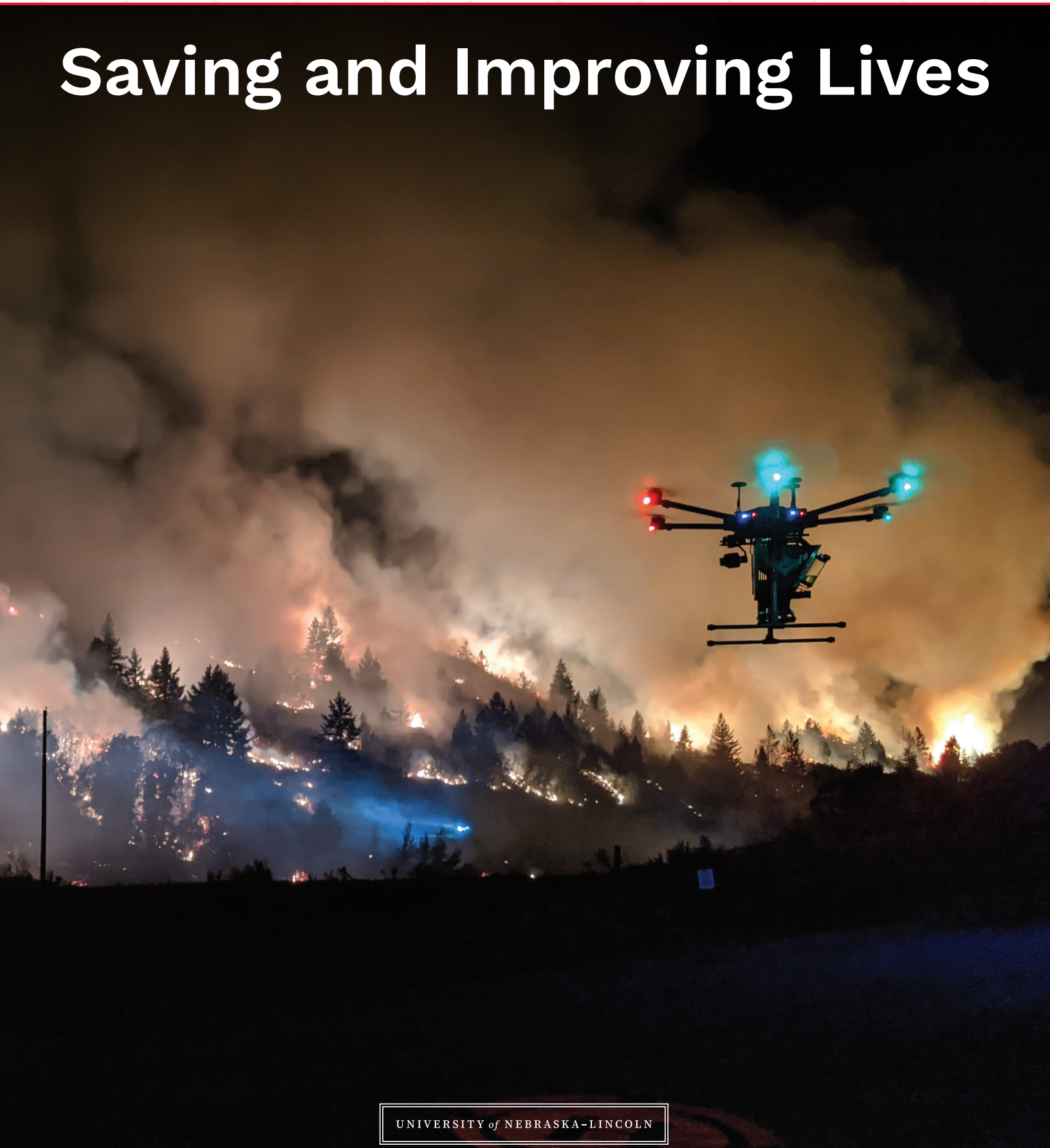
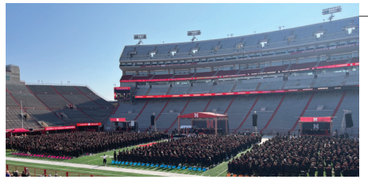
ENGINEERING AT NEBRASKA | FALL/WINTER | 2023

# Saving and Improving Lives



UNIVERSITY of NEBRASKA–LINCOLN

# CONTENT














## ALSO IN THIS ISSUE



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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!

COLLEGE OF ENGINEERING



ENGINEERING AT NEBRASKA
**Fall/Winter 2023**


On the cover and inside the magazine (page 12): Drone Amplified, a company cofounded by Professor Carrick Detweiler, is a pioneer in wildfire management technology using state of the art IGNIS software.

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Top (from left): UNL conferred a record 3,748 degrees during Spring Commencement 2023 in Memorial Stadium, including 566 from the College of Engineering; (middle) NEAT Labs hosted an open house for industry partners in June as an additive manufacturing showcase that included a presentation by mechanical engineering student Tanner Brandl (middle right); industry professionals like Ross Barron, state bridge engineer, Theresa Luensmann, Jeffrey S. Raikes School of Computer Science and Management, Alex Flamme of Huffman Engineering, and Meghan Behrens-Kleinschmit and Taylor Sutton of NPPD take questions at an industry panel for ASEE 2023 at UNL in September as the college's Phil Carter served as moderator; Doug Durham, CEO and co-founder of Don't Panic Labs, delivered a keynote address to kickoff ASEE 2023 while graduate student Shiseido Robinson of Kansas State poses next to her poster entry at Nebraska Union; and Seth Caines celebrates at Spring Commencement, graduating with a B.S. in Biological Systems Engineering.








# DEAN'S MESSAGE

LANCE C. PÉREZ

Dean, College of Engineering

Omar H. Heins Professor of
Electrical and Computer Engineering

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

SAVING LIVES

# ENGINEERING SAVES LIVES

## 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.

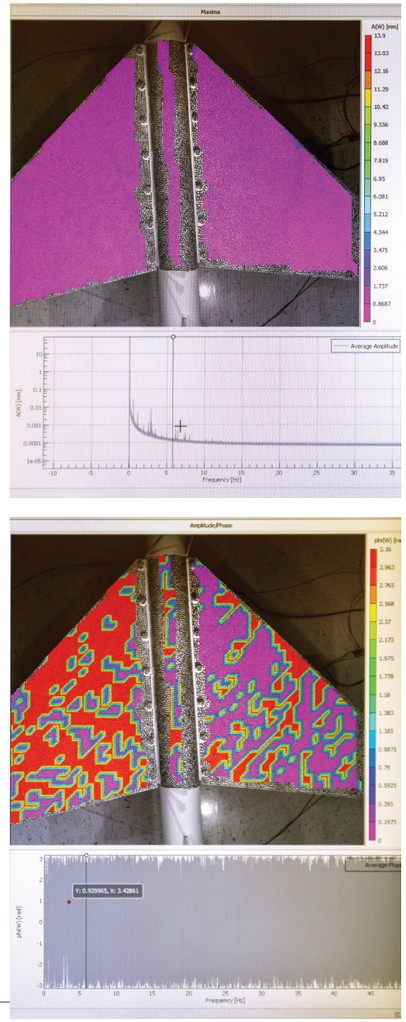
"Bolt and joint loosening has been studied since the Industrial Revolution because it's been a problem since then," said Moore, whose research will focus on rotational loosening, which is caused by vibrations in structures.

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.

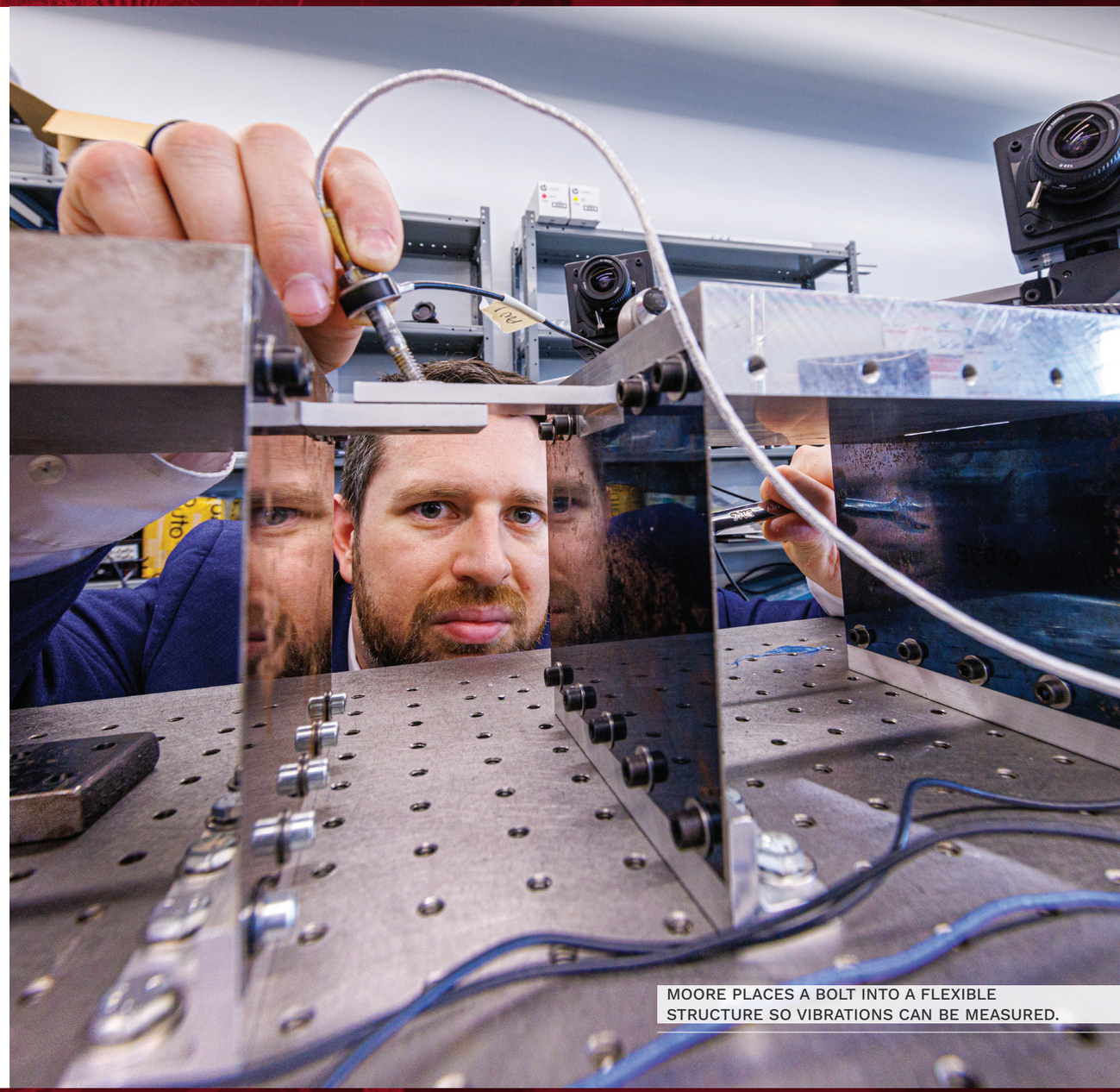
Lock washers are the most common approach used to prevent bolts from loosening, but in many cases they're ineffective or even increase the rate of loosening. Other approaches, including torque nuts and the use of two nuts on a bolt, seem to at best delay, not prevent, loosening.

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.

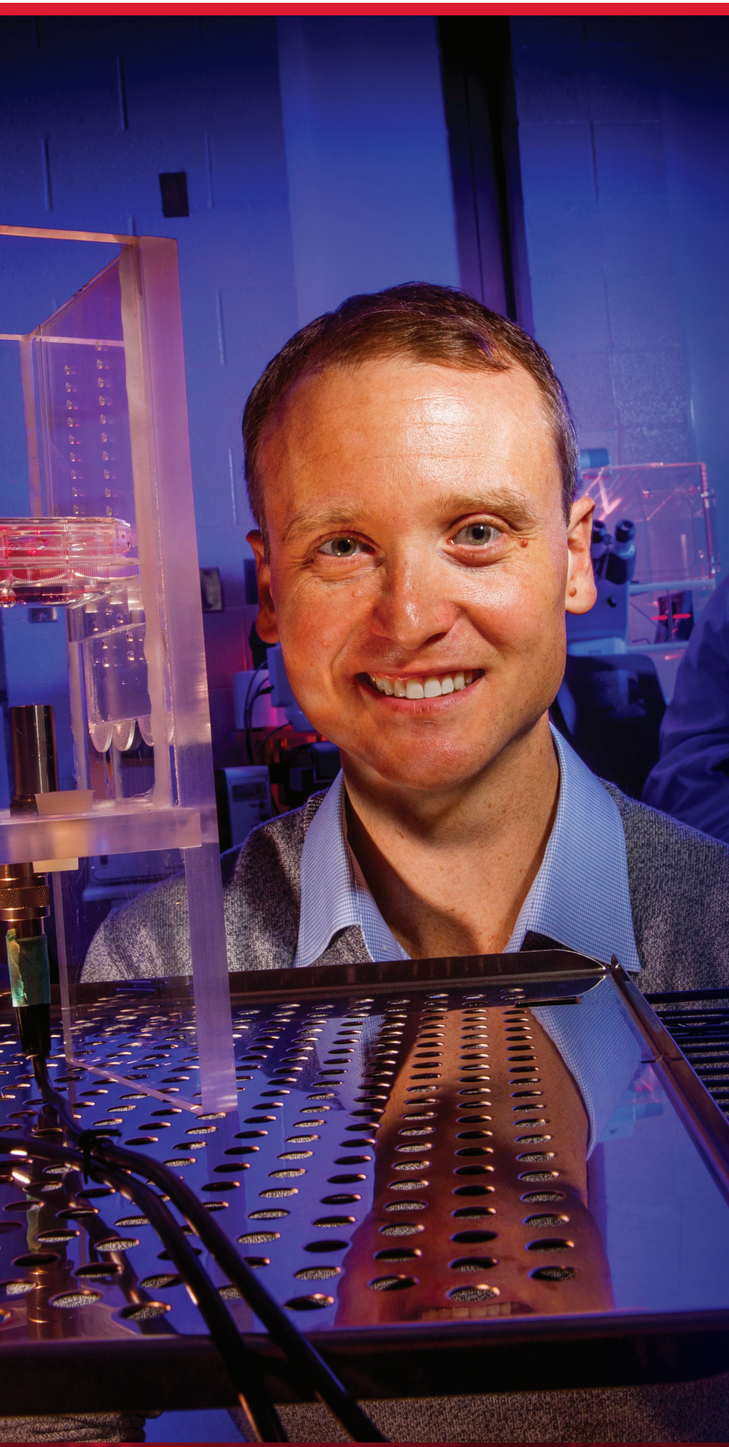
"This will hopefully give us a new window to what's going on in the interface that we've never had before and we'll be able to measure how that changes the dynamics as the bolt loosens and as the structure shakes," said Moore, assistant professor of mechanical and materials engineering.




VIBRATIONS ON A WING OF A MODEL AIRPLANE ARE RENDERED IN COLOR BY COMPUTERIZED CAMERAS IN MOORE'S LAB.



MOORE PLACES A BOLT INTO A FLEXIBLE STRUCTURE SO VIBRATIONS CAN BE MEASURED.



## 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 $190 billion annually in health care expenditures.

Ryan Pedrigi, Robert F. and Myrna 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 2017. "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 physiologic 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 make these sites in the vasculature particularly susceptible to atherosclerosis, whereas blood flow in straight arterial segments is streamlined or laminar, which protects against atherosclerosis.



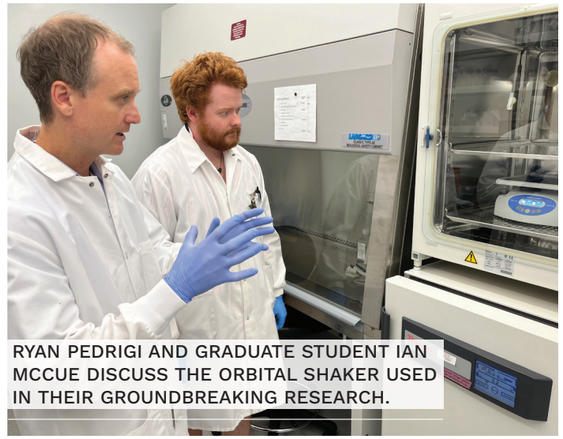


In a recent study published in iScience, Pedrigi's lab demonstrated for the first time that the mechanical effects of laminar blood flow are not only protective, but also therapeutic. To do this, his team used mice with high cholesterol and instrumented the carotid arteries with a blood flow-modifying 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."



RYAN PEDRIGI AND GRADUATE STUDENT IAN MCCUE DISCUSS THE ORBITAL SHAKER USED IN THEIR GROUNDBREAKING RESEARCH.

PEDRIGI'S LAB CONTINUES TO DEVELOP A NEW THERAPY FOR ATHEROSCLEROSIS.

## 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.

KAZI ALBAB HUSSAIN AND HIS SON, ABYAN, DEMONSTRATE WHAT SHOULD NOT BE DONE

"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, $1.36 million Grand Challenges Catalyst award led by Yusong 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 typical 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."

GHOSE

> "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 44,575 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 firefighters off front lines and out of harm's way."

Drone Amplified technology features unmanned aerial vehicles, approximately six feet in diameter and significantly larger than drones found on Amazon or a sporting goods store, that are equipped with chemical filled IGNIS ignition spheres – "dragon eggs" that are proportional to the size of ping-pong balls. The drone's fuselage, described by Detweiler as the "F150 of drones," are manufactured by Freefly but outfitted with IGNIS by Drone Amplified. Some of the larger drones are even modified with cameras and can carry as many as 450 dragon eggs to cover as much as 400 acres, flying into areas where they strategically place spheres that are lit remotely via an app the user monitors on a controller.

"We wanted to have features firefighters need and are easy to use," explained Detweiler, who completed his Ph.D. at MIT's Computer Science and Artificial Intelligence Lab. "By giving them easy to use tools they can focus on fighting fires and not wondering, 'how do I fly this thing?'"

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 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 firefighters off front lines and out of harm's way."
>
> — Carrick Detweiler, professor

ALUMNI SPOTLIGHT

# ALUMNI FEATURES

STAN FEUERBERG (CENTER) WITH SHELLEY ZABOROWSKI AND FORMER UNL CHANCELLOR RONNIE GREEN

> "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."
>
> — Stan Feuerberg, alumnus

## Alumni Master Stan Feuerberg admires College of Engineering's growth, impact

When visiting campus last spring to receive a 2023 Alumni Masters Award, Stan Feuerberg came away impressed with Nebraska's engineering facilities, new and not-so-new, admiring the significant growth and changes that have occurred since his days as an engineering undergraduate and, later, as a student at the College of Law.

"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. "The current student body may take all of the enhancements for granted; no doubt, but I came away impressed with the engineering facilities on both the campuses in Lincoln and Omaha."

Feuerberg and his wife, Robyn, spent Alumni Masters weekend reliving memories and sharing stories with classmates beyond UNL, too, as he and several of his 1970 Lincoln Southeast High School classmates got together for an impromptu mini reunion at a Lincoln sports bar where more than two dozen high school friends and their spouses attended, making it a memorable return to Nebraska.

"Since retiring (April 2022), I've been nearly as busy as I was during my career in the energy industry," he admitted. "I've worked on several consulting engagements and I've provided both technical and legal advice on a pro bono basis to a few not-for-profit entities. Surprisingly there are people and companies that value my thoughts and opinions."

For three decades, Feuerberg served as president and CEO of the Northern Virginia Electric Cooperative (NOVEC) in Manassas, Virginia. NOVEC supplies power to 180,000 customers in the Washington D.C. metropolitan area. Under his leadership, NOVEC ranked No. 1 nationally in power quality and reliability by JD Power and Associates six times.

As part of his UNL visit, Feuerberg addressed students with classroom visits and a presentation on the challenges associated with electric vehicles and rechargeable battery technology along with renewable and alternative energy.

"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."

## Garcia recognized during Homecoming Week for outstanding contributions to Omaha community

To help others realize the American Dream is also César Garcia's dream as the executive director of Canopy South. Garcia was honored during UNL's Homecoming Week as a 2023 Distinguished Alumni Award recipient at the Multicultural Homecoming Reception at Wick Alumni Center.

Presented by the Chancellor's Commission on the Status of People of Color, the award recognizes outstanding alumni making a difference in the community and enhancing the quality of life.

Garcia, who earned a bachelor's degree in mechanical engineering in 2007 and a 2009 master's degree in civil engineering, is originally from one of the largest cities in Colombia but immigrated to the U.S. as a teenager to pursue an opportunity at a better education and realize the American Dream at making a difference in the community he serves.

In addition to currently serving on multiple boards and committees in the Omaha metro area, Garcia oversees Canopy South, an organization established to promote a culture of collaboration and to transform neighborhoods and revitalize communities with high-quality mixed income housing and provide an effective cradle to career education pipeline and comprehensive community wellness resources.

Garcia was previously an engineering sector leader and principal at DLR Group where he was lead engineer on multiple projects like the Henry Doorly Zoo & Aquarium Conservation Academy, Madonna Rehabilitation Hospital, and new addition to Central High School.


GARCIA HONORED DURING UNL'S 2023 HOMECOMING WEEK

### Garcia's Recognitions

- **Cited for civic leadership by:**
  - Midlands Business Journal's 40 under 40
  - Ten Outstanding Young Omahans
  - Leadership Omaha
- **Active with:**
  - Ace Mentor Program Nebraska
  - Heartland 2050's Regional Planning Committee
  - Greater Omaha Chamber's ConnectGO Technical Group

# SUPPORT FROM MCNEELS IMPACTS UNL AT MANY LEVELS

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

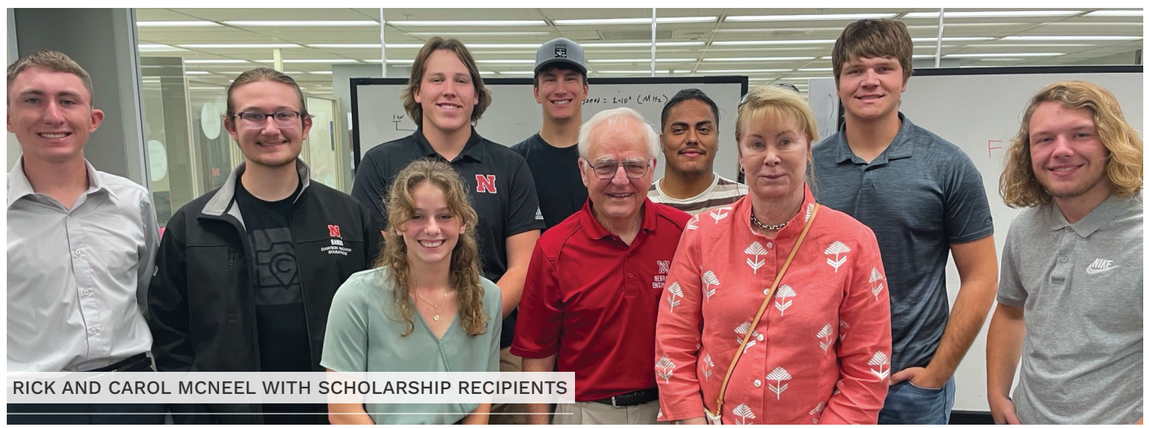
With a relentless focus on student success and the opportunity to enhance faculty and academic excellence, the University of Nebraska launched “Only in Nebraska: A Campaign for Our University’s Future” last November. Rick and Carol McNeel exemplify relentless support of Nebraska through and through, whether it’s establishing scholarships to promote student access or funding professorships to support and retain quality faculty in the College of Engineering.

As state funding of the university has declined, a greater need for private support has increased leading to the College of Engineering Advisory Board to establish strategic initiatives to grow the college, including an emphasis on financial support for students in need, improving and maintaining quality faculty, and expanding research grants. The McNeels have assisted UNL and the college in these areas by establishing the Richard L. and Carol S. McNeel Engineering Faculty Support and Retention Fund in 2016 as well as donating to the construction of Kiewit Hall, and by supporting nine engineering students from western Nebraska with scholarships.

“College is much more expensive today,” noted Rick, who grew up on a cattle ranch outside of North Platte, Nebraska, and attended a one-room school through eighth grade and put himself through college. “It’s my feeling that someone in those circumstances today would not be able to attend UNL and get an engineering degree without financial support.”

Rick graduated from UNL in 1969 with a B.S. in Chemical Engineering and his career as engineer culminated in serving as group vice president of BP/Amoco Chemical before becoming CEO of LORD Corporation in North Carolina. He joined the advisory board of the chemical engineering department more than 25 years ago and became a member of the College Advisory Board nearly two decades ago. Carol, an Illinois native, met Rick in the suburbs of Chicago, contributing to the couple’s Midwestern values and desire to support UNL and the college.

“We encourage all young alumni to get involved in some way in giving back to UNL,” he explained. “We have lunches annually with most of our scholarship students and it’s extremely rewarding to see the energy exhibited by these future leaders.”



RICK AND CAROL MCNEEL WITH SCHOLARSHIP RECIPIENTS





# SHARING OUR SUCCESS

## HuskerBot team takes top honors at inaugural Farm Robotics Challenge

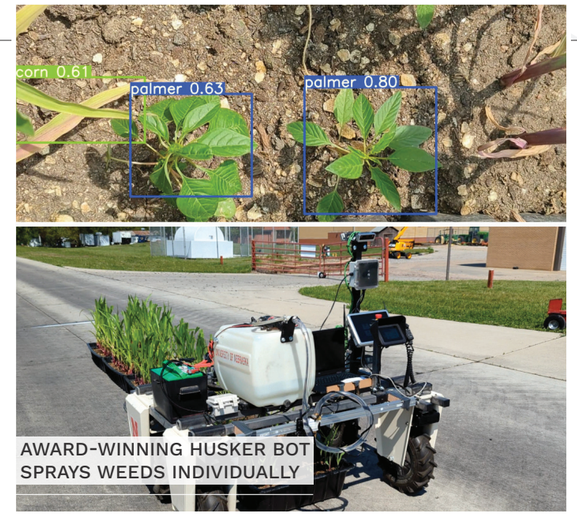
PITLA

Imagine a farming future where weeds are controlled and sprayed by robots. It’s a reality on the horizon as eight UNL students designed and built such a robot to win a Complexity in Design Award at the 2023 Farm Robotics Challenge competition. They also won a prize of $5,000 and a paid trip to showcase their robot in Salinas, California in September.

As part of the inaugural Farm Robotics Challenge sponsored by Beck’s Hybrids and hosted by the AI Institute for Next Generation Food Systems and University of California Agriculture and Natural Resources, the UNL team created the “HuskerBot Weedbot” and came away with first place in the Complexity of Design category, defeating engineering teams from Carnegie Mellon University, BYU and Purdue.

The Farm Robotics Challenge is an invitation-only student design event for undergraduate and graduate students to develop skills in robotic systems, electronics, and sensing technologies by simulating a fully autonomous robotics solution to a common agricultural process like harvesting or weed management. According to Santosh Pitla, associate professor of Advanced Machinery Systems, in addition to the robotics challenge, teams also submitted a poster and a written report describing the development and function of their robot.

> “If you want to manage weeds at scale, you need robotics and robotic solutions.”
>
> — Santosh Pitla, associate professor




AWARD-WINNING HUSKER BOT SPRAYS WEEDS INDIVIDUALLY

“We made a lot of modifications to it so that we can do targeted spot spraying of the weeds,” described Pitla, whose area of research is agricultural robotics and served as advisor to the team. He noted that the UNL students constructed a gantry on HuskerBot X to allow for a computerized spray nozzle to move laterally. “So that when the nozzle identifies a weed it will move on the gantry to that position and spray only there.”

Integrating software to innovate weed management was the team’s biggest challenge as the spray nozzle featured everything from customized cameras to integrated sensors that moved laterally along the gantry so AI could be used to identify weeds.

This isn’t the first award for HuskerBots in an ASABE sponsored international robotics competition. In 2022, Pitla’s Husker robotics team won a cotton picking ASABE event in Houston, Texas sponsored by Cotton Incorporated. Pitla attributes victories in these competitions to the work ethic of the students and also having a diverse multidisciplinary engineering background to solve problems.

“In a way robotics is underrepresented in Midwestern agriculture because, traditionally, a lot of robotics in agriculture has been done East Coast, West Coast where you have high value crops,” Pitla admitted. “If you want to manage weeds at scale, you need robotics and robotic solutions.”

## Federal funding drives EV safety protocols, establishes safe driver academy


The Nebraska Transportation Center's two main transportation research and technology transfer programs have each received multimillion-dollar grants that could make more Americans safer at home and abroad.

**The Rise of Electric Vehicles**

Receiving $2.2 million in funding over four years from the U.S. Army's Engineer Research and Development Center, the Midwest Roadside Safety Facility (MwRSF) is teaming with Auburn University on a challenge made more urgent by changes in transportation technology — the rise of electric vehicles (EVs). The grant aims to safeguard the entry points of military bases against the specific threats posed by hostile driven EVs.

"EVs are a different kind of an animal compared to gasoline vehicles," said Cody Stolle, assistant director of MwRSF and a research assistant professor of mechanical and materials engineering.

For starters, EV batteries add thousands of extra pounds to a vehicle and cause the center of gravity to be lower than gas-powered vehicles. Also, electric motors produce torque almost as soon as foot meets pedal, accelerating to top speed exponentially faster.

The Nebraska team will also re-examine the design of perimeter barriers of U.S. military bases and the gated checkpoints used by friendly vehicles. Stolle said those passive barriers must be engineered to withstand high-speed ramming from EVs, which make up a growing percentage of the world's automotive fleet.

"Most of our highway guardrail applications are designed to handle impact forces and structural requirements on the order of between 10,000 and 50,000 pounds. Systems which 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 have to do it over (just) a couple of feet, not spread over an entire system.

"That changes the way that you design these systems, so that their capacities are much higher. And we're using innovative technologies to accomplish that purpose."




To devise and test their designs, the team — which includes Ronald Faller, research professor and director of the MwRSF; and Joshua Steelman, associate professor of civil and environmental engineering — will employ sophisticated modeling of EV dynamics, which is supported by software and database from corporate partners Ansys and Caresoft Global.

**Region 7 University Transportation Center**

A U.S. Department of Transportation award will provide the Mid-America Transportation Center with $3 million per year for the next five years to establish the Mid-America Transportation Center for Safety and Equity (MATC-TSE) as the Region 7 University Transportation Center.

MATC-TSE will connect UNL researchers with those from five partner institutions from Kansas, Missouri and Iowa to improve transportation safety in the Midwest with a focus on equity, said Aemal Khattak, MATC director and professor of civil and environmental engineering.

"This grant also allows us to continue developing the next generation of professionals and to expand our work with underserved students that includes the Native American community in Nebraska and throughout the region." Khattak said.

Funding from this grant will provide the resources for MATC-TSE to establish a safe driver academy at NICC, located in Macy, Nebraska that will offer free driver training to Native American students.






UNL ENGINEERING STUDENTS ANGELINE LUTHER (LEFT), CJ MCCOY AND SAM ATKINS.

## Aerospace Club teams reach new heights in 2023, VEXU Team competes at World Championships

Aerospace Club teams soared and scored at 2023 competitions. The Nebraska Lunabotics Team participated in the prestigious NASA Robotic Mining Challenge in May at the University of Alabama. Nebraska's rover, which was tested on the sand volleyball courts north of Abel Hall on City Campus, helped prepare the lunabot for the national competition by simulating lunar regolith — a debris blanket of dust and sand-like material on the surface of the moon caused by impacts from meteorites. Robots competing at the NASA Robotic Mining Challenge submitted "proof of life" videos to NASA showing that the robot was competition ready.

In late April, the VEXU Robotics Team qualified for and competed at the World Championships in Dallas, Texas. The challenge for the VEXU Robotics Team was disc golf with competing teams charged with building robots to collect discs across a golf course and programming them to fling or throw the collected discs into a basket. The Nebraska team won two of nine rounds at the competition.

Not to be outdone, the UNL Rocketry Team successfully launched its largest rocket ever in Concord, Nebraska in Dixon County. The nearly 10-foot-tall rocket named EVE for Enclosed Vegetation Environment, rocketed to nearly two miles (9,760 feet) during the April 23 launch. The nearly 10,000-foot distance was reached during one of the team's final tests before competing at the Spaceport America Cup in Las Cruces, New Mexico in June where EVE carried corn sprouts as its payload and finished with an overall ranking of 39 (out of 119 teams competing from around the world).

JUDGES AND PARTICIPANTS AT THE NUTECH VENTURES AND COLLEGE OF ENGINEERING PITCH COMPETITION.

## Engineering entrepreneurs shine at pitch competition

It's not quite "Shark Tank" but a UNL program launched by NUtech Ventures and the College of Engineering five years ago is motivating entrepreneurship.

At the 2023 NUtech Ventures and College of Engineering Pitch Competition, three teams took home top honors and prize money to further develop their business ideas. First place, a check for $3,000, was awarded to Beacon — a startup company using American-made drones to perform bridge safety inspections. Maci Wilson, a computer science major in the Jeffrey S. Raikes School of Computer Science and Management, noted how more than 600,000 bridges in the United States are required to be inspected once every two years, typically by a harnessed inspector or an inspection relying on a Snooper underbridge and maintenance truck. Beacon utilizes drone technology to conduct routine bridge inspections — expected to grow into a $6.3 billion valuation by decade's end.

Second place and a $1,500 check was awarded to PartShopAI, a computer-aided design (CAD) team, specializing in improving the CAD software experience, which is a $10 billion market. The third place prize and $1,000 was awarded to Wearasense, a company offering lightweight healthcare wearable technology that detects clostridioides, a bacteria responsible for more than $1 billion in healthcare costs.

Competitors were allowed seven minutes to pitch their solutions to three judges: John Wirtz, co-founder and chief product officer for Hudl; Brad Roth, president and executive director for NUtech Ventures and associate vice chancellor for technology development at UNL; and Kathy Andersen, director of innovation and partnership for Lincoln Partnership for Economic Development. Judges were allotted three minutes after the pitch to ask follow-up questions. Coaching was also available to all teams competing in the competition and provided by Zane Gerhart, senior technology manager for NUtech Ventures; Joy Eakin, entrepreneurship program manager for NUtech Ventures; Jessica Minnick, technology manager for NUtech Ventures; Eric Markvicka, assistant professor of mechanical and materials engineering; and Traci Williams Hancock, business operations and customer success director for the Scott Data Center.

DEPARTMENT NEWS

# DEPARTMENT/SCHOOL HIGHLIGHTS

## Biological Systems Engineering


CRONK


MUÑOZ-ARRIOLA

■ During drought conditions, such as those that have recently been affecting much of Nebraska, some wells show higher levels of nitrates, which are known to lead to cancer, thyroid disease and birth defects in humans. Jonathan Cronk (master's student) and Francisco Muñoz-Arriola (associate professor) are developing models of Nebraska wells that could identify those that contain higher levels of nitrates and share that information with well owners to help find mitigation solutions.

## Chemical and Biomolecular Engineering


DISHARI

■ 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.

## Civil and Environmental Engineering


EUN

■ An NSF Early Career Development Program grant is supporting Jongwan Eun (associate professor) in studying how frozen soil's capacity to absorb water can be affected by snowmelt, rapidly changing temperatures and rainfall. All were important factors in the 2019 flooding that caused several eastern Nebraska communities to evacuate residents, a dam and three bridges to give way, four people to die and $1.3 billion in damage. This information could enable better predictions of how soil conditions, in combination with frozen water in soils, may affect the severity of flooding in order to mitigate damage.

## The Durham School of Architectural Engineering and Construction

■ Two teams of Durham School architectural engineering students swept the top prizes in the competition for the 2023 Illuminating Engineering Society Howard Brandston Student Lighting Design Education Grant. The team of Lukose George, Peyton Leute, Connor Mensch and Jace Pauli took the grand prize and an award of $3,000, while the team of Dylan Dropinski, Josh Sabata, Bentley Tonniges and Tristan Wilkins earned honorable mention honors and an award of $1,000. It is the ninth grand prize win by Nebraska Engineering teams since 2009. The teams are advised by Michelle Eble-Hankins (associate professor of practice) and Rodrigo Manriquez (principal, lighting studio leader of SmithGroup JJR).

## Electrical and Computer Engineering


QIAO

■ 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 an internationally recognized engineer in the areas of sustainable energy and energy efficiency. His work focuses 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


WILLIAMS


DVORAK


STELLING

■ The Nebraska Industrial Assessment Center (NIAC), which since 2017 has helped over 80 small- and medium-sized manufacturers save more than $8.7 million on energy costs and provided engineering experience to nearly 100 students, was chosen by the U.S. Department of Energy as its 2023 IAC of the Year. NIAC, under the direction of Robert Williams, Bruce Dvorak and Karen Stelling, has given 79 students real-world experience in providing free assessments to clients in six states: Nebraska, Iowa, Minnesota, South Dakota, Kansas and Missouri, resulting in an average yearly energy savings of $109,341.

## School of Computing


BALASUBRAMANIAM

■ As new threats to global environments and health continue to emerge and evolve, developing a better understanding of bacterial species can help decision makers create strategies to prevent harmful impacts. 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 electrochemical sensors and engineered biosensors to collect data and monitor bacterial communication signals in real-time. The signals and data will be transmitted to the HCC 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


KIEWIT HALL

Progress on Kiewit Hall continues this fall with many final construction details coming to a conclusion before classes are first held in the building 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 also be LEED Gold and WELL Silver certified, and was entirely funded by donors, including a $25 million naming gift from Kiewit Corp.


(Top) 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.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The fall season is now in full swing, with winter not far behind.

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