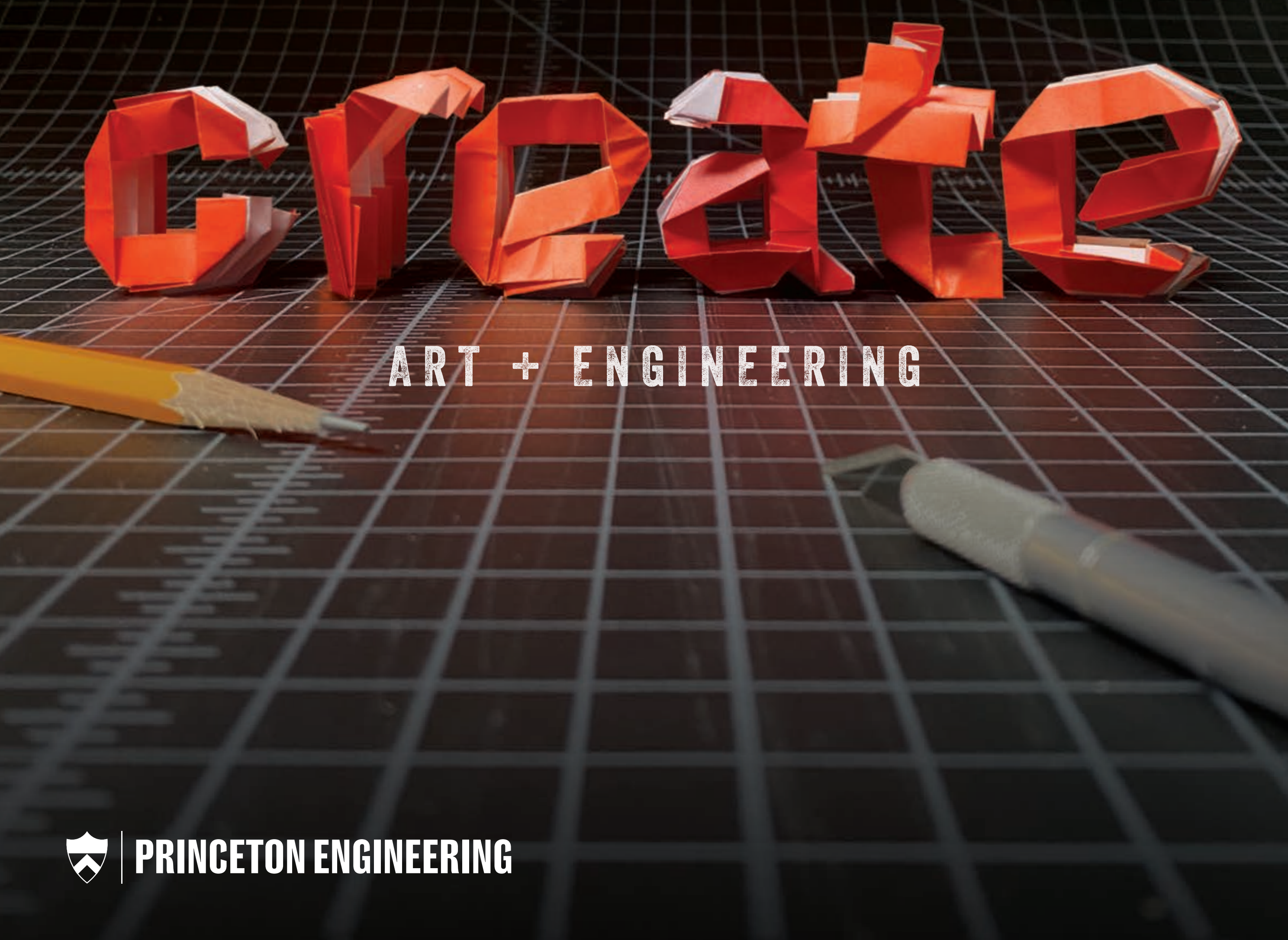
EQUAD NEWS

Spring 2025, Volume 36, Number 2

Supplement to the *Princeton Alumni Weekly*



ART + ENGINEERING

PRINCETON ENGINEERING

DEAN'S NOTE

Art and Engineering

The magic of interdisciplinary research is that faculty and students from vastly disparate fields can unleash creativity and innovation beyond anything they've imagined on their own. Wonderfully, here at Princeton, such transformative collaborations occur frequently. In this edition of EQuad News, we highlight one fertile intersection that spans the whole University: engineering and the arts.

In the projects you'll read about here, engineers, artists, and art historians contribute equally to something bigger than the sum of its parts. Often these collaborators return to their own disciplines with new perspectives on their research and teaching, opening greater potential for positive impact.

As some of our readers may have seen in February, this will be my last note in EQuad News as I prepare to take on the presidency of Stony Brook University. As I reflect on my time at Princeton and ideas I want to carry into my new role, the subject of this magazine exemplifies what makes Princeton Engineering so special. The eagerness of faculty and students to collaborate across fields has been key to our recent growth in areas such as bioengineering, robotics, quantum engineering, wireless technology, blockchain, and artificial intelligence.

It has been a tremendous pleasure and honor to serve as dean of engineering, and I am deeply grateful to the whole Princeton community for their partnership in everything we have accomplished. I look forward to following Princeton Engineering as it reaches new heights of excellence and impact.

Andrea Goldsmith
Dean | Arthur LeGrand Doty Professor of Electrical and Computer Engineering

Photo by David Kelly Crow

EQuad News
Spring 2025
Volume 36, Number 2

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EQuad News is published twice a year by the Office of Engineering Communications in collaboration with the Princeton University Office of Communications.

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In the Nation's Service and the Service of Humanity

During a panel moderated by Jesse Jenkins (right), speakers discussed the potential impacts of AI on the energy system. Left to right: Allison Clements, Lucia Tian, Matt DeNichilo, and Jenkins. Photo by Tori Repp/Fotobuddy

Andlinger Center conference unpacks AI's double-edged role in the clean energy transition

The rise of artificial intelligence presents opportunities and risks for the clean energy transition, speakers said at the Andlinger Center for Energy and the Environment's 13th annual meeting in October.

On one hand, the energy consumption from AI and its associated data centers will exacerbate challenges to already struggling clean energy ambitions. On the other, AI's ability to quickly process and react to unprecedented amounts of data will unlock new ways of approaching energy and climate challenges, allowing people to access information and complete tasks at speeds previously seen as impossible.

"AI is influencing nearly every academic discipline — frankly, nearly every human endeavor," said Jennifer Rexford, Princeton's provost and the Gordon Y. S. Wu Professor in Engineering, during the day's welcoming remarks.

Keynote speaker Melanie Nakagawa, Microsoft's chief sustainability officer, said the key to navigating the energy and environmental challenges of AI's rise is to consider its impacts across the global ecosystem.

"Ultimately, this is a systems challenge," Nakagawa said. "We want to create an impact beyond our company, so we are investing in solutions and advocating for policies that can support a net-zero future for everyone."

Echoing Nakagawa's systems approach, panelists underscored that AI and its associated data centers will be just one driver of future energy demand, alongside the wider adoption of electric vehicles and the growth of emerging energy technologies such as hydrogen electrolysis. Beyond AI, they said the real challenge is preparing the energy system for this period of sustained growth after decades of plateaued energy demand.

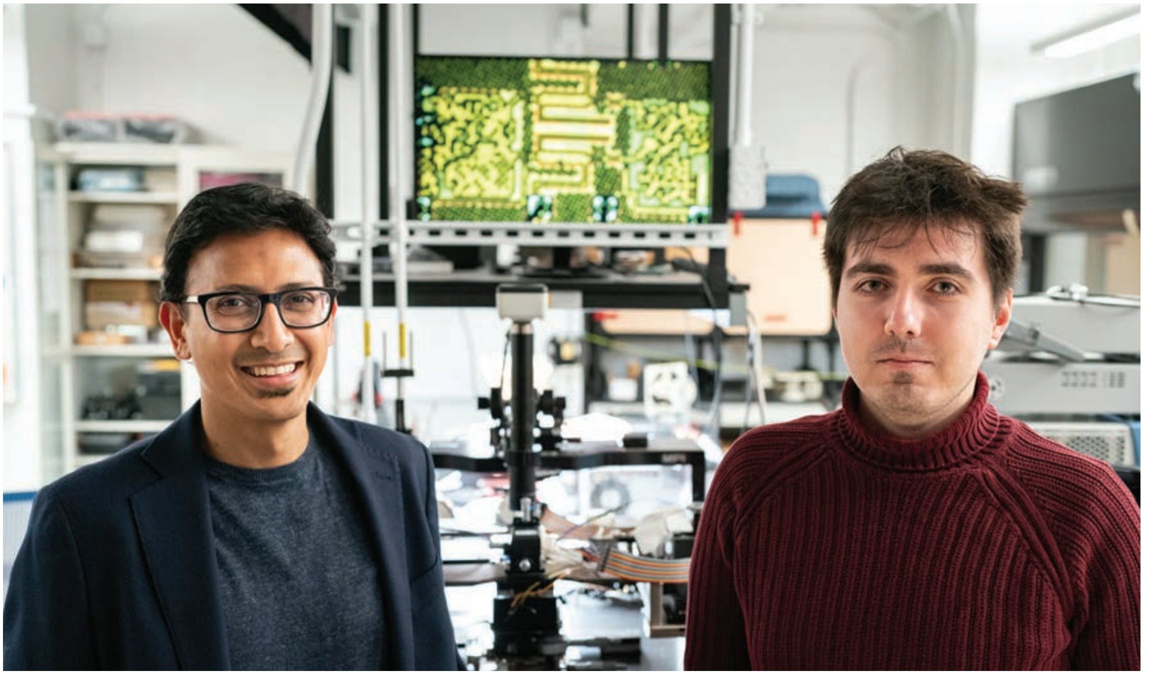
Lucia Tian, head of clean energy and decarbonization technologies at Google, argued that AI's growing energy footprint is an opportunity to grow global investments in clean energy technologies that will catalyze the broader energy transition.

Beyond accelerating the deployment of renewables like wind and solar, Tian pointed to Google's recent investments in enhanced geothermal energy, advanced small modular nuclear reactors, and long-duration energy storage, all of which could help Google meet its goal of achieving 24/7 carbon-free energy.

"Some of our early investments and partnerships can bring these emerging technologies that are at a premium today down the cost curve, so they can be available for everyone," Tian said.

–by Colton Poore

Professor Kaushik Sengupta, left, and lead study author Emir Ali Karahan, a graduate student in electrical and computer engineering. Photo by Tori Repp/Fotobuddy



AI slashes cost and time for chip design, but that's not all

Specialized microchips that manage signals at the cutting edge of wireless technology are astounding works of miniaturization and engineering. They're also difficult and expensive to design.

Now, researchers at Princeton Engineering and the Indian Institute of Technology have harnessed artificial intelligence to take a key step toward slashing the time and cost of designing new wireless chips and discovering new functionalities to meet expanding demands for better wireless speed and performance. In an article in Nature Communications, the researchers described their methodology, in which AI creates complicated electromagnetic structures and associated circuits in microchips based on specified design parameters. What used to take weeks of highly skilled work can now be accomplished in hours.

What is more, the AI behind the new system has produced strange new designs featuring unusual patterns of circuitry. Lead researcher Kaushik Sengupta said the designs were unintuitive and unlikely to be developed by a human mind. But they frequently offer marked improvements over even the best standard chips.

"We are coming up with structures that are complex and look random shaped and when connected with circuits, they create previously unachievable performance. Humans cannot really understand them, but they can work better," said Sengupta, a professor of electrical and computer engineering and co-director of NextG, Princeton's industry partnership program to develop next-generation communications.

These circuits can be engineered toward more energy-efficient operation or to make them operable across an enormous frequency range that is not currently possible. Furthermore, the method synthesizes inherently complex structures in minutes, while conventional algorithms may take weeks. In some cases, the new methodology can create structures that are impossible to synthesize with current techniques.

"There are pitfalls that still require human designers to correct," Sengupta said. "The point is not to replace human designers with tools. The point is to enhance productivity with new tools. The human mind is best utilized to create or invent new things, and the more mundane, utilitarian work can be offloaded to these tools." **–by John Sullivan**

Initiative aims to make Princeton a leader in AI accelerated engineering

As part of a set of investments around artificial intelligence, Princeton University has launched AI for Accelerating Invention to spur breakthroughs across engineering disciplines, including biomedicine, robotics, and nuclear fusion.

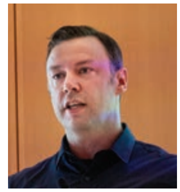
"What we have the opportunity to do here is to transform engineering by taking this tool and using it in ways that haven't yet been imagined," Andrea Goldsmith, dean of the School of Engineering and Applied Science and the Arthur LeGrand Doty Professor of Electrical and Computer Engineering, said at the Aug. 29 launch event. "We have an opportunity to lead."

Mengdi Wang, associate professor of electrical and computer engineering and the Center for Statistics and Machine Learning, and Ryan Adams, professor of computer science, lead the initiative.

AI for Accelerating Invention is one of three research initiatives, including Natural and Artificial Minds and Princeton Language and Intelligence, which round out the Princeton Laboratory for Artificial Intelligence (AI Lab).

"Researchers here at Princeton are tackling the most challenging and important scientific problems our society faces," said Adams. "Our hope is that a collaborative community around artificial intelligence can amplify the capabilities of everyone at Princeton to achieve new scientific heights."

–by Allison Gasparini

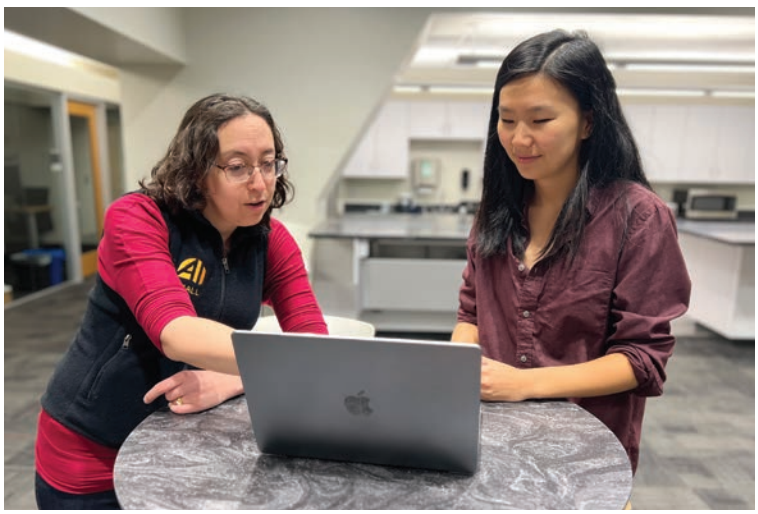


Professors Mengdi Wang and Ryan Adams lead the initiative. Photos by David Dooley/Fotobuddy

More checks make AI fairer

As artificial intelligence increases its role in everything from education testing to medical diagnoses, ensuring the systems' fairness is a key goal for researchers and policymakers. Currently, AI engineers evaluate fairness with a single leaderboard number, but research from Princeton Engineering shows that reducing fairness to a single metric could lead to societal harm.

"Things like fairness and even intelligence are multidimensional," said researcher Angelina Wang *24, a former graduate student at Princeton who has been appointed to the faculty at Cornell Tech in New York City.



Associate Professor Olga Russakovsky, left, and Angelina Wang *24. Photo by Emily Reid

In an article in the journal Patterns, Wang and Olga Russakovsky, associate professor of computer science and associate director of the Princeton AI Lab, argue for a multidimensional approach in which fairness is evaluated on several levels depending on the context of the application.

For example, consider an image-captioning algorithm that infers the gender of individuals in the images. Gender inference may be the preference of low-vision or blind users, but not transgender or non-binary individuals. A suite of tests that reveals how gender or race is treated broadly will help users understand which system may work best for them.

"Depending on the context, one model may be more fair than another, and a benchmark suite of disaggregated metrics can tell you that," said Wang.

–by Julia Schwarz

Princeton researchers equipped the wings of a remote-control plane with feather-inspired flaps and flew it at Princeton's Forrestal Campus to prove that the flaps help prevent airplanes from stalling. Left to right: Ahmed K. Othman, Girguis Sedky, Hannah Wiswell, and assistant professor Aimy Wissa. Photo by Lori M. Nichols

Bird wings inspire new approach to flight safety

Taking inspiration from bird feathers, Princeton engineers have found that adding rows of flaps to a remote-controlled aircraft's wings improves flight performance and helps prevent stalling, a condition that can jeopardize a plane's ability to stay aloft.

"These flaps can both help the plane avoid stall and make it easier to regain control when stall does occur," said Aimy Wissa, assistant professor of mechanical and aerospace engineering and principal investigator of the study, published in the Proceedings of the National Academy of Sciences.

The flaps mimic a group of feathers, called covert feathers, that deploy when birds perform certain aerial maneuvers, such as landing or flying in a gust. Biologists have observed when and how these feathers deploy, but no studies have quantified the aerodynamic role of covert feathers during bird flight. Engineering studies have investigated covert-inspired flaps for improving engineered wing performance but have mostly neglected that birds have multiple rows of covert feathers. The Princeton team has advanced the technology by demonstrating how sets of flaps work together and exploring the complex physics that governs the interaction.

The covert flaps deploy or flip up in response to changes in airflow, requiring no external control mechanisms. They offer an inexpensive and lightweight method to increase flight performance without complex machinery.

The study uncovered the physics by which the flaps improve lift and identified two ways that the flaps control air moving around the wing. One of these control mechanisms had not been previously identified. The researchers uncovered the new mechanism, called shear layer interaction, when they were testing the effect of a single flap near the front of the wing. They found that the other mechanism is only effective when the flap is at the back of the wing.

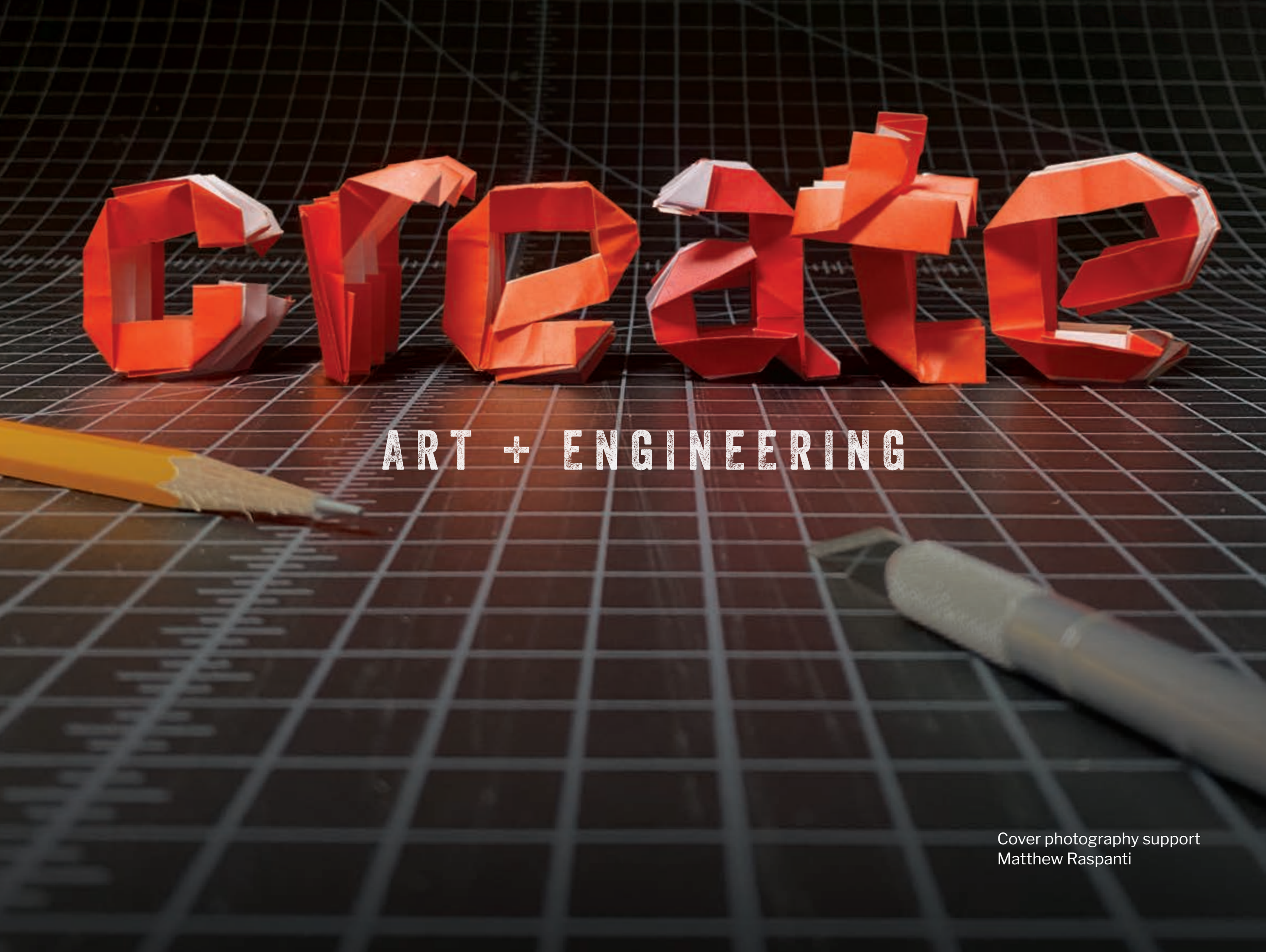
Wissa said this study could open the door to collaborations with biologists to learn more about the role of covert feathers in bird flight, and that the results of this study will help form new hypotheses that can be tested on birds. "That's the power of bioinspired design," she said. "The ability to transfer things from biology to engineering to improve our mechanical systems, but also use our engineering tools to answer questions about biology." **–by Alaina O'Regan**

The magic of collaboration

At Princeton, artists and engineers work together regularly, not just to solve technical problems but to create new areas of research, new modes of expression, and new approaches to technology. In 2016, building on years of projects and popular courses, faculty members founded the consortium creativeX to build further collaborations and visibility. One of the consortium's first projects, with Princeton's Council on Science and Technology, was to create "Transformations in Engineering and the Arts," a hands-on, project-based course taught by faculty in the visual and performing arts and various engineering disciplines (see page 10).

CreativeX has grown to more than a dozen faculty members from across engineering as well as architecture, visual arts, music, dance, theater, and creative writing.

The stories featured in this magazine provide a glimpse into how faculty and students at Princeton are pushing the boundaries of what origami can create, engineering new performance arts, exploring the human-robot interface, and more.



Cover photography support
Matthew Raspanti

Stretching boundaries, literally and figuratively

"Noli Timere" premiered in February at Princeton's McCarter Theatre Center. Photo by Marie-Andrée Lemire

How can engineers and dancers use nets to explore structural designs and collective motion? At Princeton, artists and researchers confront this question head-on, exploring the complexities of giant nets and seeking to understand how they respond to human movement and dynamic loads.

Spearheaded by Rebecca Lazier, professor and associate director of the Program in Dance at the Lewis Center for the Arts; Sigrid Adriaenssens, a professor of civil and environmental engineering; and visual artist Janet Echelman, the project traces its origins to a serendipitous meeting at a 2018 symposium.

"We saw the potential of the artistic expression — the living, human system of the net," Lazier explained. "The net was an extension of the body, and plucking a single line can make the whole system move. It also has this layer of how we think about the world we're in, the earth we're on."

This shared vision led to subsequent collaborations with architects, engineers, and dancers, exploring dance within net structures through residencies and co-teaching at the University of Washington and the Atelier Program at Princeton.

Adriaenssens leads efforts to use machine learning to develop mathematical models that capture nets' nuanced behavior. The collaborators test the models in performance spaces. Thus, the stage becomes an alternative laboratory for engineers to observe how different net configurations impact their mechanics under various loads and configurations.

"We're interested in studying the behaviors we observe in the nets because very little is known about how they behave. Nets are complex systems that warrant deeper exploration," Adriaenssens said.

An ongoing multidisciplinary performance from this collaboration, "Noli Timere" is a soaring aerial dance. Eight performers, suspended up to 25 feet in the air, move within Echelman's monumental net sculpture, where every movement reverberates through the intricate web. "Noli Timere," Latin for "be not afraid," renders interconnectedness visible and demonstrates the delicate balance of our ecosystem as small actions have ripple effects across the world.

"Noli Timere" has a residency this year at the MIT Center for Art, Science & Technology and premiered at Princeton's McCarter Theatre Center in February. **–by Mark DeChiazza**

DeChiazza is a documentary filmmaker who was the Edward T. Cone Visiting Fellow in the Humanities Council and Department of Music in 2022. He is the producer and documentarian for Princeton's CreativeX partnership between engineering and the arts.

International venue showcases collaboration and innovation

For over 100 years, Venice has been a premiere showcase for the best of contemporary art and architecture, with biennial exhibits featuring stars of the visual and creative worlds.

Although Sigrid Adriaenssens is an engineer rather than a professional artist, she has sent exhibits to both the Venice Biennale and the European Cultural Center Venice Biennale. A professor of civil and environmental engineering and director of the Form Finding Lab, she uses technology to revive and reimagine traditional craft techniques.

In 2023, she presented an exhibit that combined classic masonry with augmented reality to create a self-supporting vault. Working with the architecture firm Skidmore, Owings & Merrill, Adriaenssens collaborated with Italian masons to build the vault in a Venetian garden. The science behind the work was based on a paper Adriaenssens and collaborators wrote in 2020, demonstrating the unique brick pattern that allowed 15th-century architect Filippo Brunelleschi to create Florence's duomo without any external support.

This year, Adriaenssens and colleagues have sent three exhibits to Venice. Two are based on the ancient paper-cutting art form kirigami. One, in collaboration with professors Elie Bou-Zeid of Princeton and Lucia Stein-Montalvo of Northwestern University, creates an urban canopy that stirs airflow over the streets below. Another, with computer science professor Ryan Adams and graduate student Isabel Moreira de Oliveira, uses steel plates to create patterns of varying depth and texture in floors.

Adriaenssens is also working with Professor Wesam Al Asali of IE University in Segovia, Spain, on an exhibit that creates roof designs that reflect traditional craft techniques from around the Mediterranean, such as basket weaving and masonry vaults.

As an engineer, Adriaenssens said she looks for scientific principles underlying traditional crafts.

"We study proven craft techniques, distill their underlying mechanical and geometric algorithms, and envisage how we can upscale them to address challenges in the urban environment," she said.

–by John Sullivan

In collaboration with Bill Washabaugh (left) at Brooklyn's Hypersonic studio, Sigrid Adriaenssens (right) and Lucia Stein-Montalvo (center) created "Kirigami d'Aria," a prototype for an urban canopy that stirs airflow over the streets below. Photo by Laura Barisonzi

Rhythm bots explore human-machine interface through dance

Naomi Ehrich Leonard ’85 has always been amazed by collective behaviors in nature, whether a flock of birds whirling through the air like a smoke cloud or a flashing, twisting school of fish.

“They move so quickly and effortlessly, and with no choreographer, no central control,” she said.

This emergent coordination inspires Leonard’s work in robotics and mobile sensor networks — exploring feedback and dynamics in collective behavior.

Across campus, dance professor Susan Marshall choreographs performances that examine the roles of control, agency, and interdependence.

Leonard, chair of the Department of Mechanical and Aerospace Engineering, was a dancer herself. She said it was clear that she and Marshall were exploring similar questions.

Although they represent different disciplines, the two have worked together for over a decade. “Our collaboration took off when I met Susan Marshall after she attended a public lecture I gave on the topic of collective motion,” Leonard said.

It started with “Flock Logic,” a performance piece that examines how individuals move in response to one another when guided by simple rules. Next, Leonard joined Marshall, director of Princeton’s Program in Dance, in a study that led to Marshall’s “Rhythm Bath,” an immersive dance performance that explored whether the synchronous movements of dancers could create a meditative space for their audience.

Inspired by these projects, Leonard consulted with Marshall in 2023 to create “Rhythm Bots,” an interactive installation where participants wander among a field of tall, slender robots that respond to their changing environment with gentle, rhythmic rotations.

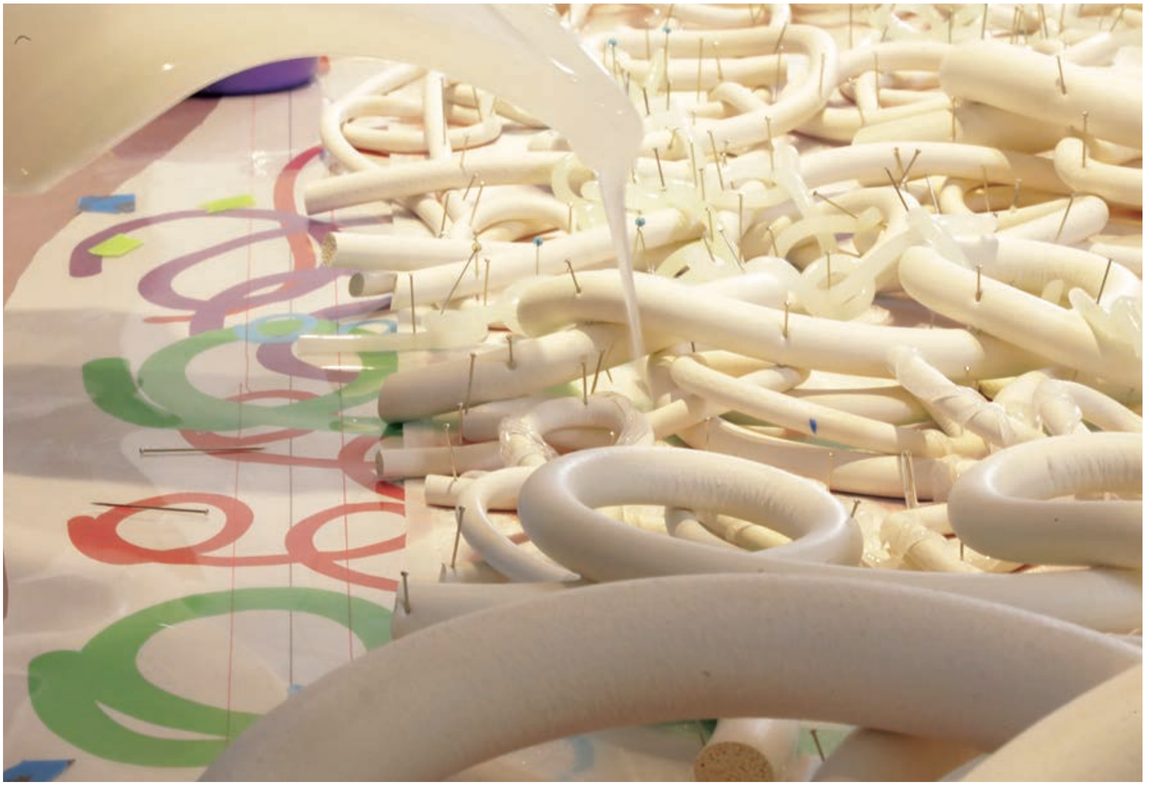
The custom-made bots, adorned with cutouts of simple shapes and colors, make independent decisions to rotate in response to communicated signals from one another and to visual cues of audience members. Synchronicity arises in the movement of the bots from their designed feedback dynamics. In 2024 Dan Trueman *99, chair of Princeton’s music department, and Jane Cox, director of theater, joined the collaboration and extended the bots’ movements with sound and light. Leonard said the project provides an inspiring avenue for her investigations into how collective behaviors emerge in a group of individuals.

She said that “Rhythm Bots” also provides a unique lens for studying human-machine interaction.

“These collaborations lead me to ask new questions,” Leonard said. “They create paths for explorations that expand my research.”

–by Alaina O’Regan

Naomi Ehrich Leonard (pictured) and Susan Marshall merged their expertise to create “Rhythm Bots,” an interactive display exploring collective behavior and rhythmic connection between humans and machines. Video still by Mark DeChiazza



To create “Rope Piece (deluge),” Lauren Dreier and other Brun lab members poured and extruded viscous polymer solutions onto a template based on mathematical simulations. Photo by Barath Venkateswaran

A da Vinci-inspired ‘deluge’ of collaborative experimentation

The blurry boundary between liquid and solid is ripe for exploration in both engineering and art, says Lauren Dreier, a graduate student in architecture who is doing her dissertation research in Princeton’s engineering school.

Dreier is also a practicing artist who has worked in media including textiles and robotics. Her research is advised by associate professors Andrej Košmrlj in mechanical and aerospace engineering and Pierre-Thomas Brun in chemical and biological engineering. Brun, who has forged several collaborations with artists, works with polymers that transition between liquid and solid. His lab has developed a new way to 3D print soft materials and a method that uses bubbles to cast components for soft robots.

Last year, Dreier used similar materials and extrusion methods to create an art piece called “Rope Piece (deluge).” Other members of the Brun lab took part in conceptualizing, planning and assembling the piece, whose base is a 15-foot-long piece of sheer organza fabric attached to the wall at eye level. At the top is a series of parallel silicone strands, which give way to ever-wavier and thicker threads, ending on the floor as a layered mass of coils evoking a flood of fluid that has become solid. Dreier used mathematical simulations to create a template for the strands based on the natural behaviors of viscous fluids.

The piece, along with a smaller work comprised of lacelike extruded coils, was displayed at The Leonardo Museum in Salt Lake City as part of the American Physical Society’s Traveling Gallery of Fluid Motion, a showcase of works inspired by Leonardo da Vinci’s studies of fluid dynamics and flight.

Da Vinci “was really curious about fluids that tend toward turbulence” and chaos, said Dreier. This fascination was exemplified by a series of “deluge” drawings depicting apocalyptic flooding, which da Vinci completed in the years just before his death in 1519.

“I have a tendency in my art practice to want to invert things, kind of take things apart as I understand them and maybe turn them upside down, or tap on the shell a little bit,” said Dreier. “One reason I’ve really liked working in [Brun’s] group is that I think he’s always been coming from that curiosity-driven place. And I think that sort of thing can only be good for our discipline.” **–by Molly Sharlach**

Teaching assistant Nneoma Onyekwere works with undergraduates Carter Gold and Anh Dao in the laboratory for the “Bridges” course. Photo by Sameer A. Khan/Fotobuddy

‘Bridges’ course embraces beauty as part of the engineering equation

Professor Maria Garlock considers engineering a form of art. Her current research explores coastal protection solutions like canopies and bridges that transform into flood barriers — structures that combine elegance and resilience.

She teaches a course, “Structures and the Urban Environment,” that encourages students to examine the structural performance of bridges and towers along with their aesthetic qualities and social context.

“The engineer can be an artist in their own right,” said Garlock, the Daniel Tsui Professor in Engineering and a professor of civil and environmental engineering. “Students get to think about what beauty is … to think beyond the equations and the formulas, about the culture and people — all these things are really important to bring into an engineered design.”

The course, known informally as “Bridges,” builds on the foundation of the late professor David Billington ’50, who first taught the course in 1974. **–by Molly Sharlach**

Students combine disciplines to discover new passions

“Transformations in Engineering and the Arts” is an undergraduate course that integrates engineering with artistic approaches to visual media, sound, structures, and movement. Students learn from faculty members in engineering, music, dance, and visual arts, and develop projects that transform concepts across disciplines. Engineering professors Naomi Leonard ’85 and Maria Garlock conceived of the course along with the Council on Science and Technology (CST) staff. Leonard and Garlock first taught the course in 2016, together with music lecturer Jeffrey Snyder, and engineering professors Adam Finkelstein and Sigrid Adriaenssens. The CST hosts the course in its StudioLab space. In a 2024 project led by Senior Lecturer in Visual Arts Martha Friedman, students created prints using platinum-cure silicone rubber. They learned how the rubber’s polymerization reaction affects material properties like viscosity and flexibility, bringing together engineering principles and artistic practice. Shown here are junior Christopher Florance and Natalia Lalin ’24. Photo by David Kelly Crow. **–by Molly Sharlach**

Professor Branko Glišić speaks to a group from the "Historical Structures" class during a 2024 trip to Athens. Photo by Kirstin Ohrt, Department of Art and Archaeology

Modern engineering hidden in ancient stone

On an unseasonably warm day last October in Athens, Greece, a group of Princeton students stepped off the tourist path in the Roman Agora.

As participants in the interdisciplinary seminar "Historical Structures," co-taught by professors Branko Glišić (civil and environmental engineering) and Samuel Holzman (art and archaeology), these students had received permission from the Greek Ministry of Culture to get a closer look at the remains of an ancient engineering breakthrough.

Builders in ancient Greece had struggled to use stone to span the long distances they needed to create majestic openings between stone columns. In the bushes of the Roman Agora, Holzman and Glišić guided students to the remains of an early, abandoned experiment that used cantilevers to divert weight away from the centers of beams to the supporting columns. These cantilevered beams had been carved around 300 B.C.E. to shade the law courts of ancient Athens.

A year earlier, Glišić and Holzman had turned to engineering undergraduate Jonathan Gagnon '24 to analyze these cantilevers and compare them to a later Greek idea of hiding shallow (flat) arches above the beam. Using mathematical and computational modeling, Gagnon found out why ancient builders abandoned this first experiment: The cantilevered beams were under more tensile stress than the beams they were relieving. The system of flat arches worked better.

Gagnon's 2024 senior thesis was awarded the Hellenic Studies Senior Thesis Prize and the Frederick Barnard White Prize in Architectural History. He is now an engineer with Guy Nordenson and Associates in New York City and says that one of the great lessons from his time at Princeton was to see engineering as more than a purely technical discipline.

"It is important to have creative ways of approaching what you are doing," he said. "The hardest problems are the ones that require you to think historically and holistically about the project."

This interdisciplinary approach was the inspiration for Glišić and Holzman's "Historical Structures" course, which introduces students to engineering and archaeological principles in tandem. The detour in the Roman Agora in their fall 2024 trip was one of many stops at archaeological sites from Delphi to the Peloponnesian peninsula.

–by the Office of Engineering Communications

In engineering, beauty does not determine functionality, but it can improve it

"If you make a system aesthetically pleasing, that may help people adopt technology for the long run and keep them interested and engaged," said Merihan Alhafnawi, a postdoctoral research associate at Princeton Engineering.

While engineers tend to focus on technology and functionality, almost everything they build is meant to be used by humans, and humans are deeply influenced by aesthetics.

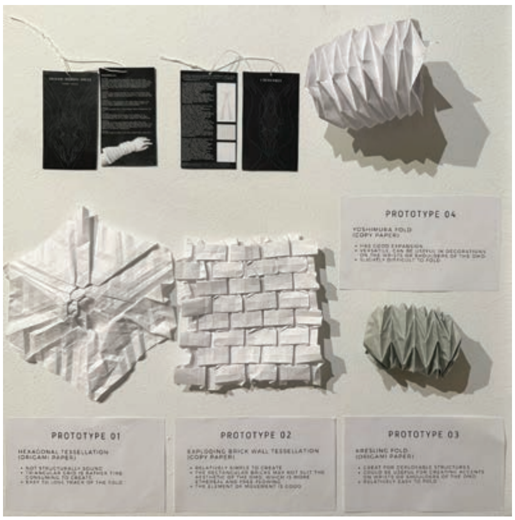
Alhafnawi works with Radhika Nagpal, Norman R. Augustine '57 *59 Professor in Engineering and a professor of computer science and mechanical and aerospace engineering. As part of her work in the Nagpal Lab, Alhafnawi helped create the Swarm Garden, an installation of robotic flowers that can be used as an adaptive shading system on a building facade.

The goal of the project, she said, is to find ways to improve the functionality of a building, "not only by maintaining light and temperature, but also by being beautiful."

The Swarm Garden, which was exhibited on campus at the Lewis Center for the Arts in 2024, is a collaboration between Nagpal; Alhafnawi; Sigrid Adriaenssens, professor of civil and environmental engineering; and Lucia Stein-Montalvo, a former postdoctoral research associate who is now an assistant professor at Northwestern University.

–by Julia Schwarz

Merihan Alhafnawi and Radhika Nagpal at the Swarm Garden exhibition in April 2024. Photo by Moamen Elmassry



Audrey Zhang, a senior majoring in art and archaeology, worked with engineering professor Glaucio Paulino to incorporate technology into her art. Photos courtesy of Audrey Zhang

Art and engineering fold into inspiration

For her junior independent project, Audrey Zhang designed a dress, but it was no ordinary dress. By incorporating precise origami folds, Zhang transformed a collection of fabric and paper into an artistic representation of a quantum memory drive.

An art and archaeology major, Zhang turned to engineering to use intricate folding patterns that evoke how the past sends flickering images in her work "Origami Memory Dress." Zhang, who often incorporates technology into her art, worked with civil and environmental engineering professor Glaucio Paulino's research team to apply origami patterns to her design.

"Incorporating origami into my work has enabled me to iterate through engineering designs in a tactile way," said Zhang, who noted that the pattern in her dress, called a Miura-ori tessellation, also has applications like satellites that unfold in orbit. "Origami also taught me how to give new form and properties to materials like paper, an idea I plan to explore more in my art."

Now a senior, Zhang again used Miura-ori patterns as part of her thesis project "StarSail," a conceptual design for an interstellar bioship that can terraform exoplanets to restart human civilization. The ship features Miura-ori petals as solar sails. Zhang said engineering illuminates "tangible ways of realizing the far-future ideas I visualize through my art."

Zhang and Paulino, the Margareta Engman Augustine Professor of Engineering, say both disciplines gain from working together.

"Art inspires engineering, and engineering inspires art," Paulino said. **–by John Sullivan**

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