Saving and Improving Lives
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Connect with LinkedIn

Connect with the College of Engineering with LinkedIn and grow your professional connections. LinkedIn is one of the best places online to find and nurture professional connections as well as serve as a potential mentor with other UNL alumni, and current engineering students seeking career and academic advice. Mentors can make a positive impact on student success. Get connected by following University of Nebraska-Lincoln College of Engineering on LinkedIn, then use the hashtag #NebEngineering and join in the conversations!

You can also connect with @NebEngineering on Instagram or join the fun on Facebook by going to Nebraska Engineering’s Facebook page and hitting “Like.” It’s a great way to keep in touch with the College of Engineering, see what students are accomplishing, and read the latest news about faculty and college happenings!
Welcome to the Fall/Winter 2023 issue of the ENGINEERING AT NEBRASKA alumni magazine. The College of Engineering’s strategic plan includes the vision statement “to positively impact the lives of every Nebraskan.” This ambitious statement stems from our belief that at its most fundamental, engineering is about solving problems and developing solutions that improve the human condition. From fighting wildfires and studying new ways to treat heart disease, to creating scholarships for the next generation of engineers, this issue is full of stories that demonstrate how our faculty, students and alumni are improving lives.

As I begin my second five-year term as Dean of the College of Engineering, I thought it would be helpful to reflect on the progress we have made. In the Fall of 2018 our undergraduate enrollment was 3,077, our graduate enrollment was 631, we had 218 faculty, and our research awards were $25.9 million. In the Fall of 2023, undergraduate enrollment is 3,413, graduate enrollment is 654, we have 238 faculty, and our research awards are $43.7 million. We also created the School of Computing to respond to the emergence of artificial intelligence and machine learning and added undergraduate degrees in Data Science (new in Fall 2023 with 15 students) and Environmental Engineering (38 students in its second year). In the next year or so, we will add a new undergraduate degree in Robotics Engineering (which nationally awarded more than 1,300 degrees last year) and, in partnership with the College of Business, reintroduce an undergraduate degree in Industrial Engineering with an emphasis on logistics and advanced manufacturing. My sincere thanks to all of the faculty and staff who have made this progress possible.

A major emphasis of the last five years has been the improvement of facilities within our City Campus footprint. In 2022, we opened the new 87,000 square foot Engineering Research Center that houses state-of-the-art research labs, including the labs of many of the faculty highlighted in this issue. In January 2024, we will open Kiewit Hall for classes. Kiewit Hall is the only LEED Gold and WELL Silver certified engineering education building in the country and will be the new academic and educational heart of the college. Finally, at the end of Spring 2024, the renovation of Scott Engineering Center will be complete. In the end, the College of Engineering will have half a million square feet of the best engineering education and research space in the country. None of this would have been possible without the tremendous support of alumni, employers and philanthropic partners.

We are fortunate to have more than 26,000 alumni around the world, and I hope you will enjoy the articles and news in this issue. If you are planning a trip to Nebraska, perhaps you can find time to visit us. Please follow the College of Engineering on LinkedIn and reach out to us to share your good news. Also, if you have any questions, please feel free to contact me at lcperez@unl.edu.

Sincerely,

LANCE C. PÉREZ
Dean, College of Engineering
Omar H. Heins Professor of Electrical and Computer Engineering
Tightening it with tech: Loose bolt study gets 5-year NSF grant

Bolts that loosen over time aren't only one of the most vexing and little-understood phenomena of basic mechanics, they create plenty of havoc and unsafe conditions.

They can result in major incidents — such as crashes of unmanned aerial vehicles or train accidents that have spilled tens of thousands of gallons of crude oil — or failures of everyday devices such as playground equipment, cars and medical implants.

Keegan Moore is looking to understand what causes these bolts to loosen and how it might be prevented with a five-year, $727,410 grant from the National Science Foundation's Faculty Early Career Development Program.

"Bolt and joint loosening has been studied since the Industrial Revolution because it's been a problem since then," said Moore, whose research will focus on rotational loosening, which is caused by vibrations in structures.

Loosening bolts is one aspect of America's aging infrastructure, Moore said. He hopes his research will lead to predictive maintenance that would focus on specific likely problem areas, which is more efficient than trying to monitor all bolts.

Lock washers are the most common approach used to prevent bolts from loosening, but in many cases they're ineffective or even increase the rate of loosening. Other approaches, including torque nuts and the use of two nuts on a bolt, seem to at best delay, not prevent, loosening.

Moore's project will measure the interface contact conditions — the surfaces the bolt holds together — using high-speed digital cameras that film at thousands of frames per second. He believes the strains measured around the bolt head or nut can be mapped to the contact conditions inside the interface around the bolt hole. He also will produce modeling frameworks to reproduce the dynamics of loosening and determine how a structure's dynamics influence loosening bolts.

"This will hopefully give us a new window to what's going on in the interface that we've never had before and we'll be able to measure how that changes the dynamics as the bolt loosens and as the structure shakes," said Moore, assistant professor of mechanical and materials engineering.
Improving cardiovascular health with mechanotherapy

As the leading cause of death in the U.S., cardiovascular disease is also unhealthy to the economy costing Americans as much as $1.0 trillion annually in health care expenditures.

Ryan Pedrigi, Robert F. and Myna L. Krohn Assistant Professor of Biomedical Engineering, is the recipient of a five-year, $543,000 award from the National Science Foundation’s Faculty Early CAREER Development program that ultimately aims to develop a new therapy for atherosclerosis, a condition characterized by the formation of fatty plaques in the inner lining of the arteries. Using his expertise in biomechanics and mechanobiology, Pedrigi hopes to utilize ultrasound technology to deliver therapeutic mechanical stimuli directly to diseased arteries to cause plaque stabilization or possibly even regression.

“No study to our knowledge has considered the biological effects of ultrasound on endothelial cells from a biomechanics perspective,” said Pedrigi, who did his post-doctoral work in bioengineering at Imperial College, London, and has been at UNL since 2011. “By understanding how vascular endothelial cells respond to mechanical stimuli from ultrasound, we may be able to hijack signaling pathways known to be sensitive to physiological mechanical stimuli to control cell functions, which, in turn, may have therapeutic properties in the context of atherosclerosis.”

Using human donor cells, Pedrigi’s research examines how endothelial cells respond to different ultrasound acoustic pressures and frequencies. Endothelial cell dysfunction is key in the development of atherosclerosis because it allows for the accumulation of low density lipoprotein (bad cholesterol) within the inner lining of arteries to form plaques. Interestingly, the mechanical effects of blood flow strongly influence endothelial functions. Blood flow around bifurcations promotes endothelial dysfunction, which makes these sites in the vasculature particularly susceptible to atherosclerosis, whereas blood flow in straight arterial segments is streamlined or laminar, which protects against atherosclerosis.

In a recent study published in iScience, Pedrigi’s lab demonstrated for the first time that the mechanical effects of laminar blood flow are not only protective, but also therapeutic. To do this, his team used mice with high cholesterol and instrumented the carotid arteries with a blood flow-modifying cuff to induce disturbed blood flow (similar to that found around bifurcations), which, in turn, caused plaque development. Then, they removed the cuff to restore normal blood flow and found that it caused a therapeutic effect called plaque stabilization. The size of this effect was comparable to mice treated with atorvastatin (or Lipitor; one of the most financially successful drugs in pharmaceutical history). This finding showed that mechanical stimuli alone could be therapeutic in this disease, even in the presence of the most important systemic risk factor, severe high blood cholesterol with values in these mice of over 850 mg/dl.

Now his team is trying to figure out how to use ultrasound to deliver beneficial mechanical stimuli to diseased arteries with similar biological effects as laminar blood flow. “Delivering mechanical stimuli into the body as a therapeutic is not a new idea,” noted Pedrigi, who has 20 years of research experience in biomechanics and mechanobiology. “For example, ultrasound has been used to break up kidney stones in the urinary tract and cataracts in the lens of the eye.” Lower intensity ultrasound has also been shown to have biological effects in certain tissues, such as bone. So, we just need to figure out the specific ultrasound parameters that activate beneficial signaling in endothelial cells.”

Typically, cardiovascular diseases are treated with prescription drugs like Lipitor that lower blood cholesterol levels and medical procedures such as stents that are placed into arteries to maintain blood flow. By treating endothelial cells in diseased arteries with ultrasound technology, patients with atherosclerosis might avoid invasive surgeries that carry some risks and incur longer recovery times.

“That is the hope as it would be less adversely impactful to the patient,” Pedrigi noted. “Throughout this process, we’re gaining considerable knowledge about how ultrasound activates signaling sensitive to mechanical stimuli within these cells to one day develop a therapeutic for this disease,” added Pedrigi. “To me, that’s what biomedical research is all about: exploring unknown aspects of how the body works in health and disease to gain new knowledge that could ultimately impact medicine — and do so as a team with students, other scientists, and clinicians in the UNL community.”
Research on microwaving plastics reveals alarming results, garnering UNL researchers international headlines

Your newborn's hungry, so it’s time to warm up a bottle so you do what millions of parents do or have done: you place it into the microwave for a few seconds, hoping to heat it quickly so you and your child can go back to sleep. Heating up the plastic bottle for just a moment is a simple everyday task but with potentially complicated results, according to UNL researchers.

Compared to refrigeration or room-temperature storage, microwaving plastic baby food containers releases large numbers of microplastics and nano plastics into food. In some cases, some containers could release as many as 4.2 million microplastics and 2.1 billion nanoplastics from only one square centimeter of plastic as a result of three minutes of microwave heating.

While Kazi Albab Hussain's research is all about keeping families safe from harmful plastics, it’s also something he wants to do for his own family as he doesn’t want to expose his 2-year-old son, Abyan, to harmful products or chemicals, especially at such a young age. Hussain is a doctoral student in civil and environmental engineering who is also lead author on the research study.

"He's definitely inspirational," Hussain said with a smile when talking about Abyan's influence on his research. "His body is small and still developing. Having him in my life has been one of the influencing factors in choosing baby food containers and pouches for my research."

When results of the research were published in Environmental Science and Technology, a journal owned by the American Chemical Society (ACS), and media outlets followed up by reporting the UNL study, Hussain's celebrity begrudgingly grew over the summer as he received positive feedback from friends and associates along with unsolicited questions from strangers on social media who reached out to ask what they’re supposed to use in lieu of plastic containers.

"I let them know what I do for my family," said Hussain, a native of Bangladesh who came to UNL in 2019 after earning a master’s degree from Florida Atlantic University. "Don’t microwave or pour anything hot into plastic containers. Transfer it to something not plastic but is still microwave safe.”

He also suggests doubling down on food safety or sterilization procedures when it comes to containers like baby bottles or food jars, transferring foods and liquids from plastics to glass containers or glass bowls when it comes to heating or reheating food in a microwave.

"Doing research like this has been impactful on people's lives," said Hussain. "What I'm doing in my research is something people do in their home every day. It's about assessing the release of microplastics and nanoplastics from common food preparation practices in households everywhere. The goal is to raise awareness and improve food safety.”

Ironically, this project started with small expectations more than three years ago before Hussain was a father and when he was just starting out as a Ph.D. student. It’s evolved into a three-year, $136 million Grand Challenges Catalyst award led by Tussou Li, associate dean for faculty and inclusion and professor of civil and environmental engineering. The team also includes Svetlana Romanova with the University of Nebraska Medical Center, Yongfeng Lu of electrical and computer engineering, Lucia Fernández-Ballester, mechanical and materials engineering, and other faculty from across the UNL campus, including Education and Human Sciences, journalism and Mass Communications, and Food Science and Technology.

"Because of the Grand Challenges Catalyst Competition, we’ve been able to expand on this research a great deal," added Li, who also serves as the lead principal investigator for the award and is Hussain’s advisor. "Lucia's investigating what type of material is leading to the release of these particles and hopes to create new material so it’s safer. Food science is also involved as is social sciences as we look into the toxicity of the particles over time as well as the socio and economic impacts on families who have no choice but to use plastics and their potential risks. It’s a very comprehensive research project.”

Finger printing security

With the world more reliant on communication between computers, cybersecurity is becoming one of the biggest threats, not just identity theft and national security but, potentially, also to an individual person's health.

Nirnimesh Ghose, assistant professor in the School of Computing, is part of a team working on a National Science Foundation grant to expand research in the field of radio fingerprinting, a physical-layer authentication technique that plays a critical role in identifying individual electronic devices.

Like humans, each wireless device has a distinct "fingerprint," a signature that is unique when it is transmitting data, even if it’s exactly the same device manufactured by the same manufacturer by the same manufacturing process,” Ghose said.

Much like a person's fingerprint can authenticate their identity, Ghose said these transmitted signatures make each device easier to identify.

"We would use this process for authentication, making sure the devices that are communicating with each other are who they say they are,” Ghose said.

Currently, Ghose said, this technology has important applications in national security and defense, such as in identifying and authenticating unmanned aerial vehicles (UAVs), also known as drones.

But with more and more medical devices being implanted in human patients and sensors being implanted in animals, Ghose said it is imperative to have a means of authenticating the signals being sent to those devices, which include pacemakers and insulin pumps.

"The problem comes in the fact that we're using identification keys that were developed 50 years ago and people have figured out how to bypass that technique,” Ghose said.

"So, how can we be certain we're always talking to the right device? What happens if that key gets leaked or someone is able to hack in and start injecting bad data? It would be very easy for someone to compromise those keys, but you couldn't with a fingerprint of a wireless device because it's embedded in how the device was manufactured.”

As with other technological advances, Ghose expects this technique could be put to wide use relatively quickly, perhaps as early as five years down the road.

"That's typically for innovation in the tech industry, but we have to remember we are playing defense,” Ghose said. "It's going to become important as we create new things to save lives in new ways, like that Virtual Incision robot that can do surgery in space, and we're going to need to make things robust to keep ahead of the people who are always innovating new ways to break through our new security.”

"What happens if that key gets leaked or someone is able to hack in and start injecting bad data? It would be very easy for someone to compromise those keys, but you couldn’t with a fingerprint of a wireless device …"

— Nirnimesh Ghose, assistant professor
WHERE THERE’S SMOKE…

Drone Amplified Responds to Wildfire Safety

According to the National Interagency Fire Center, the 10-year average for wildfires is 44,725 wildfires and more than 6 million acres burned – that's the average PER YEAR, not the number of fires in a decade. So far in 2023, 44,000 wildfires have burned 2.3 million acres. A below average year much to the relief of fire fighters and emergency personnel, but an alarming statistic nonetheless as the number of wildfires has increased exponentially since 2013 when there were less than 39,000 wildfires reported.

Helping to combat and control wildfire devastation and keep fire fighters and emergency responders safe from these deadly events is Drone Amplified, a company co-founded by Carrick Detweiler, professor of computing. Drone Amplified is a pioneer in the field of fire ignition management and a recipient of numerous awards and recognition as its wildfire management technology is used globally to manage wildfires and controlled burns in some of the most dangerous territory on Earth as well as monitor avalanches in Alaska.

“Taking photos or making videos and just flying around are most people’s perceptions (of drones) so I'm happy to be making a name for drones,” says Detweiler, who is on leave from UNL and the College of Engineering to work more closely with the company. “It's all about safety, keeping fire fighters off front lines and out of harm's way.”

Detweiler says firefighters receive many hours of training before being certified to operate the system, including piloting the drone as well as the capability to use the software application and app to set fires remotely for controlled burns. “Going back to a more natural landscape requires more controlled burns,” added Detweiler, “Areas with invasive weeds, dried out trees are more fire prone so if you can plan (a fire), you know it's a safer alternative than one that starts and burns out of control.”

Drone Amplified began as a concept in 2015 between Detweiler and Sebastian Elbaum, now a member of the University of Virginia faculty, as they were exploring applications for drones as tools rather than toys. A year later, Detweiler was on Faculty Development Leave exploring the business side of Drone Amplified, evaluating a whole page of drone ideas. “There was a real critical need to address wildfire safety. That was one of the biggest motivating factors,” Detweiler mentioned. “We came to the conclusion that drones can change the industry and, more importantly, save lives.”

Today, with the federal government, mainly the U.S. Forest Service, as its biggest client and by doubling the size of the company (Drone Amplified acquired a New Jersey-based drone company earlier this year), Drone Amplified’s focus is on growing and improving IGNIS with newer technologies such as LIDAR, and being a leader in keeping first responders safe whether it's a controlled burn or an Alaskan avalanche. “We're passionate about making top quality products for IGNIS where working in domains like firefighting and avalanche controls risk the safety of those involved,” Detweiler added. “I see Drone Amplified continuing to grow and be the market leader in this technology.”

“Taking photos or making videos and just flying around are most people’s perceptions (of drones) so I'm happy to be making a name for drones. It's all about safety, keeping fire fighters off front lines and out of harm's way.”

— Carrick Detweiler, professor
ALUMNI SPOTLIGHT

AND FORMER UNL CHANCELLOR RONNIE GREEN

STAN FEUERBERG (CENTER) WITH SHELLEY ZABOROWSKI

When visiting campus last spring to receive a 2023 Alumni Masters Award, Stan Feuerberg came away impressed with the engineering facilities on both the UNL campuses in Lincoln and Omaha.

"The classroom and lab facilities are bigger and better," said Feuerberg, a 1974 graduate with a bachelor's degree in electrical engineering and a 1978 graduate of the UNL College of Law.

"I thoroughly enjoyed the opportunities to visit with, interact, and teach some of the undergrad and graduate students. I left Nebraska confident that our young students may become the USA's technical and industrial leaders of the decades ahead."

"I left Nebraska dates back to his childhood. "I left Nebraska confident that our young students may become the USA's technical and industrial leaders of the decades ahead." I thoroughly enjoyed the opportunities to visit with, interact, and teach some of the undergrad and graduate students," added Feuerberg, whose affection for the University of Nebraska dates back to his childhood. "I left Nebraska confident that our young students may become the USA's technical and industrial leaders of the decades ahead."

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Establishing scholarships, funding professorships and encouraging young alumni to get involved,

"With a relentless focus on student success and the opportunity to enhance faculty and academic excellence, the University of Nebraska launched "Only in Nebraska: A Campaign for Our University's Future" last November. Rick and Carol McNeel exemplify relentless support of Nebraska's public university by donating to the University and the College of Engineering. The couple's contributions have grown the university, including an emphasis on financial support for private support has increased leading to the College of Engineering.
there are many ways for us to handle impact forces and structural requirements on the footpath. Stolle said that these systems also have to be designed to handle impacts from EVs, which make up a growing percentage of traffic. Passive barriers must be engineered to withstand high-speed impacts from EVs, which make up a growing percentage of traffic.

The Nebraska team will also re-examine the design of checkpoint used by friendly vehicles. Stolle said those systems are designed for big trucks may have to withstand 200,000 or 300,000 pounds over the contact footprint, Stolle said. "Well, anti-ram barrier systems have to do that, too, but they are designed for big trucks."

EVs are a different kind of an animal compared to gasoline vehicles," said Cody Stolle, assistant director of Transportation Engineering Research at the University of Nebraska. "That changes the way that you design these systems, so that you have to do it over (just) a couple of feet, not spread over an almost as soon as foot meets pedal, accelerating to top speed in under four years from the U.S. Army's Light Combat Vehicle."

Funding from this grant will provide the resources for MATC-University of Nebraska Transportation Center to establish a safe driver academy at NICC, located in Macy, Nebraska. It will offer free driver training to underserved students that includes the Native American community in Nebraska and throughout the region. "This grant also allows us to continue developing the next generation of the driver academy," said Aemal Khattak, MATC assistant director for the Scott Data Center.
## DEPARTMENT/SCHOOL HIGHLIGHTS

### Biological Systems Engineering

- Shudipto Dishari (Ross McCollum associate professor) is working on a National Science Foundation grant to make green materials more prevalent in green energy. Dishari’s research team is using lignin from Christmas trees and remnants of corn plants to create a new polymer to replace those used in electrochemical devices and electrodes that often contain toxic fluorocarbon-based materials. These new polymers, Dishari said, could also speed up the flow of protons in electrochemical reactions and, thus, increase fuel cell efficiency.

### Chemical and Biomolecular Engineering

- Dishari is developing electrochemical devices and electrodes that do not use toxic fluorocarbon-based materials. The team is using lignin from Christmas trees and corn remnants to create a new polymer to replace those used in electrochemical devices and electrodes that often contain toxic fluorocarbon-based materials. These new polymers could speed up the flow of protons in electrochemical reactions and increase fuel cell efficiency.

### Civil and Environmental Engineering

- An NSF Early Career Development Program grant is supporting Jonathan Cronk (master’s student) and Francisco Muñoz-Arriola (associate professor) in studying how water can be affected by snowmelt, how frozen soil’s capacity to absorb water can be affected by snowmelt, and how frozen soil’s capacity to absorb water can be affected by snowmelt.

### Electrical and Computer Engineering

- Wei Qiao (Clyde Hyde Professor) has been elected a senior member of the National Academy of Inventors (NAI). The Senior Member program honors early-stage innovators and inventors who are rising leaders in their fields and whose research has gained momentum toward significant achievement in innovation. Each member holds a U.S. patent that has been licensed or commercialized, and/or five or more issued U.S. patents. Qiao is internationally recognized as an electrical engineer and has been working on developing models, software and hardware solutions, and decision support tools that enable some of the most promising technologies of the future, including next-generation wind and solar power, electric vehicles and electric grids.

### Mechanical and Materials Engineering

- Dishari and Jonathan Cronk are working on a project to increase fuel cell efficiency. They are developing new polymers that could speed up the flow of protons in electrochemical reactions and improve fuel cell efficiency.

### School of Computing

- Sasitharan Balasubramaniam (associate professor) is leading an international team of researchers that is studying microbial communication and activity patterns by connecting living bacteria to its digital twin. Researchers in Ireland will use supercomputers to create a “digital twin” counterpart of the bacteria, which Balasubramaniam and his team will use to simulate and predict the evolution of bacterial conversations and behavior.

### CONSTRUCTION UPDATE

Progress on Kiewit Hall continues this fall with many final construction details coming to a conclusion before classes begin in January. When spring semester begins on Jan. 22, 2024, the $115 million Kiewit Hall will open as one of the nation’s premier facilities for engineering education and engagement. With a total square footage of 182,080, Kiewit Hall will open as one of the nation’s premier facilities for engineering education and engagement. With a total square footage of 182,080, Kiewit Hall will open as one of the nation’s premier facilities for engineering education and engagement. With a total square footage of 182,080, Kiewit Hall will open as one of the nation’s premier facilities for engineering education and engagement. With a total square footage of 182,080, Kiewit Hall will open as one of the nation’s premier facilities for engineering education and engagement.
Recruiters like Tessa Yackley, a recent graduate in civil engineering from UNL and now with Olsson, meets with students at the Fall Career Fair in the Nebraska Union; Dean Lance C. Pérez visits with an alum during the college’s Fall Engineering Tailgate; Emily Ciesielski (left) and Jillian Weland visit the Aerospace Club table during the City Campus Engineering Club Fair; MME and physics major Leandro Castellanos (right) looks for career advice at the CED table at the Fall Career Fair; Associate Dean for Research Mark Riley (middle) visits with alumni at the Fall Engineering Tailgate the last weekend of September; and the growing footprint of the College of Engineering on UNL’s City Campus includes the recently completed Engineering Research Center on 16th Street—connecting with Nebraska Hall and Scott Engineering Center.

As Nebraska’s only engineering college, the College of Engineering requires philanthropic investment to expand to meet the state’s workforce need for more engineers. The college seeks to grow its enrollment as it develops statewide engagement and outreach initiatives to offer engineering expertise, programming for Nebraska’s youth and partnerships with communities to enhance their STEM workforce. It’s all possible. And it’s all happening right here. Only in Nebraska.
The fall season is now in full swing, with winter not far behind.

**Gear Up and Stay Warm**

with clothing from the Nebraska Engineering E-Store.

Featuring t-shirts, polos, sweatshirts, pullovers, jackets and more.

nebraskaengineeringstore.com