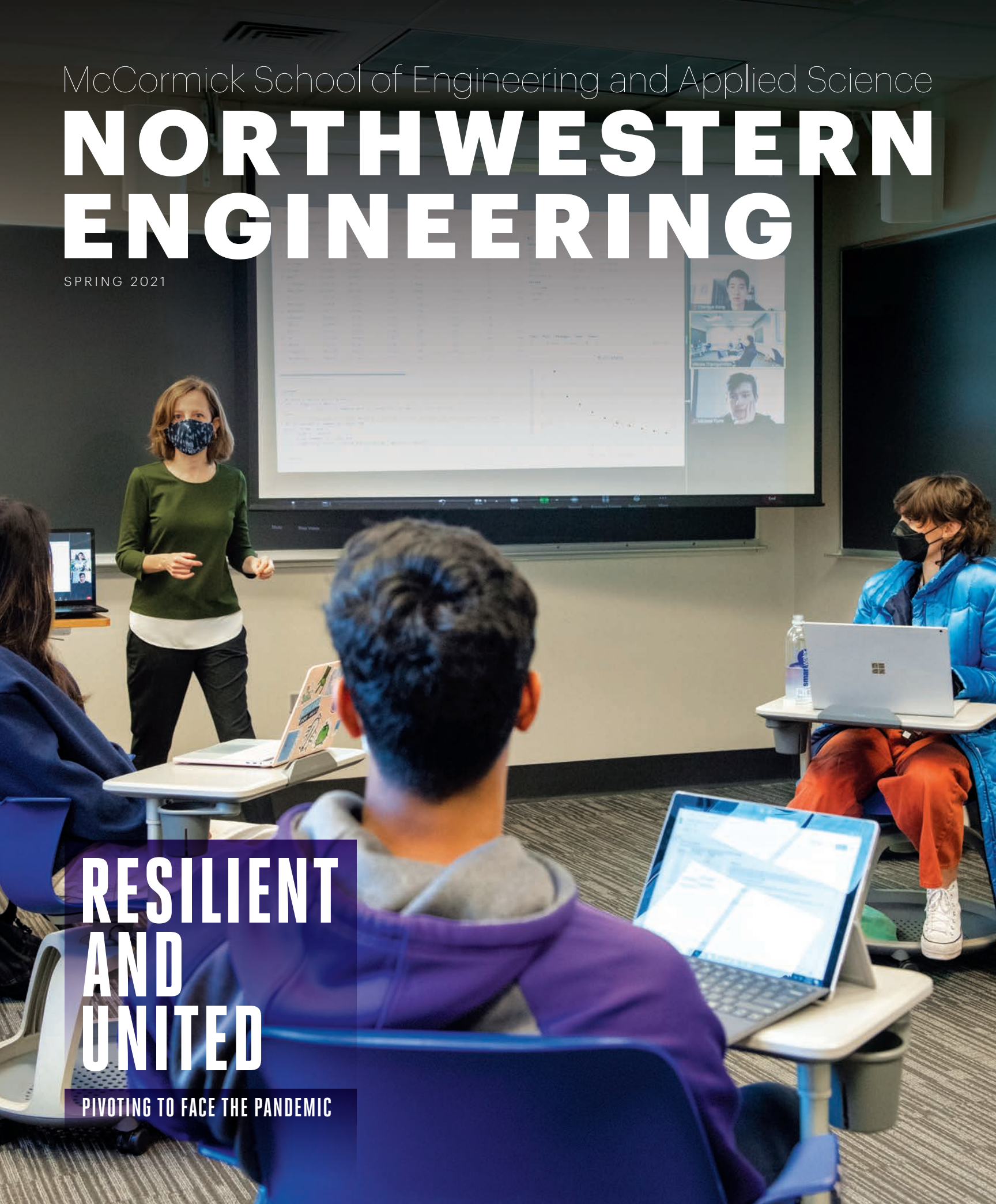
McCormick School of Engineering and Applied Science

NORTHWESTERN ENGINEERING

SPRING 2021



RESILIENT AND UNITED

PIVOTING TO FACE THE PANDEMIC

REGENERATION RAINBOW

Captured via scanning electron microscopy, these rainbow-colored, micron-sized pillars can be used as an underlying substrate for cell culture to test the mechanical forces cells exert on different biomaterial coatings. This process is used to screen new biomaterials that could be implanted as biodegradable scaffolds to guide regeneration of damaged tissues or organs.

Image by Nick Sather (Samuel I. Stupp Laboratory/Simpson Querrey Institute)

"Let me emphasize the word 'together.' Though we have been physically distanced—some of us operating from the other side of the world and others working mere blocks from campus—we remain one strong, connected community."

GREETINGS FROM NORTHWESTERN ENGINEERING

Anticipating and adapting to change is what engineers do. We need only to think back to a year ago to realize how quickly changes can come and shift our worldview forever.

This issue of *Northwestern Engineering* is full of stories that show how well our community has faced COVID-19 together and adjusted with creativity and perseverance.

Let me emphasize the word "together." Though we have been physically distanced—some of us operating from the other side of the world and others working mere blocks from campus—we remain one strong, connected community. This year, we have forged and tested bonds in research, in teaching, and, importantly, with each other.

In this issue you will find stories that show how our students and faculty have handled this unusual year's challenges—by pivoting research topics, adjusting pedagogy, juggling family obligations, and more—all while playing the dual roles of offering and receiving support.

This is not the first time in Northwestern's history that we have weathered intense change. In this issue, we highlight how the GI Bill reshaped our campus after World War II, with students living in Quonset huts quickly built throughout campus. As always, the challenge tested Northwestern's mettle, and we emerged stronger.

Challenges inspire innovation, which in turn fosters new business opportunities. Now, under Hayes Ferguson's leadership at the Farley Center, we will take entrepreneurship education to a new level.

Meanwhile, we continue work on pressing problems of our times—including environmental issues. The Center for Synthetic Biology is working on possible routes to produce cleaner water by reprogramming cellular machineries, while Josiah Hester used a battery-free Game Boy to exemplify what is possible in the realm of environmentally sound electronic devices.

These stories feature only a few of those who have persevered in our community. I applaud all of you for standing up to these unexpected challenges with equal amounts of grace and tenacity. I am grateful for your ongoing support.

As always, I welcome your feedback.

JULIO M. OTTINO
Dean, McCormick School of Engineering and Applied Science

On the Cover With COVID-19 restrictions in place, Northwestern offers hybrid classes, including this one led by Professor Karen Smilowitz, with some students taking part on campus and others attending virtually.
Photography by Steven E. Gross
Some images predate COVID-19 regulations.

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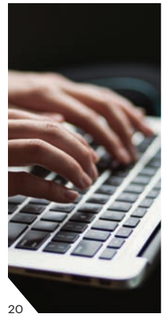
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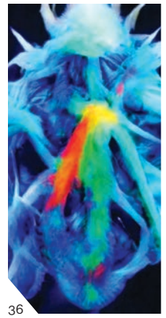
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NEWS

COLGATE, MAHMASSANI ELECTED TO NATIONAL ACADEMY OF ENGINEERING

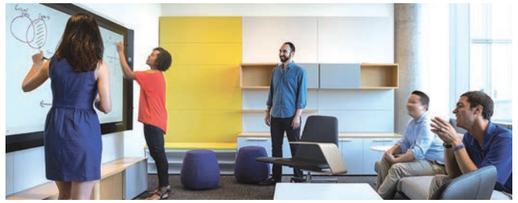
Northwestern Engineering's J. Edward Colgate and Hani Mahmassani, leaders in robotics and in transportation and operations, respectively, were elected to the National Academy of Engineering, one of the highest professional distinctions awarded to an engineer.

They are among the 106 new domestic members and 23 new international members. Current members elect new inductees of the NAE, founded in 1964.

Colgate, professor of mechanical engineering, primarily focuses on human-robot interaction, and has worked extensively in the areas of haptic (touch) interface, cooperative robotics, remote manipulation, and advanced prosthetics.

Mahmassani, who directs the Northwestern University Transportation Center, is William A. Patterson Distinguished Chair in Transportation and professor of civil and environmental engineering and (by courtesy) of industrial engineering and management sciences.

"WE ARE EXTREMELY PROUD THAT ED AND HANI HAVE BEEN RECOGNIZED AT THE HIGHEST LEVEL IN OUR FIELD. THEY ARE BOTH OUTSTANDING AS INNOVATORS, RESEARCHERS, AND EDUCATORS, PUSHING THE LIMITS OF THEIR FIELDS." **JULIO M. OTTINO** Dean, Northwestern Engineering



KELLOGG, McCORMICK ANNOUNCE MBAi JOINT DEGREE PROGRAM

The Kellogg School of Management and the McCormick School of Engineering launched an MBAi joint degree program at the intersection of business and technology management. The accelerated, five-quarter offering responds to a growing and global need for leaders who can spearhead strategic, business-driving innovation while understanding the complexities and nuances of the technologies that enable it.

The program is designed for students with strong technology work experience or academic grounding who are interested in a focused curriculum covering machine learning, robotics, computational thinking for business, introductions to the frontiers of science and technology, and how data science and artificial intelligence drive innovation.

The MBAi program also includes an experiential summer quarter that allows students to gain work experience.

90

Percent water by weight of a material developed by Samuel Stupp and Monica Olvera de la Cruz that acts as a soft robot

2

Faculty elected to the National Academy of Inventors

DESIGN-A-THON IDEAS RISE TO THE OCCASION

The McCormick Design-A-Thon 2020 had an important goal: harness the power of Northwestern students' thinking to find ways to build community during the pandemic. Just as Fall Quarter started, 180 students rose to the occasion.

The virtual hackathon-style event challenged the 37 participating teams to answer, "How might we understand and reimagine our 'community' in the age of COVID-19 for students at Northwestern University?"

Twelve finalist teams presented three-minute videos of their concepts to a panel of judges that included Northwestern Engineering faculty and alumni.

After competitors presented ideas ranging from a program that mimics chance encounters on Sheridan Road to an app that connects music lovers, team Tech Labyrinth's idea, Roomz, emerged the winner. The platform creates virtual rooms where students can watch live lectures with classmates and collaborate and discuss the material using a pause feature.

One McCormick Lecture Series Highlights Diverse Student Groups

To build community and enhance connectivity during the COVID-19 pandemic, Northwestern Engineering launched the One McCormick lecture series as a venue for presenting ideas.

The virtual series focused initially on the student experience, including diversity, health and wellness, and student success. Fall presentations included leaders of student groups such as the Northwestern chapters of the National Society of Black Engineers, the Society of Women Engineers, and the Society of Asian Scientists and Engineers.

Each organization's leaders explained their role in the McCormick School of Engineering community and what their membership provides to the school specifically and the University as a whole, such as volunteerism and mentorship.

"The best thing faculty can do is make sure they have a good enough connection with students so if they are having issues within their classes, they're comfortable talking to them—and to keep having those conversations."

LEAH PAYNE
Junior, Chemical Engineering,
President, Northwestern chapter of NSBE

66

Women in Computing members who attended the 2020 Virtual Grace Hopper Celebration

26,000

Movies analyzed by Luís Amaral to count how many women worked in film from 1910 to 2010

364

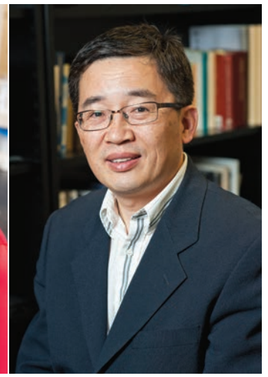
Master's and PhD graduates in December

SCHOOL OF COMMUNICATION, McCORMICK LAUNCH CENTER FOR HUMAN-COMPUTER INTERACTION + DESIGN

Northwestern Engineering and the Northwestern School of Communication launched the Center for Human-Computer Interaction + Design (HCI+D), which aims to develop the future of human and computer interaction.

The center's core vision and values build on Northwestern's unique interdisciplinary, socially engaged, people-centered approach to interaction and design. It also supports researchers in their pursuit of new interaction paradigms that will foster a collaborative, sustainable, and equitable society.

To achieve those goals, HCI+D draws upon the University's pioneering leadership in interaction and design research, leveraging Northwestern's history of research among diverse disciplines—including communication, computer science, design, learning sciences, several areas of engineering, medicine, and psychology.



INAUGURAL PEPPER, ACHENBACH CHAIRS NAMED

Kimberly Gray and Yonggang Huang were named the inaugural holders of Northwestern Engineering's two newly endowed chairs.

Gray is Roxelyn and Richard Pepper Family Chair in Civil and Environmental Engineering, a rotating professorship held by the department chair. She is professor of civil and environmental engineering and (by courtesy) chemical and biological engineering. The gift was endowed by alumni Roxelyn (Roxy) ('53) and the late Richard Pepper ('53).

Huang, a faculty member since 2007, serves as Jan and Marcia Achenbach Professor in Mechanical Engineering. A gift from the late Professor Jan Achenbach and his wife, the late Marcia Achenbach ('65 MA), supported this professorship.

COVID-19 NOTES

Clinical-Grade Wearables Offer Continuous Monitoring for COVID-19

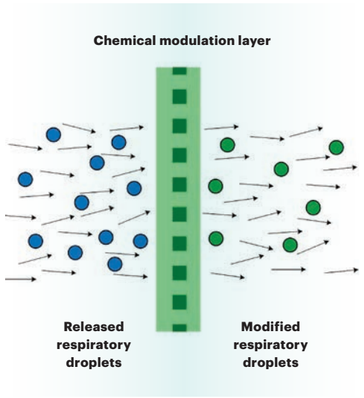
Northwestern University researchers caution that consumer-grade wearables are not sophisticated enough to monitor COVID-19.

The team, led by Professor John Rogers, published a perspective in *Science Advances* in which researchers differentiate between popular consumer electronics fitness trackers, which sit on a wrist or finger, and clinical-grade monitoring systems, which sit at the base of the throat.

This follows the introduction by Rogers's group and researchers at Shirley Ryan AbilityLab of a novel wearable device and set of data algorithms specifically tailored to catch early signs and symptoms associated with COVID-19 and to monitor patients as the illness progresses.

"A CONVENTIONAL WEARABLE DEVICE, SUCH AS A FITNESS TRACKER, SITS ON THE WRIST OR FINGER—NOT THE ANATOMICAL LOCATION THAT IS MOST RELEVANT TO COVID-19."

JOHN A. ROGERS
Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering, and Neurological Surgery



FACE MASK AIMS TO DEACTIVATE VIRUS TO PROTECT OTHERS

Researchers led by Professor Jiaxing Huang developed a concept for a mask that aims to make the wearer less infectious. The central idea, supported by the National Science Foundation through a Rapid Response Research (RAPID) grant, is to modify mask fabrics with anti-viral chemicals that can sanitize exhaled respiratory droplets.

By simulating inhalation, exhalation, coughs, and sneezes, the researchers found that non-woven fabrics used in most masks work well to demonstrate the concept. A lint-free wipe with just 19 percent fiber density, for example, sanitized up to 82 percent of escaped respiratory droplets by volume. Such fabrics do not make breathing more difficult, and the on-mask chemicals did not detach during simulated inhalation experiments.

NORTHWESTERN LEADS NIH PROGRAM FAST-TRACKING COVID-19 TESTING TECHNOLOGIES

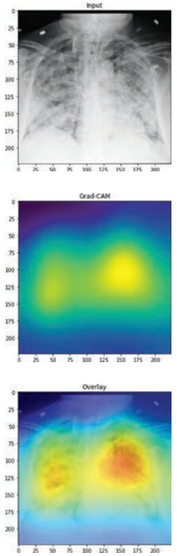
The Center for Innovative Point-of-Care Technologies for HIV/AIDS at Northwestern (C-THAN) is leading a program from the National Institutes of Health (NIH) designed to fast-track new technologies capable of increasing COVID-19 testing capacity up to 100-fold above current standards.

The program, called Rapid Acceleration of Diagnostics (RADx), is supported by a $6.7 million supplementary grant from NIH that aims to develop and scale technological innovations for testing to reduce the risk of future outbreaks and to support efforts to return to in-person activities, like school and work.

RADx comprises four stages for technologies that demonstrate notable innovations to the COVID-19 testing process. C-THAN, a member of NIH's National Institute of Biomedical Imaging and Bioengineering Point-of-Care Technologies Research Network, is leading RADx in collaboration with other network partners.

"X-RAYS ARE INEXPENSIVE AND ALREADY A COMMON ELEMENT OF ROUTINE CARE. THIS COULD POTENTIALLY SAVE MONEY AND TIME—ESPECIALLY BECAUSE TIMING IS SO CRITICAL WHEN WORKING WITH COVID-19."

AGGELOS KATSAGGELOS Joseph Cummings Professor of Electrical and Computer Engineering



AI DETECTS COVID-19 ON CHEST X-RAYS WITH ACCURACY AND SPEED

Northwestern University researchers developed an artificial intelligence (AI) platform that detects COVID-19 by quickly analyzing X-ray images of the lungs.

Called DeepCOVID-XR, the machine-learning algorithm outperformed a team of specialized thoracic radiologists—spotting COVID-19 in X-rays about 10 times faster and 1 to 6 percent more accurately. Typically, getting results for COVID-19 tests can take hours or days.

The study's authors, including Professor Aggelos Katsaggelos, say their goal is not to replace actual testing. Instead, physicians could use the AI system to rapidly screen patients admitted to hospitals for reasons other than COVID-19 and potentially flag patients for isolation and testing. Faster, earlier detection of the highly contagious virus potentially could protect healthcare workers and other patients by triggering the positive patient to isolate sooner. The researchers note that X-rays are routine, safe, and inexpensive.

AI Tool a Potential Timesaver for COVID-19 Researchers

Northwestern Engineering computer scientists are aiming to speed up treatments for COVID-19 by making researchers' jobs easier.

The team, led by Professor Diego Klabjan and graduate student Ning Wang, developed a tool called CAVIDOTS (Coronavirus Document Text Summarization) that searches through scientific literature and predicts the most useful results for each user. After pulling documents of interest, the tool uses artificial intelligence to generate a short, easy-to-skim summary of each paper.

Initially developed to sift through and analyze financial news, the tool was shifted toward helping the medical community sort through thousands of research papers related to the virus, saving them time by guiding them to key information.

1,000

Masks per day produced by HARP, a method of 3D printing developed by Chad Mirkin

30,000

Documents in the COVID-19 Open Research Dataset analyzed by CAVIDOTS, which predicts the most useful scientific literature for researchers

HOW WELL DOES COVID-19 PUBLIC POLICY ALIGN WITH SCIENCE?

The rapid development of effective COVID-19 vaccines is a powerful example of how the business and scientific worlds can successfully work in tandem. But there is a thornier, related question: How well does public policy co-evolve with science?

To understand the co-evolution of science and policy, Professor Dashun Wang, as part of a team, analyzed tens of thousands of policy documents worldwide. Team members studied the scientific research those documents drew on, as well as COVID-19-related documents from intergovernmental organizations like the World Health Organization. The team was interested in how the type and volume of policy documents were influenced by the number of COVID-19 cases in a country, as well as how closely policymaking relied on scientific research.

Overall, their study revealed good news, finding that global policy attention to COVID-19 closely follows the number of cases and draws heavily on the rapidly evolving science.

"COVID policies rely on validated science," Wang says. "So, there's great synchrony between policy attention, the realities of the outbreak, and sound research."

LAB NOTES

MEDICAL DEVICE USING NORTHWESTERN-INVENTED BIOMATERIAL RECEIVES FDA CLEARANCE

An orthopedic medical device fabricated from a biomaterial pioneered in Professor Guillermo Ameer's laboratory received clearance from the US Food and Drug Administration for use in an implantable medical device. The biomaterial, called CITREGEN, is the first thermoset biodegradable synthetic polymer to receive such approval.

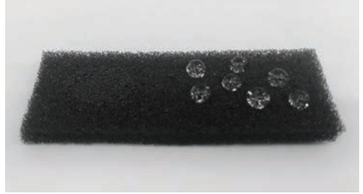
With citrate as its key component, CITREGEN is the core material technology in the CITRELOCK Interference Screw System. Set to be produced and marketed by Acuitive Technologies Inc. this year, the system is intended for soft tissue attachment or fixing ligaments and tendon graft tissue in joint surgeries.

As CITREGEN is absorbed by the body after surgery, it leaves behind a biocompatible ceramic structure metabolized by the body's tissue. This bioresorption process avoids degradation and chronic inflammation that commonly accompany other biodegradable polymers.

Acuitive's orthopedic distribution partner handles the CITRELOCK Interference Screw System.

"CITREGEN is an unprecedented and innovative bioresorbable biomaterial technology developed to support the body's normal healing process and promote tissue regeneration. When used to fabricate devices for reconstruction of tissues, such as ligaments, blood vessels, bladder, and bone, results have been impressive and beyond our expectations."

GUILLERMO AMEER
Daniel Hale Williams Professor of Biomedical Engineering and Surgery



Sponge Could Clean Up Oil Spills

A team led by Professor Vinayak Dravid developed a highly porous sponge that selectively soaks up oil in water.

With an ability to absorb more than 30 times its weight in oil, the sponge could be used to clean up oil spills inexpensively, efficiently, and without harming marine life. After the oil has been squeezed out of the sponge, it can be reused many dozens of times without losing its effectiveness.

The sponge's secret lies in a nanocomposite coating of magnetic nanostructures and a carbon-based substrate that is oleophilic (attracts oil), hydrophobic (resists water), and magnetic. The nanocomposite's nanoporous 3D structure selectively interacts with and binds to the oil molecules, capturing and storing the oil until it is squeezed out.

3

Students named to *Chicago Inno*'s 2020 "25 Under 25" list of rising innovators

95

Percentage of proteins, DNA, and small molecule drugs caught by using a nanoparticle net developed by Evan Scott

FAIR JUSTICE SYSTEMS NEED OPEN DATA ACCESS

Although US court documents are publicly available online, they sit behind expensive paywalls inside a difficult-to-navigate database. Anyone who files a lawsuit in a federal court must pay a $400 filing fee—unaffordable for many Americans—and some litigants apply to waive fees. Because there is no standard for reviewing these requests, judges' decisions—and access to data about them—vary widely.

That was the finding of a Northwestern-led team of computer and data scientists, legal scholars, journalists, and policy experts that is developing an artificial intelligence (AI) platform to enable open access to the information and insights hidden inside federal court records, regardless of the user's data and analytics skills.

The AI-powered platform, called SCALES-OKN (Systematic Content Analysis of Litigation Events Open Knowledge Network), makes federal courtroom data and insights available to the public. The team believes the tool has potential to transform the ways academics, scientists, and researchers approach legal study, as well as how journalists cover the justice system.

SWARMING ROBOTS AVOID COLLISIONS, TRAFFIC JAMS

To help bring self-driving vehicles closer to reality, Professor Michael Rubenstein developed the first decentralized algorithm with a collision-free, deadlock-free guarantee.

Rubenstein's research team tested the algorithm in a simulation of 1,024 robots and on a swarm of 100 real robots in the laboratory. The algorithm views the ground beneath the robots as a grid. By using technology similar to GPS, each robot knows where it sits on the grid. Before making a decision about where to move, each robot uses sensors to communicate with its neighbors, determining whether or not nearby spaces within the grid are vacant or occupied.

The robots converged reliably, safely, and efficiently to form a pre-determined shape in less than a minute. Rubenstein says his algorithm could be used in fleets of driverless cars and in automated warehouses.

"BY UNDERSTANDING HOW TO CONTROL OUR SWARM ROBOTS TO FORM SHAPES, WE CAN UNDERSTAND HOW TO CONTROL FLEETS OF AUTONOMOUS VEHICLES AS THEY INTERACT WITH EACH OTHER."

MICHAEL RUBENSTEIN
Lisa Wissner-Slivka and Benjamin Slivka Professor in Computer Science, Assistant Professor of Computer Science and Mechanical Engineering

Hunting in Savanna-like Landscapes May Have Poured Jet Fuel on Brain Evolution

Professor Malcolm MacIver discovered that complex landscapes—dotted with trees, boulders, and knolls—might have helped land-dwelling animals evolve higher intelligence than their aquatic ancestors.

MacIver developed computational simulations to test the survival rates of prey being actively hunted by a predator under two different decision-making strategies: habit-based and plan-based.

In both simple and highly packed aquatic and terrestrial environments, the survival rate was low for prey that used habit-based actions and for those with the capability to plan. When patches of vegetation and topography are interspersed with open areas similar to a savanna, however, simulations showed planning delivers a huge survival payoff compared to habit-based movements. Because planning increases the chance of survival, evolution would have selected for the brain circuitry that allowed animals to imagine future scenarios, evaluate them, and then enact one.

MacIver found, however, that planning did not give human ancestors the upper hand in all landscapes. In simple landscapes—open ground or packed landscapes like dense jungle, for example—there was no advantage.

150

Years of US Congress voting data tested by Daniel Abrams to determine if views have become more polarized

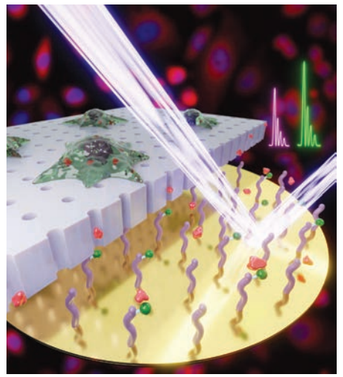
17

Different water contaminants detected by the ROSALIND test developed by Julius Lucks

TECHNIQUE SEAMLESSLY CONVERTS AMMONIA TO GREEN HYDROGEN

Professor Sossina Haile developed a highly effective, environmentally friendly method for converting ammonia into hydrogen, a major step toward a zero-pollution, hydrogen-fueled economy.

To accomplish the conversion, Haile built a unique electrochemical cell with a proton-conducting membrane and integrated it with an ammonia-splitting catalyst. The conversion uses renewable electricity instead of fossil-fueled thermal energy and generates pure hydrogen that can be used in fuel cells. Haile predicts the new technology could be transformative in the transportation sector.



"We envision that this technique can be used in scenarios such as screening drugs or designing and optimizing treatment courses that can arrest disease progression in cells."

HORACIO ESPINOSA
James N. and Nancy J. Farley Professor in Manufacturing and Entrepreneurship

METHOD ALLOWS MINIMALLY INVASIVE CELL SAMPLING

A team led by Northwestern Engineering developed a minimally invasive method to sample cells that can be repeated multiple times, one of the first to do so.

The process, called localized electroporation, has implications in studying processes that evolve, such as cells' response to treatments for cancer.

Professor Horacio Espinosa led the team that created the live-cell analysis device (LCAD), which can nondestructively sample the contents from a small number of cells many times as well as deliver proteins into cells. When LCAD is coupled with SAMDI (Self-Assembled Monolayer Desorption Ionization), a highly sensitive and label-free method for quantification of enzymatic activity using mass spectrometry, the intracellular contents sampled by LCAD are then analyzed for the presence of enzymes. SAMDI was developed in Professor Milan Mrksich's lab.

The LCAD-SAMDI platform offers an opportunity for biologists and physicians to investigate how specific treatments may alter enzymatic activities and the associated diseases over time.

The platform allows a biopsy but performed on cells at the nanoscale.

Most established methods require killing the cells to be analyzed. Currently, complex computational methods are used for retrieving temporal information from single snapshots, but assumptions about the dynamics and limitations on the time scales and scenarios remain.

This method opens up the possibility to investigate time-dependent processes like cell differentiation, disease progression, or drug response at regular intervals.

Partnership to Produce Next-Generation Medical Sensors

Northwestern's Querrey Simpson Institute for Bioelectronics (QSIB) formed a long-term partnership with Maxim Integrated Products Inc. to develop wireless, bio-integrated medical sensors.

A world leader in integrated circuit design and manufacturing, Maxim Integrated has pledged a gift of $750,000 over 10 years. The partnership is the first between Northwestern and Maxim Integrated and the longest-term corporate-gift agreement ever to support research at the University.

"Medical innovation doesn't happen within a year or two," says Professor John Rogers, director of QSIB. "Given this, we wanted to set a decade-long timeline focused on improving healthcare and patient outcomes with advanced, next-generation medical sensors. We are ecstatic to partner with Maxim Integrated to help take our technologies out of the laboratory and get them to those who need them most."

180
Participants in the virtual McCormick Design-A-Thon 2020

14
Faculty named to annual Highly Cited Researchers 2020 list by Clarivate Analytics

BACTERIA IN IRON-DEFICIENT ENVIRONMENTS PROCESS CARBON SOURCES SELECTIVELY

In low-iron environments, microbes survive by slowing down carbon processing and extracting iron from minerals. However, this strategy requires microbes to invest precious food sources into producing mineral-dissolving compounds.

Looking at a group of bacteria called Pseudomonas found in soil, a team led by Professor Ludmilla Aristilde discovered that these organisms overcome limitations in their carbon-processing machinery by rerouting their metabolic pathways to favor producing iron-scavenging compounds. The work is the first to use metabolomics, a high-resolution technique to monitor carbon flow in the cells, to study the impact of iron on the carbon cycling in bacterial cells.

The bacteria studied also exist as pathogens in the human gut, plants, and elsewhere in the environment. Aristilde hopes that because the bacteria are ubiquitous, these findings will be a roadmap for future research.

AQUATIC ROBOT INSPIRED BY SEA CREATURES WALKS, ROLLS, TRANSPORTS CARGO

A team led by Professors Samuel I. Stupp and Monica Olvera de la Cruz has developed a first-of-its-kind, life-like material that acts as a soft robot. It can walk at human speed, pick up and transport cargo to a new location, climb hills, and even break-dance to release a particle.

The secret to the robot's precise movement and agility lies within its water-filled structure and the embedded skeleton of aligned nickel filaments that are ferromagnetic. Nearly 90 percent water by weight, the centimeter-sized robot moves without complex hardware, hydraulics, or electricity. Instead, it is activated by light and walks in the direction of an external, rotating magnetic field.

Resembling an octopus with only four legs, the robot functions inside a water-filled tank, making it ideal for use in aquatic environments. The researchers imagine customizing the movements of miniature robots to help catalyze different chemical reactions and then pump out the valuable products. The robots also could use their mechanical movements and locomotion to precisely deliver biotherapeutics or cells to specific tissues.

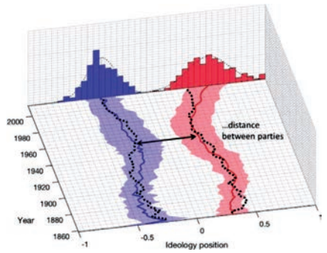
"The design of the new materials that imitate living creatures allows not only a faster response but also the performance of more sophisticated functions."

SAMUEL I. STUPP
Board of Trustees Professor of Materials Science and Engineering, Chemistry, Medicine, and Biomedical Engineering

12
Electronic material compositions discovered via James Rondinelli and Wei Chen's computational approach

25 CENTS
Cost of mirror needed for Michael Peshkin's remote learning hack

140
Students signed up for Computer Science's new student-run mentorship program



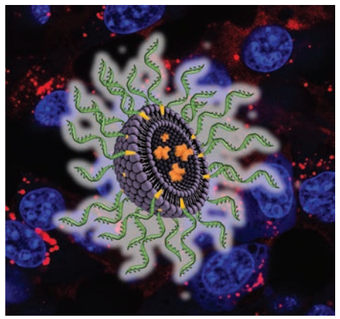
WHY ARE US PARTIES SO POLARIZED?

A model developed by a team including Professor Daniel Abrams shows political polarization stems from the US political parties' quest for voters.

The team created a mathematical model using differential equations to understand how a rational political party would position itself to get the most votes. The tool is reactive, with the past influencing future behaviors of the parties. The team then tested 150 years of US Congressional voting data and found the model's predictions consistent with the political parties' historical trajectories: Congressional voting has shifted to the margins, but voters' positions have not changed much.

Instead, the team found polarization is tied to the ideological homogeneity within the constituencies of the two major parties. To differentiate themselves, the politicians of the parties move further away from the center.

The new model helps explain why. The moves to the extremes can be interpreted as attempts by the Democratic and Republican Parties to minimize an overlap of constituencies to win elections.



Therapy Extends Breast Cancer Survival Rate, Prevents Reoccurrence

An immunotherapy developed by Professor Chad Mirkin and his team dramatically extends the survival time of mice with triple-negative breast cancer, one of the most aggressive and difficult-to-treat forms of the disease.

In a study, mice treated with the therapy, which comprises two immunity-boosting drugs housed inside a nanoparticle, experienced complete tumor remission for at least 100 days. The nanoparticle, called a spherical nucleic acid (SNA), is a globular form of DNA that can easily enter and stimulate immune cells. None of the treated mice experienced adverse side effects or autoimmune responses. All untreated mice died by day 30.

CUSTOMIZABLE SMART WINDOW TECHNOLOGY COULD IMPROVE ENERGY EFFICIENCY OF BUILDINGS

A multi-institutional team of scientists including Professors Wei Chen and Cheng Sun combined solar cell technology with a novel optimization approach to develop a smart window prototype that maximizes design across a wide range of criteria.

The optimization algorithm, called multi-criteria optimization, uses comprehensive physical models and advanced computational techniques to maximize overall energy usage while balancing building temperature demands and lighting requirements across locations and throughout changing seasons. For example, to reduce the energy required to cool a building in the summer, the optimal window design might minimize the amount and type of light passing through, while maintaining the desired luminosity inside. On the other hand, when winter savings are a priority, the design might maximize the amount of sunlight that passes through, thereby reducing the energy required for heating the building.

"THE MODEL WE CREATED ALLOWS FOR EXPLORATION OF MILLIONS OF UNIQUE DESIGNS BY AN ALGORITHM THAT MIMICS BIOLOGICAL EVOLUTION."

WEI CHEN Wilson-Cook Professor in Engineering Design, Chair and Professor, Mechanical Engineering

RESEARCHERS DEVELOP A NEW WAY TO CREATE A SPECTRUM OF NATURAL-LOOKING HAIR COLORS

Professor Nathan Gianneschi and his team developed a way to create a spectrum of natural-looking hair colors, from blond to black, using enzymes to catalyze synthetic melanin.

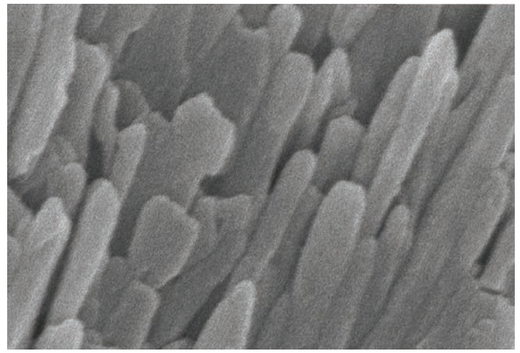
To color hair, stylists typically use bleach to strip the hair's melanin, then add ammonia and dye to open and penetrate the hair cuticles for permanent color. The team replaced melanin instead of removing it and deposited color on the surface of hair instead of within it. In this process, hair is dyed by combining mushroom enzymes with an amino acid, causing a process that mimics naturally occurring reactions in the body. Testing revealed potential for the colored layer to persist through several washes.

10

Years Northwestern will partner with Maxim Integrated to develop bio-integrated medical sensors

33

Minutes needed for a printable biosensor developed by Mark Hersam to detect contaminated fish



DRILLING DOWN TO VULNERABILITIES INVOLVED IN HUMAN TOOTH DECAY

A team of Northwestern Engineering researchers led by Professor Derk Joester has cracked one of the secrets of tooth decay.

In their study of human enamel, which covers a tooth's entire crown, the materials scientists are the first to identify a small number of impurity atoms that may contribute to the enamel's strength but also make the material more soluble. They also determined the spatial distribution of the impurities with atomic-scale resolution.

Tooth decay is a major public health problem, especially as the average life expectancy of humans increases. The discovery in the building blocks of enamel—with detail down to nanoscale—could lead to a better understanding of human tooth decay as well as genetic conditions that can compromise or prevent enamel formation.

Yonggang Huang

Kenneth Forbus

Jian Cao

Samuel I. Stupp

Jiaxing Huang

Zhaoran Wang

David Seidman

Michael Jewett

Danielle Tullman-Ercek

John Rogers

Daniel Brown

Jonathan Rivnay

Faculty Awards

Yonggang Huang and Samuel I. Stupp Elected to National Academy of Sciences

Membership in the academy is one of the highest honors given to a US scientist. Also, Huang was elected to the American Academy of Arts and Sciences. Stupp also received the 2020 Nanoscience Prize from the International Society for Nanoscale Science, Computation, and Engineering.

David Seidman Named Distinguished Scientist by Microscopy Society of America

The award honors preeminent senior scientists from both the biological and physical disciplines who have a long-standing record of achievement in the field of microscopy or microanalysis.

John Rogers Earns Herbert Pardes Clinical Research Excellence Award

The Pardes Award recognizes the study that best shows a high degree of innovation and creativity, advances science, and has an impact upon human disease.

Kenneth Forbus, Jiaxing Huang, and Michael Jewett Named AAAS Fellows

Election as an American Association for the Advancement of Science fellow recognizes distinguished efforts to advance scientific contributions in research, teaching, and technology.

Daniel Brown and Michael Jewett Named to National Academy of Inventors

Fellow status is the highest professional distinction awarded solely to academic inventors.

Jian Cao Receives ASME's Milton C. Shaw Manufacturing Research Medal

The American Society of Mechanical Engineers bestows the Shaw Medal to recognize significant fundamental contributions to the science and technology of manufacturing processes.

Zhaoran Wang Selected for NSF CAREER Award

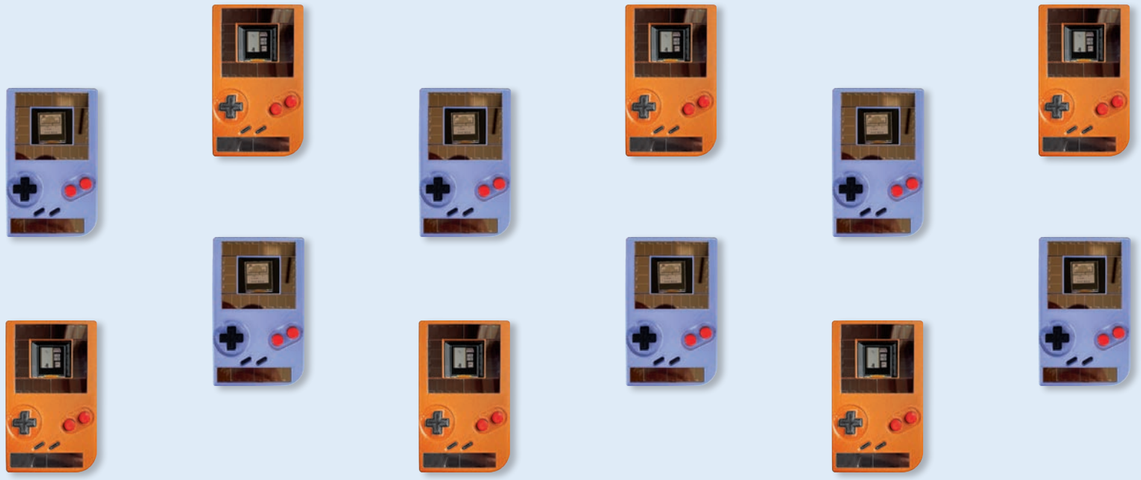
The National Science Foundation's CAREER Award supports promising young faculty members who exemplify the role of teacher-scholar through the combination of outstanding research and education.

Danielle Tullman-Ercek Receives Young Investigator Award

The *Biochemical Engineering Journal* honored Tullman-Ercek for her excellence in research and practice in the field.

Jonathan Rivnay Selected as Outstanding Early-Career Investigator

The award from the Materials Research Society recognizes outstanding, interdisciplinary work in materials research by an early-career scientist or engineer.



A Future Played without Batteries

Northwestern Engineering's Josiah Hester is bringing attention to climate change through the power of video games. Battery-free power, that is.

Hester has developed the first mobile video game console that operates without battery power. Called Engage, the device looks and performs just like the original 8-bit Nintendo Game Boy yet relies on sustainable energy sources.

"We wanted to show what's possible with a more ecologically friendly model of computation," says Hester, assistant professor of electrical and computer engineering and of computer science at the McCormick School of Engineering. "The device presents an opportunity to have a conversation about climate change and the effect our devices have on electronic waste."

A FAMILIAR LOOK

While replicating the original 1989 Game Boy in both form and function, Engage's hardware and software, developed in collaboration with researchers from Delft University of Technology in the Netherlands, represent the latest advances in intermittent computing. The console is part of a new class of small, inexpensive devices that rely on natural sources of energy to provide power only when needed.

> "We wanted to show what's possible with a more ecologically friendly model of computation. The device presents an opportunity to have a conversation about climate change and the effect our devices have on electronic waste."
>
> **JOSIAH HESTER**
> Assistant Professor,
> Electrical and Computer Engineering and Computer Science

PROFESSOR JOSIAH HESTER BUILDS A BLUEPRINT FOR SUSTAINABLE ELECTRONICS WITH THE WORLD'S FIRST BATTERY-FREE GAME BOY.

Small solar panels affixed to the console's front shell power gameplay, while button pressing harvests additional energy. Because the device is intermittently powered, power failures are common. To address this, Engage's non-volatile memory lets users return to the exact moment in the game where they left off after power returns.

The hand-held system has nostalgic appeal—the device can play any game from Space Invaders to Tetris to Super Mario Land using an original Game Boy cartridge—while serving as a valuable proof of concept for sustainable computing.

"Batteries are expensive, bulky, and degrade over time," Hester says. "We can harvest the energy we need when we need it. We don't have to store it in little chemical factories."

A BATTERY-FREE, PROGRAMMABLE FUTURE

A Native Hawaiian, Hester finds motivation for his research approach in his ancestors' connection to ecology and sustainability. In developing his computational devices using intermittent power, he hopes to create technology that lasts lifetimes. He says Engage represents an inflection point in that work of developing sustainable computational devices that show promise to positively impact the planet.

"Climate change is such an important and pressing problem," he says. "We need to think outside the box, get a little radical on the technical side, to come up with solutions that at least mitigate its effects, if not reverse them."

Hester's Ka Moamoa Lab has developed a suite of battery-free technology that includes National Science Foundation-funded projects like sensors for smart face masks and PPE and soil-powered sensors that will monitor future ecologically minded smart cities.

Long-term, his lab aims to make all of his devices not only battery-free, but also programmable.

"There will soon be a trillion devices in the world, and we are connected to thousands of them every day. To have them function properly, we need to be able to control them and define what we want them to do," Hester says.

"We're showing it's possible. Democratizing access to smart devices in a sustainable way is really where this is going."

ALEX GERAGE

Game Boy photography by Przemysław Pawełczak

NO STRANGER TO CHANGE

WHILE NORTHWESTERN FEELS DIFFERENT—EMPTIER AND WITH COURSES HELD REMOTELY—ANOTHER PERIOD OF NOTABLE CHANGE POSED A TOTALLY DIFFERENT SET OF CHALLENGES.

MELVILLE HODGE ('52) arrived on campus in September 1947 as a 17-year-old from Rock Island, Illinois, prepared to study electrical engineering. He brought with him a single suitcase of belongings, little familiarity with Evanston or Chicago, and few expectations of what student housing would look like.

Despite at least 50 dormitories and fraternity and sorority houses then on the Evanston campus, Hodge was one of more than 400 students who spent the academic year living in one of dozens of Quonset huts composed of lightweight, portable materials and assembled in days. Erected from Deering Meadow to what was then known as Dyche Stadium, the huts were built to meet the surge in demand for student housing following the end of World War II.

Each Quonset hut housed up to eight students who slept on wrought iron bunk beds placed at opposite ends of the unit. They studied at desks constructed out of sheet metal, and each was provided a small bookcase and two-drawer chest. A bathroom, which included a 3'×3' shower, toilet, and wash basin, stood in the middle of each hut. Electric heaters provided relief from the cold Evanston winters. Hodge lived in one of the "Music Huts," named for their proximity to the old School of Music building at the corner of Clark Street and Sherman Avenue.

"We were used to all sorts of limitations in life from the war," Hodge says. "I can't say that winding up in the Quonset hut was any big shock. I never knew anything different. It felt standard for college life."

AN ENROLLMENT EXPLOSION

As World War II hit in 1942, Northwestern faced enrollment declines as students headed to war. Fred D. Fagg, Jr., then-vice president and dean of faculties, described the University as a ship that "may not be able to detour around the storm center."

But in the aftermath, that changed. Hundreds of thousands of American military members returned home, ready to resume their lives. The Servicemen's Readjustment Act of 1944, commonly known as the "GI Bill," offered significant education and training subsidies to support vets returning to college as well as those who'd previously never had the means to get a degree.

Northwestern felt the impact immediately.

"The United States is engaged in a magnificent experiment in the democratization of higher education," wrote Northwestern President Franklyn Bliss Snyder in the University's 1945–1946 President's Report. "Northwestern will participate to the full in this experiment."

In September 1945, 933 veterans enrolled. By Spring Quarter, that number exploded to more than 6,100. At the start of the 1946–47 academic year, a total of more than 10,000 veterans were enrolled between Northwestern's Evanston and Chicago campuses—an 11-fold increase from the previous year. By September 1947, veterans on campus totaled more than 11,000.

When Melville Hodge ('52) first heard the name Jane Smith ('52), he was a first-year student living in a Quonset hut. Jane was a chemical engineering major—the only female student at the time—and president of Willard Hall, her first-year residence. Later, she served as president of the Mortar Board, then Northwestern's senior women's honor society, and gained a proud place in Northwestern's history as the second woman to earn an engineering degree.

Mel and Jane met while taking a calculus course. He asked her out six times before she said yes. Three weeks after graduation, the couple married.

This photo, featuring Jane, Mel, and their four children, was taken in 2002, commemorating the couple's 50th wedding anniversary. Jane passed away in 2014.

"Few of our surviving classmates will remember me, but it's likely many remember Jane," Mel says.

from left daughter Barbara Williams, daughter Susan Johnson, Jane Hodge, Mel Hodge, son Tom Hodge, and daughter Rebecca Clewett.

"We were used to all sorts of limitations in life from the war. I can't say that winding up in the Quonset hut was any big shock. I never knew anything different. It felt standard for college life." **Melville Hodge ('52)**

That meant the full- and part-time student population grew from 19,000 in 1939 to nearly 30,000 just nine years later, an enrollment higher than ever before in the University's history. The Quonset hut project, which erected nearly 100 huts in total at a cost of $750,000—nearly $11 million today—provided a temporary, yet effective housing solution for incoming students.

LIFE IN THE QUONSET HUTS

Although he had not served in the military, Hodge had experienced the hardships of life during wartime, assuming several full-time jobs at home during the war out of necessity—he delivered mail at age 15.

Once on campus, Hodge quickly connected with his roommates, many of whom had returned from serving overseas.

"Some of my very best friends were people back from service," says Hodge, noting that two, the late Robert J. Anderson ('52) and the late Donald B. Helm ('51), served as a fighter pilot in the European theater and a naval officer on a destroyer in the Pacific, respectively. "I probably picked up some bad habits from my other roommates. They taught me how to drink coffee and smoke cigarettes."

Hodge, who later endowed Northwestern Engineering's Melville and Jane Hodge EXCEL Scholars program, a bridge program for incoming McCormick students who have demonstrated leadership skills and a commitment to diversity, says the campus community reflected the mood of the country at that time.

"There was a general spirit of togetherness in society, especially among college students," Hodge says. "There's a lot of political division today, but in my mind, back then it just didn't exist. During the war and after, people were so united."

FULL STEAM AHEAD

By 1946, despite facing the challenges caused by the enrollment boom, Vice President Fagg wrote that the University was poised to enjoy calmer waters.

"It seems to me that we find the ship in excellent condition, the cargo intact, and the crew eager to break out full sail, accepting the challenge of ever-widening horizons."

Through times of change, this look back offers hope for the future.

"One of the best parts of my role as dean is talking to alumni who have seen this institution go through dramatic changes before," says Julio M. Ottino, dean of the McCormick School of Engineering. "Few organizations have the staying power of universities, and I am certain that we will continue to adapt to achieve our mission in new and innovative ways."

ALEX GERAGE

Special thanks to Kevin Leonard, Northwestern University archivist, for supporting research on this story.

REFINING REMOTE

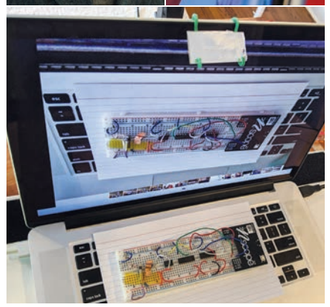
NORTHWESTERN ENGINEERING PROFESSORS FIND THEIR GROOVE CREATING NEW LEARNING TOOLS AND EMPHASIZING MENTORSHIP.

While the pandemic kept many academic communities apart this year, Northwestern Engineering thrived, finding new ways to educate students during an unprecedented situation.

After abruptly shifting away from in-person learning in March 2020, by Fall Quarter, professors got into their remote teaching rhythms. By Winter Quarter, they had further refined materials and lesson plans.

This shift meant transforming gaming from a pastime into a valuable learning tool, developing new gadgets to connect, tweaking in-person courses to fit the reality of remote, and doubling down on mentorship. Some new moves may find a permanent place in the McCormick School of Engineering's pedagogy once students return to the classrooms and labs.

BRIAN SANDALOW



DEVICES FOR DISTANCE LEARNING

Michael Peshkin, professor of mechanical engineering and Breed Senior Professor of Design, built on his extensive experience creating devices for the classroom to develop aids that support remote learning.

In fall 2020, Peshkin developed a simple mirror hack that redirects a laptop webcam to become a document camera. All Northwestern students could request one be sent to them free. The hack allows students to show their written work to their professor or TA in real time, get feedback, and work on it together.

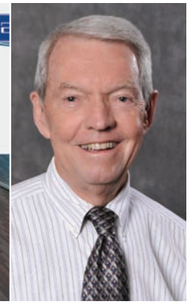
Peshkin's earlier inventions also found new life. Lightboard, which he developed in 2013, helps faculty produce "asynchronous" or pre-recorded content easily. Using the glass chalkboard, teachers can face toward their viewers as they write and draw, with their marks glowing in front of them.

Then there's nScope, a portable electronics lab that fits in a backpack. The small, USB-powered device turns any laptop into an electronic workbench, allowing students to carry their lab equipment with them anywhere. nScope turned out to be pandemic-ready as a lab course.

Peshkin also hosted mini-webinars on how to get the most out of teaching virtually. "I wanted to teach our community the best practices," Peshkin says. "Here are the tools, here's why you might want to use them, and here's how to do Zoom in a secure way."

"HERE ARE THE TOOLS, HERE'S WHY YOU MIGHT WANT TO USE THEM, AND HERE'S HOW TO DO ZOOM IN A SECURE WAY."

Michael Peshkin Professor of Mechanical Engineering and Breed Senior Professor of Design



WINNING THE GAME

William White, professor of industrial engineering and management sciences, developed four video game-like stories for his IEMS Organizational Behavior course.

"These new, interactive case studies give students an immersive opportunity to think about how they would behave if they were in charge," White says.

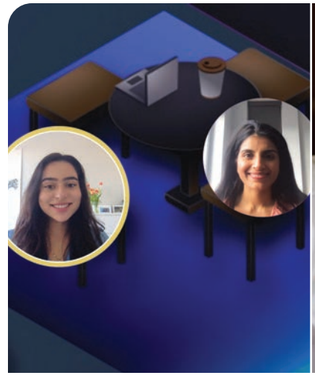
The web-based experiences, complete with dossiers, use sounds and visuals familiar to video gamers. One challenge places the players at the head of a company. A good decision adds points to their score; a bad one knocks them back—and is announced by a clip of Michael Scott from *The Office*, whose management skills aren't exactly best practices.

Creating the experiences also opened up learning opportunities. Enlisting the help of IEMS student Ben Nelson Bentley ('21), White recruited four student developers who had lost internships because of the pandemic and paid them through grant funds.

"It can be difficult to stay focused on a laptop screen for hours on end during Zoom calls," Bentley says. "Using interactive elements to break up the lecture kept students engaged and helped to develop a better understanding of the cases on which they're based."

"Using interactive elements to break up the lecture kept students engaged and helped to develop a better understanding of the cases on which they're based."

Ben Nelson Bentley Senior, Industrial Engineering and Management Sciences



REINVENTING MENTORSHIP

During the pandemic, students have benefited from experiences outside the classroom as well as inside. Students took advantage of the biomedical engineering mentorship program last fall to help them to connect to alumni.

Suzanne Olds, undergraduate program chair and professor of instruction of biomedical engineering, worked with the department advisory board to launch a biomedical engineering four-year mentorship program. Though the program had been in development for more than a year, the launch during the pandemic could not have come at a more helpful time.

As of fall 2020, 166 BME undergraduates were paired with a unique alumni mentor whom they meet with each quarter. The students use those connections primarily to get career and internship advice during an unusual job search period.

"My mentor is an absolute perfect match," says BME student Izabela Stankiewicz ('21). "I have struggled figuring out post-grad life and am overjoyed that I finally have somebody to talk to who is working in a position I am extremely interested in and who also has a similar background to me."

"My mentor is an absolute perfect match. I have struggled figuring out post-grad life and am overjoyed that I finally have somebody to talk to who is working in a position I am extremely interested in and who also has a similar background to me."

Izabela Stankiewicz Senior, Biomedical Engineering

IMPROVISING AT A DISTANCE

Improvisational performance is partner-based, supporting teammates' ideas and feeding off their energy.

Despite the challenge of going remote, adjunct lecturer Byron Stewart and Assistant Dean Joe Holtgreive said, "yes, and," by bringing Engineering Improv I (The Art of Allowing) and II (The Art of Inspiration, which became The Art of Application) to Zoom.

As always, these courses offered through the Office of Personal Development challenge students to tackle unexpected obstacles, building leadership and resilience skills that can be leveraged in both academic and non-academic contexts.

"Having to go remote required creativity in how we teach the mindset and practices of Engineering Improv I," Stewart says.

"And completely rethink the goals of Engineering Improv II," Holtgeive adds. "Zoom may not be the best platform for teaching improv, but it turns out improv is the best way to engage our students on Zoom."

The students reported feeling more confident and comfortable in their other remote classes when applying the lessons of Engineering Improv.

"ZOOM MAY NOT BE THE BEST PLATFORM FOR TEACHING IMPROV, BUT IT TURNS OUT IMPROV IS THE BEST WAY TO ENGAGE OUR STUDENTS ON ZOOM." **Joe Holtgreive** Assistant Dean for Undergraduate Engineering

ELEVATING ENTREPRENEURSHIP EDUCATION

Hayes Ferguson sets sights on the future with a new vision for the Farley Center for Entrepreneurship and Innovation.

Photography by Steven E. Gross

"My vision is that Farley will be the premier academic center for entrepreneurship and innovation, recognized across campus and beyond for our contributions."

HAYES FERGUSON Director, Farley Center for Entrepreneurship and Innovation

As a journalist in Mexico in the 1990s, Hayes Ferguson learned to translate while covering events like the Zapatista uprising in the southern part of the country. She used her Spanish skills to interview sources, and driven to share what she'd discovered, would then translate the sometimes-complex content from those interviews into stories for the American news media.

That desire to inform has followed her throughout her career, from journalist to executive to entrepreneur-in-residence. Now, it drives her latest commitment: director of Northwestern Engineering's Farley Center for Entrepreneurship and Innovation.

"I'm at a point in my career where I can impart what I've learned to students," Ferguson says. "We live in a time where innovation and entrepreneurship are more important than ever, and Northwestern has extraordinarily talented, driven, bright students who have good ideas. We want to arm those students with life-long entrepreneurial skills that can serve them in myriad ways."

Translating diverse skills into a rewarding career

After five years as a foreign correspondent for *The Times-Picayune* and the Newhouse News Service, Ferguson returned to the United States in 1999, at the dawn of the dot-com era. She was awarded a one-year fellowship at the University of Michigan, where she studied a range of topics, from law to coding. She then moved to Chicago, connected with the city's startup scene, and ultimately met the founder of what would become Legacy.com, a global network of online obituaries.

"A lot of people thought putting obituaries online was weird, but with my background in newspapers and interest in storytelling, I thought it was something important," she says. She joined the company's founding management team and spent 15 years there before it was sold to a private equity firm.

During that time, she taught a few courses at the Medill School of Journalism, Media, Integrated Marketing Communications and realized she loved teaching. After her stint at Legacy.com, she became an entrepreneur-in-residence at The Garage at Northwestern, where she mentored student teams and built programs like Propel, which provides networking, mentorship, and immersive learning experiences for female students.

Through the program, Ferguson mentored students like Ana Cornell ('22), who is building a business around an at-home DNA testing kit. "I count myself lucky to have met Hayes Ferguson when I did," Cornell says. "Her advice and expertise are invaluable to young entrepreneurs, and I credit the high degree of success I've had with my startup to her mentoring, advising, and connecting."

The right fit at Farley

With Ferguson's position at Farley, she stays within Northwestern's entrepreneurship ecosystem while taking on more opportunities to guide curriculum. Though she says students often have a far better grasp of recent technological innovations than she does, Ferguson knows successful businesses require more than good ideas: they require business plans, funding, and perhaps most importantly, a good team.

That's why she is excited about Farley's innovative, team-focused, cross-disciplinary curriculum that pulls together both graduate and undergraduate students and its connections with other Northwestern schools. For example, a course called Consulting for Wearable Tech brings together student teams to work with companies spun out of the Querrey Simpson Institute for Bioelectronics. John Rogers, Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering, and Neurological Surgery and a bioelectronics pioneer, leads the class.

NUvention, the center's flagship suite of courses, puts together diverse teams to learn the entire startup company process, from idea to execution. The courses cross several domains, including analytics, medicine, and energy. As the director, Ferguson is part of the team teaching NUvention: Web + Media, and she has plans to expand course offerings in the future.

"Farley has such a solid foundation, but I see it as my responsibility to take the center to the next level," she says. "I'd really like to continue to ramp up our collaborations with partners within Northwestern and beyond our campus. My vision is that Farley will be the premier academic center for entrepreneurship and innovation, recognized across campus and beyond for our contributions."

EMILY AYSHFORD

VIJAY VAITHEESWARAN

VISITING FELLOW

"As a writer, you have the opportunity to live many lives," says Vijay Vaitheeswaran, US business editor for *The Economist*.

He should know: his three-decade career as a journalist has taken him around the world, covering politics in Latin America, the rise of private sector companies in China, and innovation in the United States. A trained engineer with a mechanical engineering degree from MIT, he's authored several books on energy and innovation.

As a visiting fellow in the Farley Center for Entrepreneurship and Innovation, Vaitheeswaran uses that expertise to be a "provocateur with an outsider's perspective." Building on his experience as chair of *The Economist's* Innovation Summit, a series of global conferences on innovation, he hosts virtual events at Northwestern that bring entrepreneurship-focused speakers from around the world to talk about their paths to innovation.

"Northwestern has a wonderfully interdisciplinary approach to thinking about technology and innovation," he says. "I want to help students understand how to use innovation to think globally and change the world in a positive direction."

McCORMICK WHERE WE ARE

THOUGH PHYSICALLY SEPARATED, WE UNITED TO MEET COVID-19 CHALLENGES WITH CREATIVITY AND SUPPORT.

As COVID-19 forced us to move much of our work off campus this past year, the Northwestern Engineering community became more resourceful and resilient than ever. Our durable spirit has inspired whole-brain thinking in many ways—personally and professionally.

One professor used reclaimed items to build an outdoor oasis for teaching and meetings, helping him to juggle life as both faculty and parent. Some student researchers redirected their efforts toward fighting the pandemic while dealing with isolation and the inability to get back into the lab. Another handled challenging coursework while supporting her mother, among the first in Chicago to battle COVID-19.

Friendships at the McCormick School of Engineering proved crucial even as the more routine challenges of life—like home improvement and settling into an internship—became doubly complicated during a period of fear and loneliness. Social distancing and travel restrictions made communication more difficult yet even more important.

Some students in Evanston have been an ocean or more away from family for months. Others returned home and found themselves hours behind or ahead of their online classes. The myriad other challenges our students faced have proven as diverse as the student body itself.

While the community has been separated, the sense of support remains intact. We honor the McCormick community by sharing a few of their stories.

BRIAN SANDALOW

JAMES HAMBLETON

Louis Berger Junior Professor, Assistant Professor, Civil and Environmental Engineering

JH: In a word, it's been chaotic. We're juggling everything. I'm a parent and a teacher and a researcher. It's the collision of those worlds constantly, and we've been on top of each other since March 2020.

Now, however, we have a space where each of us can be on our own.

We methodically took apart our deck in the summer of 2019 and set the lumber aside, intending to build something with it. Then the pandemic struck, and we realized we could really use a separate physical space.

My wife, Rachel, suggested we build a tiny house, and that's what we did. We thought it was going to be a playhouse, but as we started to plan it, it was very clear that this would be so much more. It's our Zoom room.

Our two kids love to play in there, though the grown-ups probably use it more. It's nice to have privacy and focus. I teach classes and hold meetings there.

It's funny how this project at home resonates in my professional life. I'm now actively looking for ways to do other things like this—doing more with less and being creative—on a bigger scale.

Photography by Steven E. Gross

ANDREW HUNT

Chemical and Biological Engineering, PhD candidate

AH: I work in Professor Mike Jewett's lab. My PhD has been focused on protein-protein interactions, and since the pandemic started, I've focused on the way coronavirus gets into human cells through that mechanism. I had the skills to work in this area, so we reached out to collaborators at the University of Washington who had a project in progress. They were trying to develop protein-based coronavirus inhibitors.

After closing the lab for a few weeks in April 2020, we were approved to work on site again. The lab is on the larger side with normally around 30 people working, but when we restarted, it was just me and two other people working in the space. It was a lot of work and a lot of long days. Now, with more people on campus, we take shifts to stay safe. The feeling of community in the lab and the ability to connect with people has been very helpful.

Professor Jewett worked hard to make sure we are working in a safe environment, and he has been particularly supportive throughout the pandemic. He encouraged me to apply my work pre-pandemic to pandemic-related issues. It's progressed significantly as a result.

The work provides me a concrete outlet, and that helps keep me sane. I can do an experiment that might help somebody stay alive.

And, like a lot of people during the pandemic, I've discovered it's fun making bread.

Photography by Steven E. Gross

EMMA ZAJDELA

Engineering Sciences and Applied Mathematics, PhD candidate

EZ: It was super scary in March 2020. My mom got COVID-19 at one of the first superspreader events, one where she works. She ended up in the hospital for 10 days. She'd been training for a marathon the year before and was in none of the higher-risk categories.

It was the very beginning of the pandemic, and we knew so little. I couldn't go see her. I could call her on the phone. Sometimes I'd call and she'd be completely out of it. There was very little information all around.

I had to quarantine because I had been in contact with her. I'm lucky I never got it. Fortunately, I can do my research from home. It was a welcome distraction from my family situation.

My department is very understanding. My adviser is Professor Daniel Abrams. He was really wonderful. I was taking a course with the chair of my department, Professor David Chopp—High Performance Computing. It's legendary for being a tough class. He was very accommodating, and I took an extension. Everybody was super supportive and sweet. It's a great community.

Now, my mom is much better, but she has long-term effects and still has tons of appointments with doctors. We just celebrated her fiftieth birthday together—everyone got tested before it. We surprised her with 40 or 50 friends from around the world on a Zoom call.

Photography by Maher Said

WONIL SOHN, '21

Biomedical Engineering

WS: I stayed in Evanston until the middle of May before returning to my family's apartment in Seoul, South Korea. Because of the 15-hour time difference, I've been taking classes either late at night or really early in the morning. Luckily most of my classes for Fall and Winter Quarters didn't require in-person attendance.

I'm hard of hearing, with a severe-to-profound high-frequency loss. My hearing loss for low-frequency sounds is mild to moderate. I use hearing aids, but when I'm in in-person lectures, it's hard for me to hear when somebody asks a question.

Now it's all online and people have their microphones on, so ironically that makes it easier for me. I use an app called Live Transcribe that provides a transcription of conversations. I rely on this a lot. With this app, I can understand lectures better than I might during in-person classes.

In online project meetings with multiple people, sometimes it's hard to know who is talking to whom. This is where I have a slightly harder time. Everybody is really understanding and respectful when I ask for something to be repeated.

Professor Jonathan Rivnay and his post-doc researcher Bryan Paulsen have been incredibly supportive. When my summer plan was derailed, they helped me figure out what I could work on remotely.

And, I'm tired. I take lots of naps. Naps are very important.

Photography by Sewon Sohn

LAUREN LOPEZ & MARYAM KAZEMZADEH-ATOUFI

Materials Science and Engineering, PhD students

MK-A: We live across the hall from each other, about two blocks from Tech. Both of us had to do remodels of our condos during the pandemic.

LL: I had walls with water damage, and there was mold. Before the pandemic started, I'd planned for the work to take place over the summer. That got delayed. It finally got fixed in November. Pretty much everything was moved out of my apartment, and I was sleeping on my couch in the center of my studio. When the workers were here, I had permission to go into my office at Tech to work. Dust was everywhere.

MK-A: At the beginning of the pandemic the unit below mine was for sale, and someone said there was water damage. They explored my unit and tore open a hole in the wall on the other side of the bathroom to see if there was a leak. The contractors thought that could be fixed in a day, but the repair turned out to be much bigger. Because of the pandemic, the work wasn't done for many months. I had to do a rip-out and remodel of the bathroom.

My partner and I didn't have a working bathroom, so we got an Airbnb for a week and a half. Then I biked back home to manage all of the workers every day. It was stressful. Being a grad student and dealing with a renovation would be tough enough. Doing it in a pandemic was really challenging.

LL: It's helpful to have a neighbor to bounce things off. There was some drama with neighbors not being very happy with work being done in a pandemic. Sometimes, I'd go over to Maryam's apartment and just bake cookies, talk, relax.

MK-A: Lauren gave me a stress-relieving bubble bath kit. It's been helpful to have Lauren across the hall and to have support from Wellness Coaching, a program from Health Promotion and Wellness that is a unit of the NU Health Service.

LEEN ABDUL RAZZAK, '23

Biomedical Engineering

LAR: I was living at 1838 Chicago residence hall. With finals about to start and the pandemic heating up out of nowhere, my friends suddenly began leaving and heading home. My sister was texting, "Come back before they close the borders of the UAE," but I knew I couldn't do well with a 10-hour time difference and jetlag before finals. Suddenly, my dorm was empty. It was just me, my RA, and maybe one other person. I had just transferred in the fall and met people in my classes doing group projects. Now they were gone.

During spring, I spent most of my time in my room, reading and making food. It got lonely, but I stayed connected to people I met in classes by texting. I really got close to some by checking on homework, studying, and learning materials online. I fell in love with walking on campus.

I had started in Professor John Rogers's lab in January 2020. I applied for three research grants. Professor Rogers was so supportive. I received one grant. Since labs were closed to undergraduates, I needed to change to a project that I could get done. I was introduced to Andreas Tzavelis, a PhD student processing COVID-19 data, and he needed help with signal processing data. So, I switched topics for my grant, then taught myself how to signal process by watching videos online.

LINUS OKOTH, '23

Computer Science

LO: When campus closed down, I left to stay with relatives in Lansing, Michigan. I had plans to go home to Kenya, but my flight had a layover in Europe, and travel from the United States to Europe wasn't allowed. So, I came back to Evanston.

It's been very difficult. This is the first time I've spent more than one month away from home. It's been even more stressful because I can't frequently communicate with people back home. My immediate family is in a rural part of Kenya, and that makes getting hold of them challenging. Internet access in Kenya isn't very good.

However, there have been highlights—my internship with Facebook being one. I developed an Android mobile application that's like social media for developers, where you can share your work and receive comments. While I definitely would rather have worked there in person—I was in virtual meetings up to eight hours a day—the experience reaffirmed my interest in software development as a career.

I've had good support. McCormick's Engineering Career Development helped me navigate my future options. ECD's Tameca Blossom-Lyons helped me secure my Facebook internship and even navigate the process of getting work authorization.

Also, I led a class on front-end web development in January. Professor Sarah Van Wart helped me. It meant a lot to turn to someone with her experience to seek feedback on how to improve the class.

Photography by Steven E. Gross

TO SAVE THE ENVIRONMENT, USE NATURE'S CODE

Engineers in the Center for Synthetic Biology reprogram cellular machinery to tackle big environmental problems.

"SYNTHETIC BIOLOGY HAS ENABLED SO MANY LEAPS, ESPECIALLY IN THE AREA OF SUSTAINABILITY. I THINK IT'S POSSIBLE TO START UPCYCLING PLASTICS THIS WAY WITHIN THE NEXT FIVE TO 10 YEARS."

DANIELLE TULLMAN-ERCEK
Associate Professor, Chemical and Biological Engineering

Water is Earth's most precious resource. It's also the source of the planet's most widespread challenges. More than 200,000 tons of plastic fill the oceans, while 2 billion people lack access to clean water.

At Northwestern Engineering, synthetic biologists see these crises as opportunities. Why not reprogram parts of cells to break down plastics? Or, how about sensing which contaminants have infiltrated a water source? Those are questions for which two Center for Synthetic Biology professors believe researchers in the field can find answers. They're also optimistic the answers can come quickly and cheaply.

Breaking down plastics for re-use

Danielle Tullman-Ercek, associate professor of chemical and biological engineering, knows plastic water bottles, usually made out of polyethylene terephthalate (PET), won't degrade within the user's lifetime. Recycling them is one solution, but it's expensive and results in a lower-quality plastic.

The real answer can be found in nature. Scientists have recently found a species of bacteria that can metabolize PET with a naturally occurring enzyme. Now, Tullman-Ercek is collaborating with Monica Olvera de la Cruz, Lawyer Taylor Professor of Materials Science and Engineering, Chemistry and (by courtesy) chemical and biological engineering, and physics and astronomy, and John Torkelson, Walter P. Murphy Professor of Chemical and Biological Engineering and Materials Science and Engineering, to engineer that enzyme to break down PET into its original chemical monomers in a cost-effective, scalable way. That way, existing plastic can be upcycled into a new product. The ultimate result would be a circular process for materials, with no new plastics created.

"Synthetic biology has enabled so many leaps, especially in the area of sustainability," Tullman-Ercek says. "I think it's possible to start upcycling plastics this way within the next five to 10 years."

A simple platform for detecting contaminants

Julius Lucks also turned to nature to find a water contaminant sensor. Lucks, associate professor of chemical and biological engineering, used bacteria's natural "taste buds" to create a simple, easy-to-use water contaminant testing platform called ROSALIND (RNA Output Sensors Activated by Ligand Induction).

When a drop of water is added to the reprogrammed taste buds, a chemical reaction causes them to glow green if a contaminant is present. The test was developed for 17 different contaminants, including lead, copper, pharmaceuticals, and cleaning products. The lab is already improving the technology to be more sensitive and detect other chemicals.

Lucks's team is also taking a whole-brain engineering approach to the problem, working with social scientists to better understand how the results affect the users. "We want to know what people would do with this information," Lucks says. "Will they be inspired to take action, or will they be paralyzed because they cannot do anything about it?"

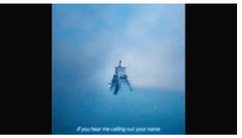
Lucks also uses the same approach to detect coronavirus in sewage and disease in crops.

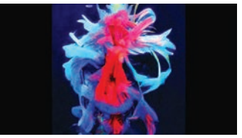
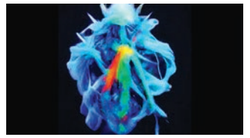
"We want these technologies to be available for everyone," he says. "Hopefully, it will help people become more aware of environmental issues and change their decision-making to take better care of the Earth."

EMILY AYSHFORD

"WE WANT THESE TECHNOLOGIES TO BE AVAILABLE FOR EVERYONE. HOPEFULLY, IT WILL HELP PEOPLE BECOME MORE AWARE OF ENVIRONMENTAL ISSUES AND CHANGE THEIR DECISION-MAKING TO TAKE BETTER CARE OF THE EARTH."

JULIUS LUCKS
Associate Professor, Chemical and Biological Engineering




HUMAN-MACHINE COLLABORATION VISUALIZES MUSIC

PhD student Andrew Paley blends his two passions—artificial intelligence and music—to add a unique dimension to his compositions and performances.




Andrew Paley is a computer scientist. As a PhD student at Northwestern Engineering, he works to democratize access to information through the power of artificial intelligence (AI) and human-centered design.

Paley is also a musician. As a solo artist and as front man for Vermont-born The Static Age, Paley has released multiple albums and performed at venues worldwide from Japan to Brazil to Europe and North America.

Paley has brought these two distinct interests together in an art-generator platform, Pixie, an AI system that leverages human-computer collaboration to produce unique visualizations for his music.

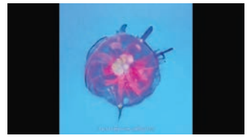
Bringing Pixie to life

While Paley has devoted the past two years to working on his PhD in the computer lab, he has also remained deeply involved in writing and recording a new solo album, *Scattered Light* (Highwires 2020), in the music studio. These dual pursuits have fostered an interest in how human-machine collaboration can support artistic endeavors.

Inspired by the idea of creating a visual accompaniment to his new music, Paley pitched the concept of Pixie—an AI platform that builds unique, blended images synced to music at the direction of the user—as an exploratory project in Professor Han Liu's Statistical Machine Learning course. After receiving positive feedback, he went to work building it.

"It felt like an opportunity to take advantage of everything I was working on," Paley says. "It was separate from my core research, but there was a thread connecting my work in these two different parts of my life."

In designing Pixie, Paley leveraged BigGAN, a conditional AI model developed by Google DeepMind that creates realistic looking images. He says his work has been influenced by Artbreeder, a collaborative flow model that generates synthetic images users can combine to create something totally new.





Pixie's approach echoes Artbreeder's concept of collaborative exploration, allowing Paley to tag model-generated images he likes for different portions of a song. Unlike other platforms, however, Pixie generates a script based on those tagged keyframes, an analysis of the song, and additional human-set preferences. It then creates animations synced to the music.

The results are hypnotic. One of Paley's videos, for his song "Give Up," is generated entirely with Pixie's architecture. Another, "Stay Safe," experimentally melds Pixie functionality—song analysis, scene collections, and script generation—with aspects of Artbreeder. Both present lush, dreamlike visuals that transition seamlessly from one form to another, all perfectly timed to the music.

"It's a process of collaboration and discovery. I tell Pixie what imagery I like and give it a song file, and then see what it dreams up," Paley says. "You can get very granular with the decisions, or you can let it be more random. Each run of the engine produces a wholly new visualization."

What's next?

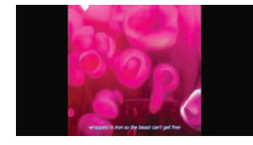
With touring sidelined by the COVID-19 pandemic, Paley continues to create more Pixie-produced music videos and expand the platform's functionality, exploring new models and forms of generative animation. He hopes to incorporate Pixie's visuals into his shows once he can resume live performances.

Paley says working at the intersection of his two interests feels natural. "It's been fun to work on something at the border between the two halves of my life," he notes. "It's a reminder that the underpinnings of these two halves are not all that different—it's all a creative process."

ALEX GERAGE

"IT'S A PROCESS OF COLLABORATION AND DISCOVERY. I TELL PIXIE WHAT IMAGERY I LIKE AND GIVE IT A SONG FILE, AND THEN SEE WHAT IT DREAMS UP."

ANDREW PALEY
PhD student, Northwestern Engineering







THE OPTIMIZER

Optimization and machine learning expert Jorge Nocedal believes that human connections are integral to learning and discovery.

Jorge Nocedal can't stop thinking about optimization. Even when gazing at Lake Michigan or lying in bed, he constantly imagines new approaches to new problems in new areas, like deep learning.

"I don't think that we have found the best optimization for machine learning—that's my main motivating force," says Nocedal, Walter P. Murphy Professor of Industrial Engineering and Management Sciences and (by courtesy) professor of engineering sciences and applied mathematics at Northwestern Engineering. "Apart from the impact that new optimization ideas could have, I'm drawn to the fact that machine learning poses problems that I've never seen before."

Nocedal's highly cited research stands at the intersection of computer science, operations research, and applied mathematics. His career achievements, including significant contributions to the theory of nonlinear optimization methods and the creation of widely applied algorithms, earned him the John von Neumann Theory Prize in 2017, regarded as the most prestigious theory prize in operations research. In early 2020, he was named a member of the National Academy of Engineering, among the highest honors in the field.

"Jorge's research over multiple decades has fundamentally transformed the landscape in large-scale nonlinear optimization," says David Morton, professor and chair of the Department of Industrial Engineering and Management Sciences. "His research is shaping our understanding of deep learning, which has led to truly remarkable advances in artificial intelligence."

The potential of machine learning

Nocedal began his career in theoretical physics, a subject that helped him discover applied math and optimization, which in turn led him to computer science. He joined the McCormick School of Engineering's computer science faculty in 1983. As he observed the rapid advances in the industrial engineering department, it felt to him like the natural home for his research. In 2013, Nocedal became chair of the department. During his three-year term, he championed the idea that certain models and ways of thinking had run their course, and that industrial engineering had to move forward to embrace data-driven models and machine learning.

Under his leadership, the department created the Center for Optimization and Statistical Learning, which Nocedal now directs. "We were one of the first industrial engineering departments to foresee that machine learning would become a major direction for industrial engineers," he adds.

The hunt for intelligent algorithms

This foresight helped attract top talent like Zhaoran Wang, assistant professor of industrial engineering and management sciences. The two now work together to find answers that lead to more intelligent algorithms in the area of reinforcement learning.

> "MY STUDENTS AND I TRY TO FIND NOT ONLY THE SOLUTION, BUT ALSO THE MOST BEAUTIFUL SOLUTION. WE AIM TO DEVELOP SOMETHING THAT PEOPLE CAN'T IMPROVE UPON—THIS IS THE IDEAL."
>
> **JORGE NOCEDAL**
> Walter P. Murphy Professor of Industrial Engineering and Management Sciences

"Can a robot learn to feed a person or help with some tasks?" Nocedal asks, then explains. "Zhaoran and I are looking at improvements in that area, which uses deep neural networks and relies heavily on optimization. Our contribution is to find the right model and optimize it efficiently."

Wang appreciates the rare opportunity to have such a renowned researcher as a mentor. "Jorge is open minded about emerging, challenging problems, such as deep learning, when most researchers are hesitating about whether to get into this field," Wang says.

A passion for collaboration

Nocedal enjoys how human connections can lead to learning and discovery. "Insights clash, intuitions may diverge, and people may get passionate. Then suddenly, out of the fog, you get some clarity," he shares. "And you feel there was a team of people who did it."

Nocedal, named Bette and Neison Harris Professor in Teaching Excellence from 1998 to 2001, thrives on the collaborative energy his students bring to his research.

"My students and I try to find not only the solution, but also the most beautiful solution," he says. "We aim to develop something that people can't improve upon—this is the ideal."

SARA LANGEN

Photography by Justin Barbin

CLASS NOTES

DRIVEN TO SUCCEED

UNSTOPPABLE **WILLARD EVANS JR.** CAN'T SAY NO TO SERVICE EVEN AFTER A LONG AND PRODUCTIVE CAREER FOCUSED ON DOING GOOD.

"You learn what sacrifice is. You learn that if you want something good, you have to do what it takes. I use that in everything that I do. I have to be all in."

When Willard S. Evans Jr. ('77, Kellogg '81) was around 12 years old, a fun outing for him was a trip to the Allied Electronics store in his West Side neighborhood of Chicago. That's where he bought parts to make his first crystal radio set, sparking a flame in the young student's imagination that set him up for an impactful career.

"That was the ignition point for me," Evans says. "Building electronic projects as a kid fueled the fire that would become my career as an engineer. It's what I was born to be."

That passion to build led Evans to Northwestern Engineering in 1973, where he majored in electrical engineering. An internship in 1974 at Peoples Gas, which provides heat for the country's third largest city, turned into a full-time job after Evans graduated in 1977. That, in turn, led to a long and rewarding career at the utility, which culminated with him retiring as its president 40 years later.

Evans's time on the Evanston campus wasn't easy. Handling his classes and working for Peoples during the summers demanded an engineering mindset and solid work ethic for him to persevere.

"You learn what sacrifice is. You learn that if you want something good, you have to do what it takes," says Evans, who also earned an MBA from the Kellogg School of Management. "I use that in everything that I do. I have to be all in."

That attitude became foundational. When he began working at Peoples, his major at Northwestern gave him a leg up and provided a solid foundation for understanding computers. That earned him a job overseeing the utility's computer system, a thankless, faceless position at that time.

Undeterred, his drive to excel propelled him up the corporate ladder, moving through 20 different positions during his tenure.

In 2013, Evans fought for the state legislature's passage of the Natural Gas Consumer, Safety and Reliability Act, which supports one of the most capital-intensive infrastructure projects in the country and modernized Illinois's natural gas infrastructure. He also helped create a partnership among City Colleges of Chicago, Peoples Gas, and the Gas Workers Union to train veterans and displaced workers to be utility workers.

True to form, Evans's love of hard work didn't allow his retirement to stick. He became chair of the Village of Skokie's Board of Fire and Police Commissioners after heading up the town's Human Relations Commission, where he led efforts to encourage understanding and respect among residents of different racial, religious, and ethnic backgrounds. He has also served as president of the Northwestern University Black Alumni Association and chairman of Chicago Commons.

His next act came unexpectedly.

As Evans was coming off a golf course in 2019, Illinois Deputy Governor Christian Mitchell called and asked him to take on the job as chairman and CEO of the Illinois Tollway.

Though Evans had been happy to serve as a consultant for a few handpicked clients in retirement, he really didn't give much thought to turning down that opportunity.

"You can't say no to your governor," Evans says. "It's truly an honor to serve."

BRIAN SANDALOW

GETTING SMARTER ABOUT THE PANDEMIC

Dorothea Koh helps speed and ease physician access to up-to-the-minute resources for diagnosing and treating COVID-19 patients.

At the start of the COVID-19 pandemic, Dorothea Koh ('06) knew doctors would have an urgent need for fast access to accurate, evolving information to treat patients infected with the virus most effectively. She also knew many hospitals have a limited number of computer terminals—but nearly every doctor has a smartphone.

So, in March 2020, Koh expanded the reach of Bot MD to include COVID-19 information that doctors needed. Bot MD is a smartphone app with an artificial intelligence (AI) clinical chat assistant that instantly answers physicians' questions about drug formularies and protocols. The AI chatbot has been used in 60 countries by more than 10,000 doctors globally since its launch. The answers come from the hospital's own content—including clinical protocols, guidelines, and call roster schedules—as well as third-party professional medical resources.

"Bot MD is a little avatar that's friendly, tells jokes, and does a lot more than give physicians information. We designed it to be like a clinical peer or a buddy," says Koh, the company's Singapore-based CEO and founder. "We really wanted to build a tool that offered them quick, reliable, and fast help, 24/7, especially when they are on call."

The chatbot, trained on medical vocabulary and clinical information, improves with more usage by the doctors. Each time a clinical user asks a question, the bot learns something new, Koh says. Using proprietary technology that leverages natural language processing, the Bot MD team aggregates and anonymizes user questions to train the application to get smarter over time.

"The bot helps find answers when they're really needed," says Koh, who majored in biomedical engineering and economics at Northwestern.

Bot MD is quickly gaining popularity. With 20 doctors on board in the National University Hospital (the first Bot MD hospital customer) in Singapore in January 2020, the app grew to have more than 4,000 users within the hospital by yearend. As COVID-19 surged, Bot MD also expanded its usage to patient facing applications like WhatsApp for vital signs monitoring of COVID-19 positive patients in Singapore. The platform has helped more than 3,600 patients monitor their heart rate, temperature, and oxygen twice daily with clinical alerts sent to doctors and nurses.

The idea for Bot MD first came to Koh during her travels in rural areas of developing Asian countries while she worked at Fortune 500 companies, including Baxter Healthcare and Medtronic. Koh saw that while few people had access to computers, smartphones were quite common. To her, it was an opportunity to help rural doctors get up-to-date information quickly and easily using the technology already in the palms of their hands.

In 2018, after nearly a decade working as a Baxter regional general manager and in business development for Medtronic, she founded Bot MD and began working on the product, two years before the global pandemic arose. This is in addition to Koh's eight pending patent applications.

In the past year, the bot has been trained on hospital and clinical content from a wide variety of hospitals. One version even allows for doctors to order, schedule, and view radiology exams and scans through the bot.

"The speed of Bot MD makes it valuable," Koh says. "Our company's mission is to empower doctors so that we can help them save time and improve the quality of care for their patients."

BRIAN SANDALOW

Finding One's Own Measure of Success

HE WORKED HARD, PLAYED HARD, AND STUDIED HARD. NOW, **MICHAEL MAPES** LIVES HIS DREAM AS CEO OF A COMPANY THAT DOES WELL BY DOING GOOD.

Growing up in Dublin, Ohio, Michael Mapes ('00) dreamed of running a company as its chief executive officer. Because he always loved math and science, studying engineering seemed like the right first step in that direction.

Although he fell in love with Northwestern—the campus, the ability to take classes across schools, the access to Chicago—the tuition alone exceeded his family's household income.

Undaunted, he pursued his dream by working hard in a variety of full-time jobs while taking advantage of every opportunity available at Northwestern. He created a network of lifelong friendships, stepped out of his comfort zone in theatre classes, and took the initiative to call the phone number on a job posting he happened to see at Ryan Field.

That fateful call set the trajectory for the rest of his career, setting him up to achieve his dream 20 years later as CEO of Trivium Packaging, one of the world's largest packaging companies.

"I wouldn't be where I am today if it wasn't for Northwestern," he says. "My experience there teed me up for life. It really opened up my world with opportunities and experiences."

GETTING EXPOSED TO A VARIETY OF BUSINESS CHALLENGES

As a student, Mapes loved industrial engineering courses, where he began to understand optimization and problem-solving. He also enjoyed exploring the world outside of engineering—playing soccer, taking classes in economics and acting, joining the Kappa Sigma fraternity, and even studying in the United Kingdom.

To make ends meet financially, he worked several different jobs, including one at Northwestern's athletic facilities. On the job at Ryan Field one day, he saw a flyer advertising an internship at Merrill Lynch. He called and ended up landing the gig, working in investment banking before graduation.

That jumpstarted his career. After graduation, he became an analyst at Mercer Management Consulting, then took a job in operational and financial restructuring for a Bain Capital portfolio company. Next, he spent a few years in management consulting at McKinsey & Company.

"I thought about my early career the same way I thought about my time at Northwestern," he says. "I looked for jobs where I could learn as much as possible and get exposed to the biggest challenges out there."

LEADING A COMPANY THAT'S A FORCE FOR GOOD

The McKinsey job led to a position at Greif, an industrial packaging company. Mapes spent 10 years there, working his way up the company ladder and leading various international businesses. When it became clear that he wouldn't be the next CEO, at least not for some time, he looked elsewhere, ultimately becoming CEO at Exal, a metal packaging company. In 2019, when Exal merged with Ardagh Group's Food & Specialty Packaging business to form Trivium Packaging, Mapes was appointed CEO.

The Netherlands-based company is a global leader in metal packaging and manufactures a wide array of products, from aerosol spray cans to aluminum bottles for major beverage companies to all types of food cans found at a grocery store. Mapes is excited about the company's focus on metal packaging, which brings in $2.7 billion in yearly revenues, because it provides an attractive solution to address the sustainability concerns facing consumers, brand owners, and governments. Metal packaging recycles forever, meaning less material ends up in landfills or the oceans and ultimately results in less carbon emissions over time.

"I wouldn't be where I am today if it wasn't for Northwestern. My experience there teed me up for life. It really opened up my world with opportunities and experiences."

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Married... with classes

Love and marriage part of life for some NU couples

BY BETH KORMANIK
The Daily Northwestern

McCormick senior Michael Mapes met the woman he was going to marry at age 8.

"Her house was right behind mine," he said. "My backyard was her backyard. We've literally grown up together. Our parents knew that we were going to get married."

Michael and his wife, Rebecca, said "I do" Sept. 4 and are now one of the campus' few undergraduate married couples. Northwestern's registrar does not keep statistics on the number of married students on campus.

The Mapeses and other young couples said they had no reason to wait for graduation to get married when they knew they were in love.

Michael said he worries about finding a job, just like any other senior, but being married adds another responsibility.

"Right now I'm trying to manage three things: school, being married and job interviews," he said. "School is the last priority."

While Michael attends class during the day, his wife teaches at Evanston's YMCA. Rebecca attended Ohio State University but is taking the year off and will transfer schools to wherever Michael takes a job after graduation.

Although adjusting to married life has been "easy," Michael said the social adjustment has been tougher.

"Being in a fraternity, it was a little awkward at first, but now they think it's pretty cool," said Mapes, who is a member of Kappa Sigma.

Tisha Whitehead, McCormick '98, was married July 3, 1996, the summer after her sophomore year at NU, to her high school sweetheart.

Tisha said she and her husband, Michael, thought about waiting to get married, but "we were both committed to it, so we thought it could work."

They had to do so while living about 1,000 miles apart.

For almost the first two years of Whitehead's marriage, her husband lived in Virginia. The couple visited each other during school breaks and during the quarter and "ran up the phone bill," she said.

Tisha said she considered transferring to the University of Virginia to be closer to her husband, but her friends persuaded her to stay at NU. In the spring of her senior year, her husband moved to Evanston.

Tisha said her parents supported her decision to get married but insisted that she finish college.

To graduate on time, Tisha said she sacrificed her social life.

At the end of her sophomore year, she switched her major to engineering from biology/pre-medicine.

"I had to take seven Tech classes per quarter the last two quarters," she said. "It was no light load. That situation will mature you quickly; it will focus you on your task. I wanted to finish, so I could be with my family."

Tisha now works as a computer program developer and lives in Carpentersville, Ill., with her husband and 3-year-old son, Brandon.

Being married limited her job search, she said.

"Most of my friends when they got out of school had more options than I did," she said. "If they wanted to apply for a job in California, they could. They didn't have to give any thought to anyone else, whereas I always had to do that."

Tisha said not all students are mature enough to get married.

"You have to make sure that both people are committed to one another and that you're committed to being together," she said. "Anything worth having is worth sacrificing for, and you have to make a lot of sacrifices."

But Tisha said she has no regrets.

"I wouldn't change anything about my situation," she said.

COURTESY MICHAEL MAPES

Rebecca and Michael Mapes were married Sept. 4. Michael, a McCormick senior, has had to balance his studies with the responsibilities of married life.

"It's important to me to make a difference in the world," he says. "I've achieved my dream of being a CEO, but I want to make sure I'm leading a company that can be a force for good, and that's what we are doing right now at Trivium."

STAYING CONNECTED WITH NORTHWESTERN

Outside of work, Mapes spends time with his wife, Rebecca, his high school sweetheart. The couple married before his junior year at Northwestern. (Married college students were so unusual, even then, that *The Daily Northwestern* wrote an article about them. Mapes was quoted as saying, "Right now I'm trying to manage three things: school, being married, and job interviews. School is the last priority.")

Now, the couple has five children and lives in Amsterdam. Mapes has also started looking for ways to give back to Northwestern by becoming more engaged. He wants to bolster hiring at Trivium with future Northwestern Engineering graduates.

He also hopes they're having the time of their lives, like he did. "It's important to do your best, but don't sweat the grades," he says. "It's more important to engage with all the resources that Northwestern has to offer. That way you can find your own measure of success."

EMILY AYSHFORD

"I WANT TO CREATE A WORLD WHERE PEOPLE CARE DEEPLY ABOUT STAYING CONNECTED AND IN A WAY THAT FEELS LIKE TIME WELL SPENT. MANY PEOPLE ARE DISCOVERING THAT FEELING, AND IT'S WONDERFUL."

REDISCOVERING CONNECTION

VLADA BORTNIK BRINGS CLOSENESS AND AUTHENTICITY TO DIGITAL COMMUNICATION THROUGH HER COMPANY, MARCO POLO.

As a student roaming the Northwestern campus with a double major in computer engineering and art, Vlada Bortnik ('01) started to believe in the magic of technology.

For a research project, she helped Northwestern Professor Todd Kuiken develop 3D-printed prosthetics that looked more realistic and cost less to produce than competitors' products, two factors known to increase acceptance and usage of such devices.

"It was inspiring to see how someone's idea could become reality," she says.

Now the CEO and cofounder of video messaging app Marco Polo, Bortnik is working to make some magic of her own—to restore meaningful connection to digital interactions, a goal that carries heightened importance during the COVID-19 pandemic.

"It's clear how important authentic communication is," Bortnik says. "We've seen many tools help us connect in more ways than ever, but the fabric of connections has loosened in our personal and professional lives."

Starting at Microsoft

After interning at Microsoft, Bortnik joined the software giant as a program manager following graduation. She helped develop and grow the Microsoft Office, Messenger, and Hotmail systems.

"I got hooked on developing technology that made a difference in people's lives," Bortnik says.

At Microsoft she also met her husband, Michal, who worked on the company's Xbox video game platform. After collaborating on Artreach, a successful nonprofit arts organization Vlada launched, the two realized they worked well together. They moved to Palo Alto, California, in 2006, where Michal joined Stanford University's MBA program, and Vlada took business classes alongside him. When thinking about the future of their careers, the pair knew they wanted to start their own company, one that would leave a lasting impact on the world and set an example.

"We knew our kids would be watching us and learning as we made these big decisions. We wanted to model for them the kind of life we hoped they would have," she says.

Discovering Marco Polo

As the mother of two young children, staying in touch with relatives became paramount. But Bortnik struggled to maintain meaningful relationships with her family spread across the United States and Europe. Video calls required too much planning during busy weekends. Social media and texting lacked a sense of personal connection. Missed impromptu calls to and from relatives were frustrating.

"What was supposed to be meaningful had the opposite effect. It felt like work," she says.

Around the same time in 2011, the couple began exploring possible directions for their future company, determined for it to be purpose driven and to ultimately positively impact one billion people. In search of learning what makes people happy, they pored over published research, watched TED talks, and conducted interviews. The answer: meaningful connection.

"Before we knew our company's purpose, we knew it would focus on fostering a sense of closeness among people," Bortnik says.

In 2012, Vlada and Michal launched Joya Communications and began developing what would become Marco Polo, an app that combines the convenience of text messaging with the interpersonal benefits—like understanding tone and context—of video chats. With this more practical alternative to existing platforms, users can start conversations with close friends individually or in groups, and recipients can respond when it's convenient for them, eliminating games of phone tag and rigid live video chat schedules.

Marco Polo is also notable for what it doesn't do: the company has promised never to sell any collected data, and the interface is devoid of ads and gamification metrics such as "likes." "Our decisions are guided by our users' well-being," she says.

The approach is paying off. Since its formal launch in 2016, more than four billion messages, or "Polos," have been sent on the app, which also offers a subscription-based plan with features like bookmarks, reminders, and message forwarding.

Promoting connection during a pandemic

As the pandemic spurred an urgent need to move from in-person to digital communication, Bortnik says the importance of meaningful connection has deepened.

"Loneliness is a real concern during a time like this, and people value meaningful connection with a few close friends," she says.

The company has benefitted. Marco Polo was the 21st most downloaded app on the Apple App Store in March 2020. Still, Bortnik remains focused on the company's unflinching and almost magical goal, to facilitate authentic communication.

"Technology can do so much good," she says. "I want to create a world where people care deeply about staying connected and in a way that feels like time well spent. Many people are discovering that feeling, and it's wonderful."

ALEX GERAGE

IN MEMORIAM

Professor Emeritus Jan D. Achenbach

Few engineers can match the accomplishments of Jan D. Achenbach. His extraordinary contributions to the field of applied mechanics, the honors they inspired, and the relationships he built at Northwestern Engineering will serve as an enduring legacy.

Achenbach, Walter P. Murphy and Distinguished McCormick School Professor Emeritus of Civil and Environmental Engineering, Engineering Sciences and Applied Mathematics, and Mechanical Engineering, passed away at age 85 on August 22, 2020.

"Jan raised the stakes for what is possible for faculty members," says Julio M. Ottino, dean of the McCormick School of Engineering. "His outside influence stretched far beyond the halls of the Technological Institute and McCormick and broadly into the field of applied mechanics."

During his five decades at Northwestern, Achenbach was renowned for his pioneering work on quantitative nondestructive evaluation and the methods he developed for flaw detection and characterization by using contact transducers, imaging techniques, and laser-based ultrasonics.

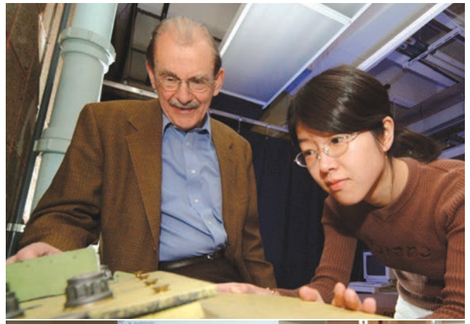
In 2003, he received a US National Medal of Technology for his seminal contributions to engineering research and education and for pioneering methods for detecting dangerous cracks and corrosion in aircraft, leading to improved safety. Two years later, he was awarded the US National Medal of Science, the nation's highest honor for innovation in technology and science in recognition of his lifetime of work.

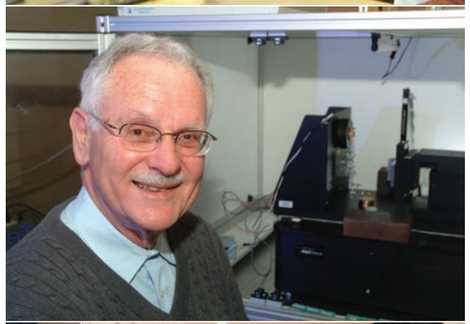
Achenbach was a member of the National Academy of Engineering and the National Academy of Sciences and an elected member of the American Academy of Arts and Sciences.

He founded Northwestern University's Center for Quality Engineering and Failure Prevention, a laboratory for quality control in structural mechanics, later renamed the Center for Smart Structures and Materials.

Born in Leeuwarden, Netherlands, Achenbach joined the Northwestern Engineering faculty in 1963 as an assistant professor of civil engineering, becoming associate professor in 1966 and professor in 1969.

Inspired by their experiences at the University, Jan and wife Marcia Achenbach made a number of commitments to support the future of the McCormick School of Engineering, including funding the Jan and Marcia Achenbach Professor of Mechanical Engineering chair.





top to bottom Jan D. Achenbach, Leon M. Keer, Charles W.N. Thompson

Leroy J. Davis '25
Andrew Halverson '25
Harold G. Schick '25
Ted Strehlow '25
Waldemar Y. Book '27
Daniel K. Brown '31
Cyril G. Griffin '40
James D. Schnepp '40
Robert E. Torp-Smith '41, '47
Richard A. Phelan '43
Gale H. Ekstrand '44
Myron E. Elliott '44
Bruce M. Guelich '44
James G. Marks '44
Albert F. Smith '44
Albert P. Gavin '45
Arthur F. Kunst '45
Edward S. Kwinn '45
Robert W. Pancoe '45
Paul G. Reis '45, '49
John H. Vanmoss Jr. '45
Louis A. Wenger '45
Walter A. Beckdahl '46
Richard A. Kroc '46
John V. Leone '46
Paul E. Lockie '46
Richard M. Zehr '46
Sverre E. Bergh '47
Robert M. Christiansen '47, '49
Robert W. Claussen '47
Edward J. Merkel Jr. '47
Robert W. Paulin '47
Harold J. Reisman '47
Donald P. Vail Jr. '47
Stephen T. Bialek '48
Joseph M. Grzesik '48, '55
Bernard Hemmeter '48, '50
Raymond V. Nolan Jr. '48
Howard Scharfman '48
Robert L. Slifer '48
Theodore J. Theodore '48
Richard R. Anderson '49
John R. Bossenga '49, '52
Bozdar Bulovic '49
Hamilton L. Cox '49
William F. Dent '49
James T. Dorsey '49
Robert G. Durnal '49
John F. Homan '49
Thomas O. Michels '49
Charles W. Otto '49
J. Don Samelson '49
Reid B. Weidman '49
John C. Bullock Jr. '50
Walter V. Cralley '50
James J. Lawley '50
Hilton Ladd Neal '50
Berne A. Schepman '50
John M. Sullivan Jr. '50, '54, '56
Philip C. Swanberg '50
Irvin H. Crawford '51
William L. Holmstrom '51
John E. Lindfors '51
Gerald Luecke '51
Donald L. Margerum '51
John W. Tierney Jr. '51
Lee R. Olson '51, '52

Professor Emeritus Leon M. Keer

Leon M. Keer's career as a prolific researcher in the field of applied mechanics is matched only by his legacy as an esteemed member of the Northwestern Engineering community.

Keer, Walter P. Murphy Professor Emeritus of Civil and Environmental Engineering and Mechanical Engineering, passed away on January 12, 2021. He was 86.

"Leon was one of the giants in the field of elasticity and mechanics and made many significant contributions to our community as a researcher, teacher, and administrator," says Julio M. Ottino, dean of the McCormick School of Engineering. "He was also one of the kindest colleagues I have ever met and was incredibly supportive of young faculty. He was always at peace with himself, which made him beloved by so many."

A Los Angeles native, Keer focused his research interests on engineering mechanics and tribology. A researcher in the mechanical engineering and civil engineering departments, he published nearly 400 scholarly articles on topics such as elasticity, fracture mechanics, and contact stress in structural materials.

During a five-decade career at Northwestern that began in 1964, Keer was an active member of the community. He taught more than a dozen classes on mechanics and structures and served on numerous McCormick and University committees. An adviser to 55 PhD students and 22 master's degree students, Keer also served as Northwestern Engineering's associate dean for research and graduate studies from 1985 to 1992 and was chair of the Department of Civil Engineering from 1992 to 1997.

His numerous honors include being elected to the National Academy of Engineering in 1997. He was a fellow of the American Academy of Mechanics, the John Simon Guggenheim Memorial Foundation, the American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers, and the Acoustical Society of America. He received multiple awards from ASME, including the Daniel C. Drucker Medal and the organization's Tribology Division Innovative Research Award and Mayo D. Hersey Award.

Professor Emeritus Charles W.N. Thompson

Charles W.N. Thompson's vast range of life experiences and pioneering research methods influenced Northwestern Engineering's research, culture, and students for nearly five decades.

Thompson, professor emeritus of industrial engineering and management sciences, passed away at age 95 on June 13, 2020. In his lifetime, he served in great military conflicts, worked in law and espionage, and built a distinguished academic career.

A member of the McCormick School of Engineering faculty for 47 years before retiring in 2016, Thompson's research interests included unstructured problems, systems design, and organization theory. He pioneered "field research methods," the process of improving organizations and systems by observing and surveying them as opposed to running experiments on them.

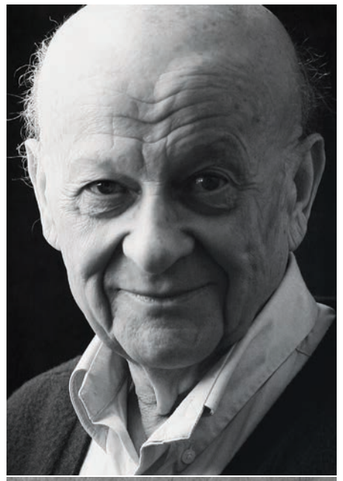
Born in 1924 in Bethlehem, Pennsylvania, Thompson earned his bachelor's degree in 1943 from Kutztown State Teachers College (now Kutztown University). He served as a US Air Force engineer in World War II and the Korean War. He worked as a criminal attorney after graduating from Harvard Law School, received an MBA from The Ohio State University, and even worked as a spy.

When he arrived at Northwestern in 1969, Thompson was troubled by the scarcity of women among both faculty and PhD students. He spent his career working to improve that and was proud that half of the 28 PhD candidates to graduate from his laboratory were women. In 2020, 34 percent of the incoming first-year students at Northwestern Engineering were women.

Thompson developed new courses for his students, who in turn designed and developed several systems still in use at Northwestern. These include the Wildcard—Northwestern University's official ID—and NUtopia, a precursor of Northwestern Engineering's current online undergraduate advising system.

"Charlie was completely intertwined in the fabric of McCormick and is one of the faculty members who comes up often in stories from alumni and friends," Northwestern Engineering Dean Julio M. Ottino says. "His wealth of life experiences helped him connect to students in the classroom in memorable ways."

John F. Endres '52
Milton J. Kenworthy '52
William E. Larson '52
Dennis Trimakas '52
Thomas E. Bailey '53
Don D. Berlin '53
Donald E. Dahlke '53
Larry A. Dale '53
Philip H. Dittmar '53
Robert S. Goodell '53
Richard D. Inman '53
Wayne Raymond Olson '53
Robert E. Parsons '53
Herschel F. Sowers Jr. '53
J. Howard Speer Jr. '53
Brian E. Baldwin '54, '55
Harvey E. Blanden '54
Benjamin Bryton '54
Robert E. Callihan '54
James E. Doyle '54
Robert S. Hathaway '54
Harold F. Leiendecker '54
Harry W. Parker '54, '56
William E. Smith '54
W. Gray Watters '54, '63
Charles B. Bastis '55
Howard Bowen '55
John J. Dombek Jr. '55
Kenneth J. Golden '55
Richard V. Gose '55
Mark J. Hammer '55, '56
John R. Nicholas '55
Dale Siefker '55
Peter J. Thalman Jr. '55
John B. Weigele '55
Fredric W. Buck '56
Derek H. Cornforth '56
Robert W. Gerstner '56, '57, '60
John C. Grieser Jr. '56
Herbert P. Krog '56
Frederick McWilliams '56
Robert G. Brave '57
Vernon E. Carlson '57
Francis E. DeSalvo '57
Michael Fulcomer '57
Eugene D. Haug '57
William J. Kooyman '57
Thomas J. Lundregan '57
John D. Munger '57
John A. Raveret '57
Robert M. Handy '58, '62
Ronald W. Koss '58
Donald August Miller '58, '61, '64
Harold B. Rice '58
Junius F. Cook III '59
John H. Crozier '59
William R. Flood '59
William H. Keltner '59
David B. Park '59, '62
Darrell D. Penrod '59
Harry E. Rueckel '59
Burrel F. Stults '59
Vicki Bailyn '60, '76
John Dash '60
Kenneth R. Johnson '60
Harold G. Kaeser '60
Edward J. Kubiak '60
Arthur E. Loos '60



top to bottom Max Epstein, Bernard J. Matkowsky

Professor Emeritus Max Epstein

Max Epstein, professor emeritus of electrical engineering and computer science at Northwestern Engineering, passed away at age 95 on April 21, 2020. He will be remembered as a leader in his field and devoted to technological advancements.

A member of the McCormick School of Engineering's faculty since 1967, Epstein was a pioneer in developing medical endoscopic imaging systems using coherent fiber optic bundles for image transmission. He also worked on holography and surface acoustic wave devices and was a trailblazer in the application of optical principles from electrical engineering to the then nascent field of biomedical engineering.

A holder of numerous patents and a frequent author of academic papers, Epstein was not only a distinguished scholar but also an entrepreneur who started multiple companies. He and his partners founded Holicon, a company that commercialized holographic portraiture. One of the firm's portraits depicting President Ronald Reagan was given to the Smithsonian Institution's National Portrait Gallery.

Epstein was born February 5, 1925, in Lodz, Poland. A Holocaust survivor, he endured the Lodz Ghetto, the Auschwitz concentration camp, and six other camps before being liberated while on transport through Czechoslovakia in 1945. He earned his bachelor of science degree from the Israel Institute of Technology in 1952 and came to the United States that same year.

Professor Emeritus Bernard J. Matkowsky

Bernard J. Matkowsky, John Evans Professor Emeritus of Engineering Sciences and Applied Mathematics, professor emeritus of mathematics, and (by courtesy) professor emeritus of mechanical engineering at Northwestern Engineering, passed away at age 80 on June 11, 2020. Matkowsky was one of the founding members of the Department of Engineering Sciences and Applied Mathematics and served as department chair from 1993 until 1999.

Born August 19, 1939, Matkowsky was a member of the McCormick School of Engineering's faculty since 1977 before retiring in 2018. A world-renowned mathematician, his research interests included asymptotic and perturbation methods, bifurcation and stability, nonlinear dynamics and pattern formation, combustion, and stochastic dynamical systems.

Matkowsky made important contributions in asymptotic analysis for both deterministic and stochastic problems and in mathematical combustion. He consulted at Argonne National Laboratory and Exxon Research and Engineering, among others.

In 2017, Matkowsky received the John von Neumann Lecture Prize from the Society for Industrial and Applied Mathematics. An Institute for Scientific Information Highly Cited Researcher, he received numerous awards and honors, including Guggenheim and Fulbright-Hays Fellowships. He was also a fellow of the American Association for the Advancement of Science, American Academy of Mechanics, American Physical Society, and the Society for Industrial and Applied Mathematics.

Enrique G. Reynes '60, '64
Glenn R. Snyder '60
Edwin B. Hassler Jr. '61
Seiji Kuniyoshi '61
Gary L. Langfitt '61
Theodore J. Reseck '61, '67
Craig A. Stratton '61
R. Ian Arthur Webb '61
Robert S. Beck '62
Kenneth F. Brettmann '62
James Louis Brown '62, '67
John L. Hudson '62
John N. LaPlante '62
Richard A. Nichols '62, '64, '66
France Rode '63
Joseph S. Zelasko '63, '66
Carl F. Mortensen '64
Robert J. Rillie '64
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Roger C. Handeland Jr. '65
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Howard W. Smith '65
Thaddeus E. Chmielewski '66
Richard L. Francis '67
Jeffrey M. Bruggeman '68
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Richard T. Russell '68
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Francis G. Grelle '72
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John W. Mayne '73
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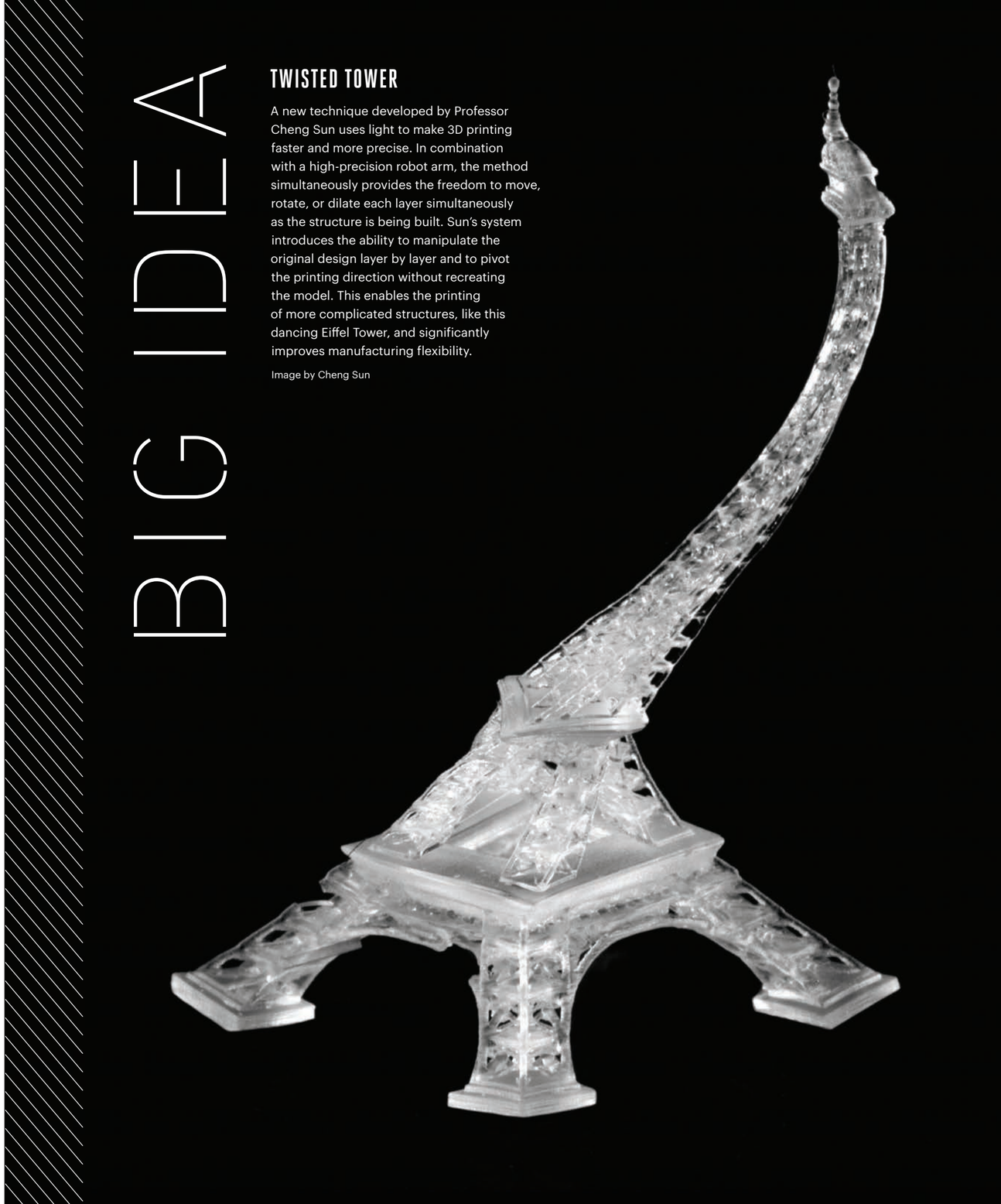
Clifford H. Spiegelman '73, '76
Minoru Taya '73, '77
Robert J. Bergeron '74
Bruce C. Klein '76
Duen-Ping Tsay '76
Tarek K. Emera '78
Michael A. Gorecki '78
Gerald Morton Hoffman '78
Liisa K.T. Thonguthai '78
Yu-Ping Tsui '78
Kim Karleen Riley '79
Zachary T. Forester '81
Scott B. Miller '81
William David Shreder '81
Michael G. Kaminski '82, '86
Lane D. Tickanen '84
Henry John Grimme '89
David L. Anderson '92
James D. Bartelme '04
Karl Zimmerman '06

BIG IDEA

TWISTED TOWER

A new technique developed by Professor Cheng Sun uses light to make 3D printing faster and more precise. In combination with a high-precision robot arm, the method simultaneously provides the freedom to move, rotate, or dilate each layer simultaneously as the structure is being built. Sun's system introduces the ability to manipulate the original design layer by layer and to pivot the printing direction without recreating the model. This enables the printing of more complicated structures, like this dancing Eiffel Tower, and significantly improves manufacturing flexibility.

Image by Cheng Sun



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ENGINEERING THROUGH THE PANDEMIC

Despite restrictions related to the COVID-19 pandemic, students continue work on a design project in the Prototyping and Fabrication Lab at the Ford Motor Company Engineering Design Center—albeit with facemasks and fewer people present. Meanwhile, Northwestern Engineering faculty have reimagined remote learning. Using new and repurposed tools—such as laptop camera "hacks" and video games that help teach case studies—they have remained engaged and connected with students during the time apart. Read more on page 20.

Photography by Steven E. Gross