generally absent from conventional numerical models.

The researchers will use large language models to translate that unstructured information into machine-readable operating rules and integrate it with physics- and AI-based models.

Together, the projects demonstrate how AI can help researchers work with systems whose complexity—and speed—have long strained the limits of conventional modeling. *—Katie Clarke*

HANDS-ON FROM DAY ONE



FYRE's expanded module lineup immerses first-year students in interdisciplinary challenges with real-world relevance

Story by Christine Fennessy | Photos by Christa Neu





In its second year, the First Year Rossin Engineering program is getting bigger—and broader.

While still in its pilot phase, FYRE has grown from three to eight modules for the 2026–27 academic year. The five new offerings tackle challenges involving natural disasters, plastic waste, human-machine interfaces, sensor technology, and the growing energy demands of artificial intelligence.

The expansion advances FYRE's goal of reshaping how students experience engineering at the start of their time at Lehigh. Through seven-week, interdisciplinary modules built around project-based learning, students take on real-world problems and begin to see how concepts in engineering, mathematics, science, computing, and design connect in practice. The approach introduces them to tools and applications that might otherwise come much later in their education and gives them a clearer sense of why the underlying fundamentals matter.

Last December, faculty across the Rossin College were invited to propose the program's next set of modules. Fifteen proposals came in for five available slots. The selections emphasized cross-disciplinary learning and timely societal challenges.

"It was such a hard decision because so many faculty are motivated to bring what they do to the forefront for students," says Christina Haden (pictured, at left), teaching professor of mechanical engineering and mechanics and director of FYRE. "We wanted modules that reflect current societal needs and show how different engineering disciplines have to come together to address them. Our goal is to prepare students for the horizon they'll face after graduation."

The FYRE lineup

The five new modules join three returning offerings to make up FYRE's 2026–27 lineup, broadening the ways first-year students can engage with engineering.

Engineering Against Natural Disasters

Analyze risks posed by earthquakes, floods, hurricanes, and other hazards, and consider how engineers can help communities and infrastructure become more resilient.

Engineering Solutions for Plastic Remediation

Investigate plastic waste, sustainable materials, biopolymers, and degradation to identify engineering approaches to reducing plastic pollution.

Human-Machine Interface

Capture and process signals from the human body to control robotic systems and other devices.

Sensing the World

Trace how sensors and chips move from raw materials through fabrication and device integration to interact with their surroundings.

Sustainable Energy Systems for AI and Microgrid Applications

Examine renewable energy, microgrid design, and the growing power demands of AI and data centers to balance computing needs with more sustainable sources of electricity.

Design and Make Foundations

Apply makerspace tools, iterative design, automation, and teamwork to build and refine a functional machine that addresses a real-world problem.

Foundations of Energy Storage

Explore electrochemical and mechanical energy storage through experiments, system design, and materials testing, including how materials perform and fail.

Harnessing Agentic AI

Learn Python and build AI agents while examining how large language models work, what they can do, and where their limitations lie.



Into the deep end

During their very first days at Lehigh, students in the new Human-Machine Interface module were already working with oscilloscopes, multimeters, and function generators—tools they will use to capture electrical signals from the human body and ultimately translate those signals into commands for a robotic arm.

The project introduces students to concepts spanning bioengineering, computing, electronics, and robotics, with applications including surgical robotics, rehabilitation technology, and medical devices.

"We're introducing students to the state of the art in engineering," says Juan Aceros, associate professor of bioengineering, who co-teaches the module with Stephen P. DeWeerth, the Lew and Sherry Hay Dean of Engineering and professor of electrical and computer engineering and bioengineering. "The skills they'll learn are applicable to computer science, robotics, mechatronics, circuits and signals, and just about anything in healthcare."

For students who have barely begun their college careers, the equipment and concepts are intentionally challenging.

"In that very first week at Lehigh, they're in the deep end of the pool," Aceros says. "But we have an amazing team of faculty and graduate students who are able to guide and help them through it."

FYRE facts

127 students enrolled for 2026–27

4 modules per student

8 Rossin College departments involved

18 faculty instructors (+ 1 dean!) across all modules

11 undergraduate engineering programs represented

What's next?

As FYRE continues through its pilot phase, the module lineup will keep evolving. Haden expects at least one new module to be added each academic year while another is retired.

"We will continuously assess if each module is the right fit for the moment," she says. "In this era of rapid technological change, much of it driven by AI, having such an adaptable and modular program is incredibly valuable. It allows us to refine what our students are exposed to and respond more quickly to changes in industry and technology than is typically possible for academic programs."

Engineering *on tap*

A new course built around brewing gives students a hands-on lesson in process design and plenty of room to experiment

Story by Christine Fennessy | Photos by Christa Neu

It may seem strange to sign up for a class focused on brewing beer when you've never even had a sip. But when Elizabeth Sterner '27 learned about the Engineering of Brewing, Winemaking, and Distilling, a course offered through the Department of Chemical and Biomolecular Engineering (ChBE), she couldn't wait to get started.

"I'm hoping to go into a food science field, and this class aligned with that goal," says Sterner, a chemical engineering major who took the course last spring. "I was excited to have this opportunity."

The idea for the class originated with Joseph Menicucci, associate chair of the ChBE department and a teaching associate professor, in collaboration with Department Chair Steven McIntosh, department technicians Paul Bader and Cody Turner, and Sam Masotto, owner and operator of Bonn Place Brewing in Bethlehem. Nicknamed "ChBEer," the course ran in the fall 2025 and spring 2026 semesters, and, due to demand, is offered in two sections this fall.

"At Lehigh, we're focused on providing hands-on opportunities to students," says Menicucci. "This class allows them to work directly with concepts like unit operations, enzymatic conversion, and heat exchange that they might be learning about in other classes. They develop the skills to replicate industrial processes involving living organisms under exacting conditions to produce a desired product."

That idea of precisely manipulating a range of variables appealed to Evelyn Wong '26. "I've never worked in a food lab before, and I wanted to learn something new," says Wong, a bioengineering major who also took the course last spring. "I'm used to working with bacteria and proteins, and in some ways, they're almost theoretical because they're so small. But the grains, oats, and hops are right there in front of you, which makes it feel like a more tangible experience."



A team of tea lovers came up with an American wheat beer infused with Earl Gray and orange blossom honey.



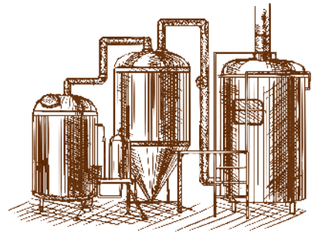
"The grains, oats, and hops are right there in front of you, which makes it feel like a more tangible experience."

—Evelyn Wong '26

LEFT: ANGRYSUN/ADOBE STOCK; ILLUSTRATION: OLEKSANDR POKUSA/ADOBE STOCK

Students are hands-on from the beginning. They learn how to design a recipe and source raw materials while digging into the unit operations of a brewery: milling and mashing grain to convert starches into sugars; boiling and quickly cooling the liquid (known as wort); fermenting to convert sugars into alcohol and carbon dioxide; separating and filtering to remove solids; and packaging and quality control to ensure consistency, carbonation, and sanitation.

Together, those brewing steps employ a range of chemical and biomolecular engineering concepts, from reaction conditions and temperature control to mass transfer and the behavior of microorganisms—concepts familiar to junior and senior chemical engineering students. But the beauty of the course, says Menicucci, is that students don't actually need a chemical engineering background to succeed. The spring cohort included several bioengineers, and this fall, ChBEer is open to all students of any discipline.



Working in teams, students design, brew, can, label, and present two beverages at an end-of-semester tasting event. Each team produces about five gallons—or approximately 40 cans—of each finished product. Teams tend to form around mutual tastes, which in some cases meant a shared *dis*like for alcohol altogether.

"I don't really drink," says Cooper Delemus '26, "and I'm still not the biggest fan of beer."

What he does enjoy, however, is learning by doing, and he particularly appreciated the creative freedom the class allowed. Delemus, a bioengineering major, initially went down a research rabbit hole trying to determine if his team could genetically modify yeast to brew a beer that glowed.

"We realized it wasn't feasible," he says. "But I learned so much about fluorescent proteins, bioluminescent organisms, yeast metabolism, and how yeast can be modified."

His careful study eventually brought him to grit, a traditional European herbal mixture used to flavor beer before hops became commonplace.

The team sourced yarrow and sweetgale *(Myrica gale)*, two of the most popular herbs used in traditional grit, and blended them with cinnamon, dried ginger, cardamom, and vanilla. It took some tweaking, but eventually the team produced a beer similar to a Christmas ale.

"Christmas ales are known for their spice flavor, and for being pretty strong," Delemus says. "Ours was about 8.9 percent ABV, but it had a very smooth taste thanks to the vanilla."

Sterner's team was similar in that they were bigger fans of tea than beer. So they came up with an American wheat beer infused with Earl Grey tea and orange blossom honey. And like Delemus, Sterner thrived in what she describes as the "choose your own adventure" ethos of the class.

"My group liked iced tea, and we wondered how we could turn that into a beer," she says. "The instructors and TAs helped us make it happen."

One of those TAs was William Clark '26. A chemical and biomolecular engineering major and dedicated home brewer, Clark helped Menicucci develop the class in its early stages. Assisting with the course in its first two semesters was not only an opportunity to deepen his knowledge of brewing, but also a chance to share his enthusiasm for the possibilities within chemical engineering.





Students work through every stage of the brewing process.

"Brewing is chemical engineering," says Clark. "You're manipulating a reaction to get a desired result. To me, it's a much more exciting process than being told to make a million tons of sulfuric acid."

It's also a process that rewards participation and feedback. After taking the class last fall and going from knowing very little about beer to brewing a respectable Italian pilsner, Zach Ostrand '26 returned in the spring as a TA largely because he enjoyed puzzling through recipes with other students.

"Some people taste one thing in a beer, while others taste something totally different," says Ostrand. "You're sharing this experience and trying to connect it to what we can do that's new, and those conversations are really fun."

Wong—whose team created the lemon shandy that was the fan favorite at the end-of-semester tasting—plans to incorporate many of the skills she developed in the class in her first industry role. She will be a process engineer in medicine formulation for the biopharmaceutical company AstraZeneca. She saw clear overlap between brewing beer and formulating medicines when it comes to process efficiency, improving yield, minimizing waste, and collaboration.

"It was so nice working with and learning from really smart people," she says. "They were all passionate about engineering and wanted to apply that passion to making great beer."

A new way to read the heart

Bioengineer Amirtahà Taebi is using seismocardiography to explore whether chest vibrations can reveal life-threatening defects in newborns that may be missed by current screening methods

Critical congenital heart diseases, or CCHDs, are a group of life-threatening structural heart defects present at birth. According to the Centers for Disease Control and Prevention, about 1 in 4 babies born with a heart defect has a CCHD, and treatment—medication and/or surgery—must take place within the first year of life.

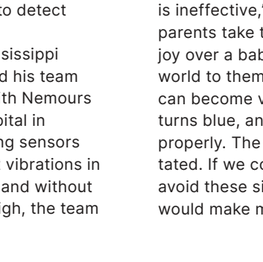
Today, all babies born in hospitals across the United States are screened for these conditions using pulse oximetry, a noninvasive test that measures blood oxygen levels.

"Pulse oximetry has had a huge effect on reducing mortality associated with CCHDs, but the method has critical flaws," says Amirtahà Taebi, assistant professor of bioengineering. "For example, it's more accurate for those with lighter skin tones. And some diseases do not necessarily affect blood oxygen levels, making them difficult for pulse oximetry to reliably detect."

Pulse oximetry works by emitting wavelengths of light to detect changes in hemoglobin. The technology was developed using algorithms trained primarily on lighter skin tones, says Taebi, which can lead to overestimated oxygen levels in patients with darker skin.

"In the U.S., about 50 percent of newborns have darker skin tones," he says. "What we ultimately want to do is create a more effective screening method that addresses both of these issues."

In 2024, while an assistant professor at Mississippi State University, Taebi received funding from the National Science Foundation's Faculty Early Career Development (CAREER) Program to develop a screening method for CCHDs based on chest vibrations. The prestigious NSF CAREER award is given to junior faculty members across the U.S. who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of the two. Taebi arrived at Lehigh in August 2025. His research focuses on seismocardiography (SCG), a noninvasive method that uses a sensor placed on the chest to record vibrations to monitor cardiovascular activity. When there is a structural abnormality in the heart, the defect creates a distinct vibration pattern.



The method has proven effective in providing clinically significant information for certain cardiovascular conditions such as heart failure. Because CCHDs share similarities with these diseases in terms of mechanical defects, Taebi hypothesized that SCG could be used to detect them as well.

While at Mississippi State, Taebi and his team collaborated with Nemours Children's Hospital in Orlando, sending sensors to record chest vibrations in newborns with and without CCHDs. At Lehigh, the team will process this data and record data from more newborns in partnership with Nemours.

"We need to first show that these vibration signals can, in fact, detect these diseases," he says.

Taebi and his team are also developing additional screening tools. One is a contactless method in which parents could use their smartphones to record videos of their newborns' chests.

"We've been working with our clinical collaborators to record and analyze these videos to extract information about chest vibrations," he says. "We want to know if a video can allow us to determine whether a newborn has a CCHD. If so, parents could potentially film their child and receive an early indication of whether medical evaluation is needed."

Another tool under development is a digital twin of a newborn's thoracic region. Using patient CT or MRI scans, the team will create computational models to simulate the propagation of heart vibrations.

"These digital twins will help our algorithms learn to better detect CCHDs," he says.

The goal, says Taebi, is to develop a screening method that can be used alongside pulse oximetry to mitigate its shortcomings. Ultimately, he believes seismocardiography could become a primary screening tool—capable of detecting all critical congenital heart diseases across a wide range of patients.

"Right now, there are newborns who are suffering because the method for detecting their disease is ineffective," he says. "Their parents take them home, full of joy over a baby that means the world to them. But these infants can become very sick. Their skin turns blue, and they can't breathe properly. The parents are devastated. If we could help families avoid these situations, nothing would make me happier."



Taebi (right) and his team are testing sensors and smartphone video as complementary screening tools.

CHRISTA NEU



A MULTIPLYING EFFECT

The Rossin College Scholarship Challenge

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Invest in the next generation of Lehigh engineers. Contact Danté Rossetti, Director of Development, at dar321@lehigh.edu or 610-758-2815 to learn more about the Rossin College Scholarship Challenge.

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EMBRACING THE CHALLENGE



First Year Rossin Engineering (FYRE) has expanded to eight modules, giving students more ways to learn by doing.

See page 20