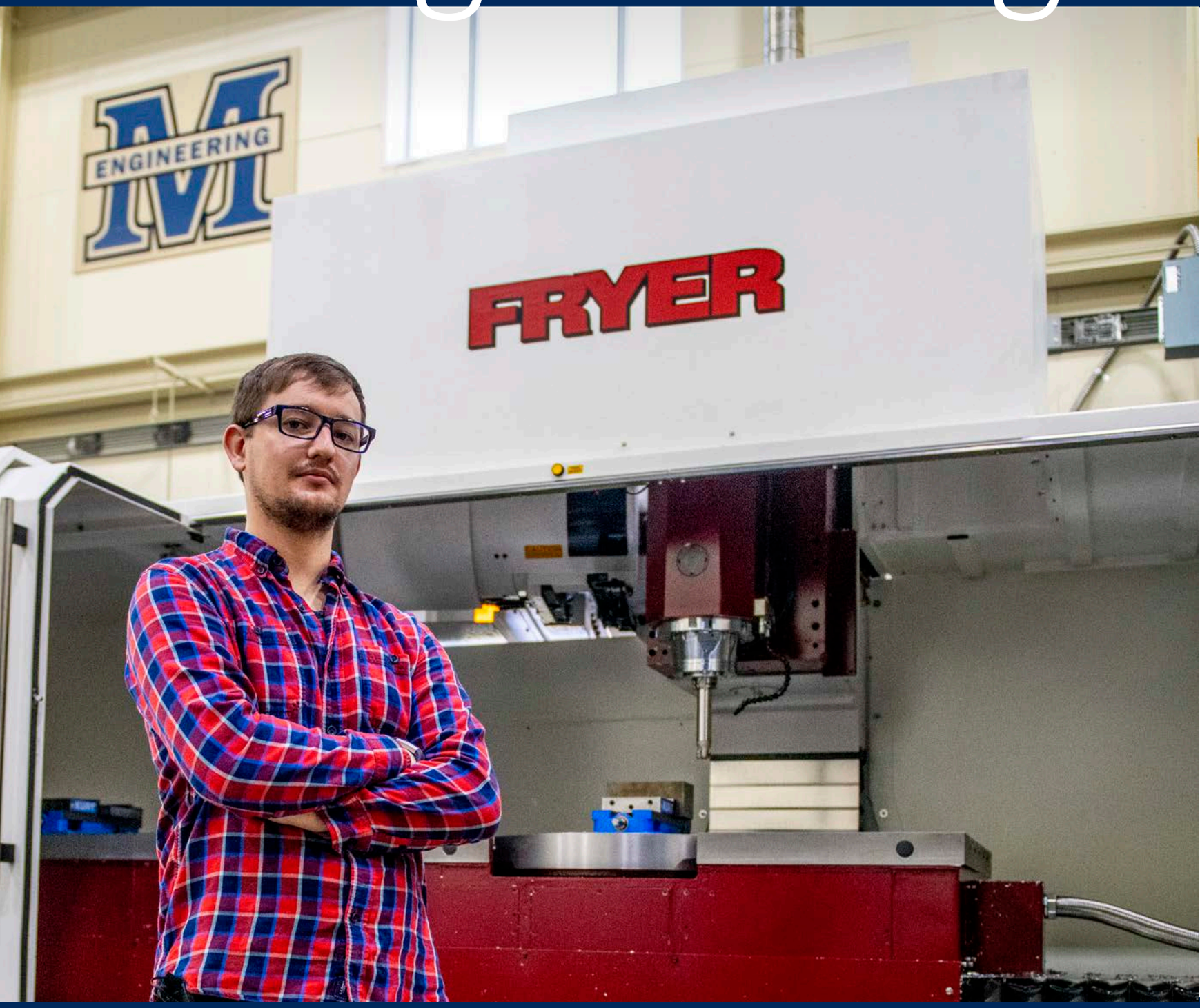
UMaine Engineering

2021/2022



ADVANCING AND ENABLING ENGINEERING

Leadership, vision and resilience today for tomorrow

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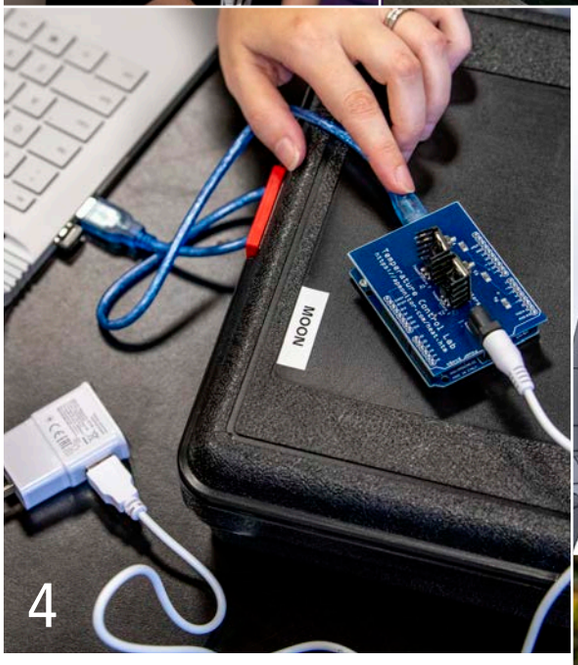

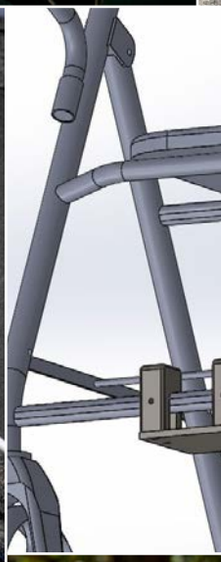

Departments

Primary editorial content by Marcus Wolf, primary photography by Adam Küykendall, design by Jenna Davenport, editing by Margaret Nagle, Division of Marketing and Communications

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Instagram and Facebook: @umaine.engineering
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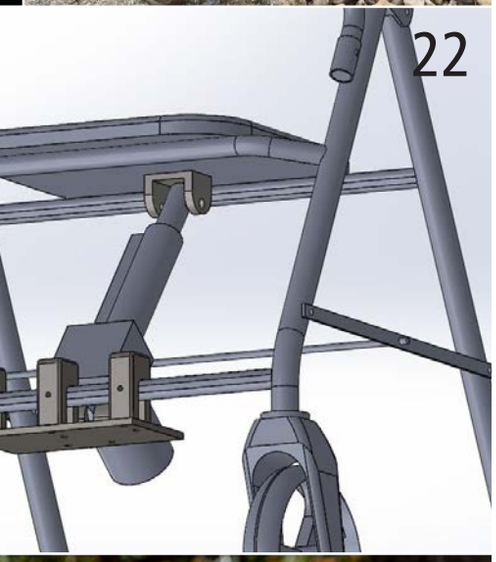
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Big things are happening in the UMaine College of Engineering! Construction of the Ferland Engineering Education and Design Center continues, with the project being on schedule and on budget. As I'm writing this letter on a sunny November day, I'm watching the masons reach the 70% done mark for the brickwork. The ribbon-cutting ceremony will happen sometime during the week of Aug. 22, 2022. Watch for further news on that and read more about Ferland EEDC in this issue.

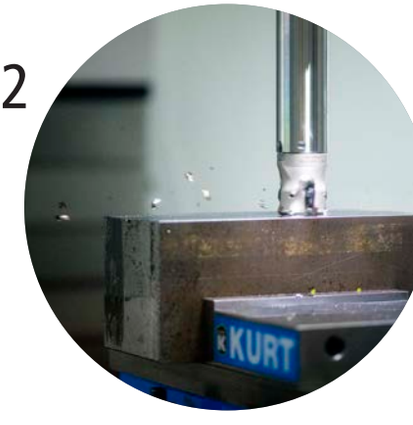
In October 2020, the Harold Alfond Foundation announced a $240 million pledge for the University of Maine System. This includes $50 million that must be matched 1:1 for renovation/replacement and expansion of Boardman, Barrows, Jenness and Crosby to meet the needs of engineering and computing. The team of Perkins Eastman/SMRT is formulating a master plan for this work, which is expected to be completed over the next decade. The Harold Alfond pledge also includes $25 million for the Maine College of Engineering, Computing and Information Science. Over 100 faculty and staff are working together to guide the formation of this new college. This is an exciting opportunity, with the long-term goal to double the number of engineering and computing graduates.

UMaine Engineering continues its tradition of hands-on programs. All of our seniors do capstone projects and 80% of our graduates have at least one internship, co-op or major research experience. Hundreds of our undergraduates are involved in research with individual faculty and in our research centers, including the Advanced Structures and Composites Center, Advanced Manufacturing Center, and Frontier Institute for Research in Sensor Technology. The placement of our graduates remains strong, with 99% reporting full-time employment or full-time in graduate school within six months of graduation.

This magazine highlights just a few of the accomplishments of our students, faculty and alumni, but there is more! I encourage you to come and visit campus — we have a lot to show you.

Dana L. Humphrey

Dr. Dana Humphrey
Dean, College of Engineering
Saunders Professor of
Engineering Leadership and Management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On the cover Fourth-year electrical engineering technology major Ezra Serdynski of Old Town, Maine is an electrical engineering intern in the Advanced Manufacturing Center, where recent equipment upgrades include a 5-axis Fryer vertical machining center. The state-of-the-art technology helps meet business and manufacturing needs statewide and beyond, and provides hands-on experience for Serdynski and other students — the workforce of tomorrow.

Enhanced capabilities

New AMC equipment furthers the future of Maine manufacturing

The University of Maine's Advanced Manufacturing Center has completed a series of major equipment upgrades designed to enhance capabilities to support industry partners and develop workforce, as well as accelerate the adoption of additive metal manufacturing in Maine.

After a series of delays related to the coronavirus pandemic, the full suite of new equipment — made possible by two significant grants totaling $2.5 million — was installed in 2021. The upgrades include a Desktop Metal FDM additive metal machine with testing equipment, 5-axis machining center, hybrid metal additive cell, wire EDM (electrical discharge machining), 4-axis lathe with live tooling, a coordinate measuring machine and a 6KW 5-axis laser with directed energy deposition.

"The pandemic has really brought into focus the dynamic needs of Maine manufacturers," says AMC director John Belding. "Over the last 18 months, we've seen firsthand how important it is to be able to meaningfully support R&D and offer companies a risk-free opportunity to experiment with new technologies, not to mention being able to deliver the skilled workforce they'll need to expand their own capabilities in these areas. This new equipment is critical to fulfilling that dual mission, and we're very excited to expand our work with Maine's manufacturing sector and beyond."

Communicating the capabilities of emerging additive metal technology (fusing small metal particles together through 3D printing to form solid metal objects) is a key goal of AMC's Center for Additive Manufacturing of Metals (CAMM). CAMM's initial funding came from a nearly $500,000 Maine Technology Institute (MTI) cluster initiative program grant, with matching funds from the university and 35 Maine companies, bringing the total to $1 million.

In 2019, the Maine Manufacturing Extension Partnership (Maine MEP) received a $1 million National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP) Competitive Awards Program grant to support and enhance CAMM. The project aims to develop state and regional additive manufacturing capacity by making additive manufacturing services at AMC accessible to Maine businesses and entrepreneurs. The funding provided for additional measurement and laser manufacturing equipment that is used to help qualify and then machine parts.

This effort is already showing results. Since the grant was received, CAMM has completed more than 30 industry projects for 42 companies, training more than 200 engineering students per year. In the past year, AMC has assisted Maine companies to create 32 new jobs and realize $12.24 million in new sales, retained sales, new investment and cost savings.

"Our organizational mission at Maine MEP is to assist Maine's small manufacturers to compete on a global scale, so applying for a grant to help build out AMC's Center for Additive Manufacturing was an easy yes," says Larry Robinson, Maine MEP president. "For today's manufacturers, being able to compete means being innovative in both product and process — and to be innovative, one has to be able to iterate quickly and inexpensively. That is where CAMM comes in. The center provides the technology and world-class know-how to assist Maine manufacturers to rapidly iterate their new product and process ideas."

Maine MEP is a public-private partnership and an affiliate of NIST under the U.S. Department of Commerce. It facilitates economic development in Maine by delivering technical services and workforce training solutions to Maine's small manufacturers.

Workforce development helps build resilience into Maine's manufacturing sector, one of the central goals of a $1.5 million grant, also awarded in 2019, that helped fund the purchase and installation of state-of-the-art additive and subtractive manufacturing equipment. That money includes a $750,000 investment from the U.S. Economic Development Administration, with matching funds from UMaine's Office of the Vice President for Research and College of Engineering, as well as the Maine Technology Institute.

With the new machinery, AMC is able to offer companies innovative technical assistance and access to cutting-edge technology, while students are developing the skills they'll need to excel in the increasingly technical 21st-century manufacturing workforce.

"This new equipment is very relevant to the industry, so we're able to do more projects with Maine companies to show them the benefits of the technology," says Belding. "Simultaneously, we're training students who will enter the job market well prepared to help businesses adopt and use it themselves."

This all adds up to good news for Maine's manufacturing sector and the companies that depend on it. ◆

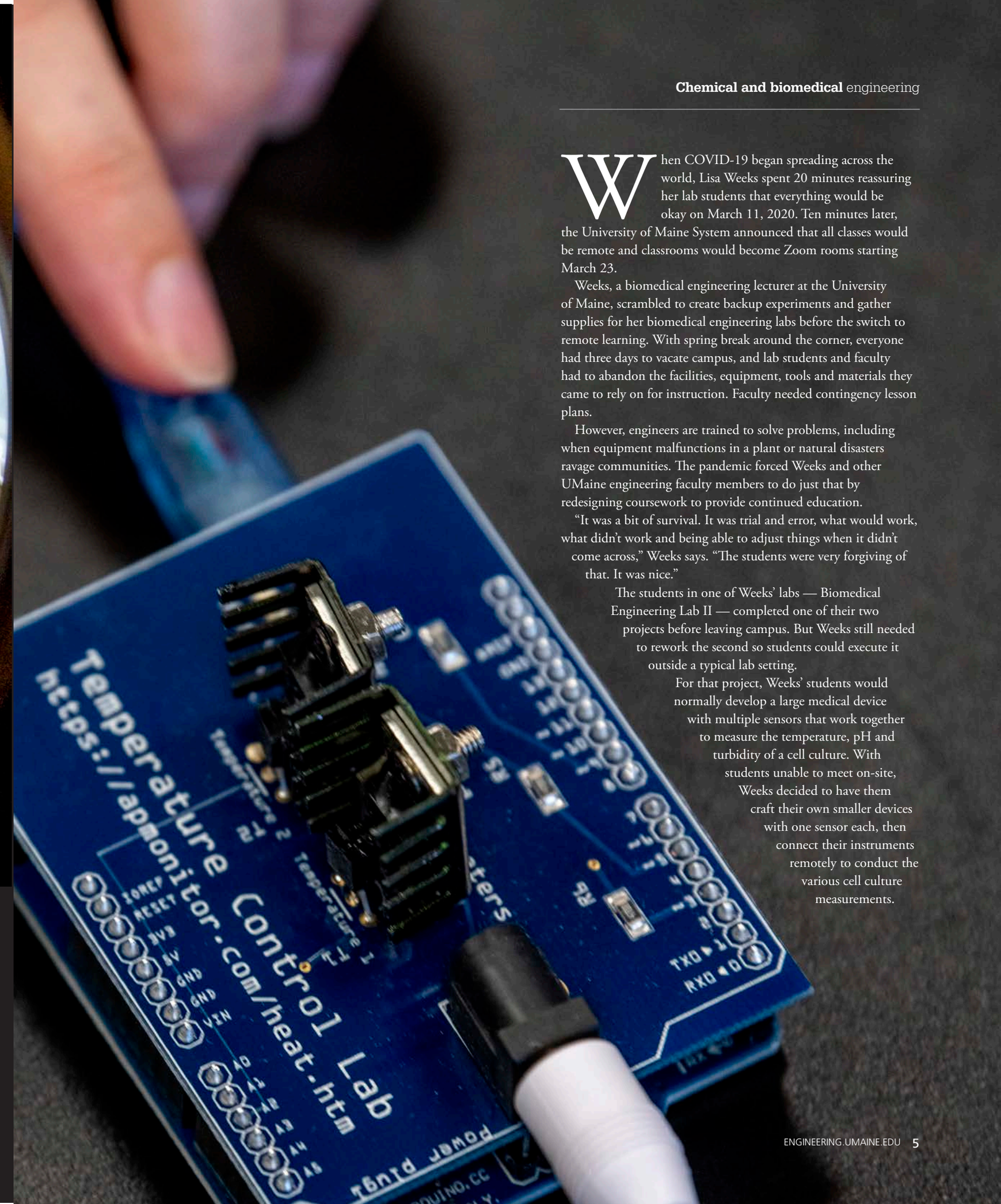
The full suite of new equipment — made possible by two significant grants totaling $2.5 million — was installed in 2021. The upgrades include a Desktop Metal FDM additive metal machine with testing equipment, 5-axis machining center, hybrid metal additive cell, wire EDM (electrical discharge machining), 4-axis lathe with live tooling, a coordinate measuring machine and a 6KW 5-axis laser with directed energy deposition.

AMC's Center for Additive Manufacturing of Metals (CAMM), launched with a 2019 grant to the Maine Manufacturing Extension Partnership, has completed more than 30 industry projects for 42 companies and trained more than 200 engineering students.

Innovation and creative solutions were key for chemical and biological engineering faculty members, left to right, Sara Walton, Lisa Weeks and John Hwalek as they led lab coursework during the pandemic for remote learning. Students received take-home kits and used webcams and other technology to collaborate and connect to campus-based resources, including the heat exchanger in the Process Development Center.

Problem-solving

Pandemic lessons in the chemical and biomedical engineering labs



When COVID-19 began spreading across the world, Lisa Weeks spent 20 minutes reassuring her lab students that everything would be okay on March 11, 2020. Ten minutes later, the University of Maine System announced that all classes would be remote and classrooms would become Zoom rooms starting March 23.

Weeks, a biomedical engineering lecturer at the University of Maine, scrambled to create backup experiments and gather supplies for her biomedical engineering labs before the switch to remote learning. With spring break around the corner, everyone had three days to vacate campus, and lab students and faculty had to abandon the facilities, equipment, tools and materials they came to rely on for instruction. Faculty needed contingency lesson plans.

However, engineers are trained to solve problems, including when equipment malfunctions in a plant or natural disasters ravage communities. The pandemic forced Weeks and other UMaine engineering faculty members to do just that by redesigning coursework to provide continued education.

"It was a bit of survival. It was trial and error, what would work, what didn't work and being able to adjust things when it didn't come across," Weeks says. "The students were very forgiving of that. It was nice."

The students in one of Weeks' labs — Biomedical Engineering Lab II — completed one of their two projects before leaving campus. But Weeks still needed to rework the second so students could execute it outside a typical lab setting.

For that project, Weeks' students would normally develop a large medical device with multiple sensors that work together to measure the temperature, pH and turbidity of a cell culture. With students unable to meet on-site, Weeks decided to have them craft their own smaller devices with one sensor each, then connect their instruments remotely to conduct the various cell culture measurements.

Students in Biomedical Engineering Lab II received kits containing the components needed to create sensing devices to measure cell culture.

In her final days on campus that spring, she collected sensors, wires, LED lights, breadboards and other components from a Jenness Hall supply room and packed them into take-home kits.

"It was kind of like the same thing every company in the world was doing. How do you work together from afar?" Weeks says.

John Hwalek and other chemical engineering faculty typically task upper-level students with conducting lab experiments using the heat exchanger in the Process Development Center (PDC) pilot plant. In collaboration with UMaine Information Technologies, Hwalek helped students remotely connect their personal computers to one in the plant that controls the exchanger, allowing them to manipulate its mechanisms and view the data from its sensors on their devices. Hwalek stayed in the plant in case anything went awry as student groups collected data and conducted analyses using the heat exchanger that regulates the temperature of water used in chemical reactions for manufacturing goods.

Students in Hwalek's lab inadvertently received real-world experience because some engineers operate equipment remotely while working with colleagues on-site who standby in case of malfunctions and other issues.

In summer 2020, Sara Walton devised a new experiment that preserved hands-on learning in her upper-level chemical engineering lab. The UMaine chemical engineering lecturer had students purchase $35 Arduino microcontrollers to conduct process control experiments, something she would normally have them execute with the exchanger.

The Arduino units send voltage signals to their two heaters attached to raise their temperature, and measure that temperature with a sensor. Students needed to create computer programs that would control the Arduino and task it with sending enough voltage to maintain the temperature of its heaters within a certain range when outside forces change.

"I'm kind of a planner, so I was very quickly on track to make contingency plans," she says. "I wanted to keep it hands-on where they could see that they were collecting data from a physical piece of equipment."

Like most classes at UMaine, Zoom became an integral part to facilitating lab instruction. Students not only conducted lab work over Zoom, but met outside of class to collaborate and delivered presentations using the platform.

Hwalek says students were more willing to seek his help with Zoom available than in previous years when he provided only in-person assistance. Students have been able to meet with Hwalek for 15-minute sessions, and he kept slots available beyond office hours.

Lab instruction persisted throughout the pandemic, but not without some challenges. From Zoom limitations to webcam and supply issues, faculty had to troubleshoot to ensure their students kept learning — fixing problems on the fly.

Weeks says helping students through webcams proved difficult, as she couldn't look closer at or hold their work in her hands. But students helped by using their phones as a second webcam to provide her a better view of their work.

Parts for Weeks' take-home experiments also broke or malfunctioned, like LED lights and circuits for sensors, she says. With no access for replacement parts, Weeks says some students had to redesign their experiments to work around the faulty components, and she helped them troubleshoot the experiments.

"That happens in the real world. Equipment doesn't always work when you want it to work, or you don't have the ideal parts and you have to replan what you can have in a short period of time," Weeks says.

The majority of engineering faculty and students returned to campus either in fall 2020 or spring 2021 for in-person lab instruction. While they looked forward to leaving their Zoom rooms behind for hands-on learning and interpersonal interaction, some instructors gained unexpected lessons and new ideas from their time teaching remotely that they plan to include in their teaching going forward.

While she has no plan to use them for her chemical engineering lab, Walton, who returned to campus in fall 2020, says she may incorporate the Arduino microcontrollers into her lecture course, giving students an earlier opportunity to tinker with technology.

Weeks says she now plans to include pre-lab "brain refreshers" she introduced during the pandemic. These materials provide students information from previous courses that would assist them with their lab projects, which she says allows them to relearn fundamental knowledge faster to execute the experiments. Weeks also says she plans to create safety training and other educational videos for labs.

"The pandemic forced me to be a little more tech-savvy," she says. ◆

A future in STEM

SARAH GLATTER always knew she would attend the University of Maine like her older brother and sister. While she hails most recently from Houlton, Glatter says she grew up "all over Maine." She remembers visiting her brother on campus when he was studying chemical engineering. Her sister completed her degree in food science and human nutrition, and is currently enrolled in a food science master's program.

Seeing her siblings succeed at UMaine made her college choice easy.

Choosing her major was a much tougher decision.

"I came out of high school with a pretty strong computer coding background, which is a little uncommon," she says. "It was a really big choice between computer science and computer engineering."

In the College of Engineering, Glatter found "freedom and creativity" in the classes students could choose. She also appreciated the college's national reputation and the value of the annual Engineering Job Fair.

Now a senior, Glatter plans to enroll in the 4+1 master's program in computer engineering when she completes her undergraduate degree in 2022. And in spite of a chronic health challenge that can disrupt her studies and her life, she remains confident in her choices, and about her future.

"I have always wanted to be a teacher. My dream is to be a collegiate professor. In computer engineering there is one female professor and most undergraduates don't get to work with her," Glatter says. "I see a big need for female computer engineering professors and even female STEM professors. That's the path I'm on." ◆

The Geotechnical Extreme Events Reconnaissance organization investigated five major landslides in and around Palu City in 2018. Aaron Gallant's international geotechnical engineering informs his teaching and research on the performance and behavior of natural landforms, geomaterials and subsurface infrastructure.

Delving into disaster

Aaron Gallant's geotechnical engineering research informs international work in earthquake reconnaissance

Palu City in Indonesia resembled a bomb site to Aaron Gallant when he arrived on Nov. 11, 2018. Two months prior, the 7.5-magnitude Palu-Donggala earthquake wreaked havoc on the city and central Sulawesi. The shockwaves, landslides and tsunami they stirred decimated communities across the region and took thousands of lives. Gallant, an assistant professor of civil and environmental engineering at the University of Maine, was there to help understand how it all went wrong.

The geotechnical engineer was conducting post-earthquake field reconnaissance as part of a group of researchers from the Geotechnical Extreme Events Reconnaissance (GEER) organization. His team focused on the five major landslides in and around Palu City that were triggered by the earthquake, attempting to collect information and data explaining how they occurred.

Gallant has investigated the interactions between the earth and manmade structures for years. The expedition in Indonesia was his introduction to disaster reconnaissance.

Oregon State University researcher Ben Mason led the team, which included Gallant, University of Washington engineer Joseph Wartman, Auburn University researcher Jack Montgomery, Auburn University undergraduate researcher Nicole Reed and Daniel Hutabarat, at the time a University of California, Berkeley graduate researcher and Indonesian native. They also worked with scientists and engineers from Indonesia's Center for Earthquake Studies (PusGen) and the Indonesian Society of Geotechnical Engineers (HATTI).

Gallant's research focuses on how the ground and built environment interact, which includes interplay between soil and structures, and how outside forces affect both. Advancing insight into this relationship factored into studies in blast densification, anchor assessment for aquaculture and other applications, and column supported embankment. Investigating the ramifications of disasters like earthquakes on infrastructure and the earth on which it is built serves as an additional avenue for Gallant's expertise.

Gallant and his colleagues conducted six days of fieldwork in central Sulawesi. Their work has produced several studies — some co-authored by members of HATTI and PusGen — but Gallant and his colleagues continue delving deeper into the tragedy. They hope to provide more insight into earthquakes like the 2018 disaster in Indonesia and how to mitigate damage.

"I jumped on the opportunity, and I would have to say it's certainly been a career highlight so far," Gallant says. "It's something I've been wanting to get into."

"Natural disasters, or extreme events, like earthquakes and tsunamis, are certainly interesting to study, and they can have some serious consequences," Gallant says.

The Palu-Donggala earthquake began more than 40 miles north of

Palu City at 6:02 p.m. on Sept. 28, 2018, and the shockwaves spread across an almost 100-mile radius from the epicenter.

The Jakarta Post reported in 2019 that the final death count for the Palu-Donggala earthquake was 4,340 people, which, according to researchers, makes it the deadliest natural disaster worldwide in 2018. The earthquake also damaged 68,451 homes, displaced 206,494 people and caused an estimated $911 million in economic losses, ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management reported in 2018.

The five landslides in and near Palu City that the GEER team investigated contributed to the majority of deaths, as well as most of the damage outside of coastal areas, which were ravaged by tsunami waves, according to researchers. These disasters, all named after the places they devastated, are called the Petobo Landslide, Jono Oge Flowslide, the Lolu Village Landslide, the Sibalaya Landslide and the Balaroa Landslide. The Petobo Landslide caused the most casualties and destroyed hundreds of homes in the densely populated residential district, according to researchers.

The team found that overly saturated soil allowed the landslides to occur when the earthquake hit. A key contributor to that wet soil was an unlined irrigation canal in the eastern Palu Basin farmers use for rice cultivation.

Gallant says water from the unlined part of the canal seeped into the soil, which made it susceptible to liquefaction, a process that occurs to saturated soil in an earthquake that weakens it. The weaker soil caused the landslides. Sand boils along four of the five major landslides served as evidence of liquefied soil.

Aaron Gallant measures a down-dropped soil block through a road near the crest of the Petobo flowslide.

All landslides ended at the canal and breached it at several locations, including along a second irrigation network, further confirming GEER's conclusions. The breaches created mudflows, according to researchers, including one at Jono Goe that "inundated multiple communities downstream of the flowslide that would have been unaffected otherwise." The more dense the irrigation supply, the greater the extent of the landslide and its damage.

According to researchers, "no significant deformations" occurred at the lined portion of the canal. Gallant says if the canal had not been there, the landslides, which caused almost 80% of casualties during the earthquake, wouldn't have occurred.

"What we learned ultimately was that a lot of it did have to do with the built environment," Gallant says. "In this case, an irrigation canal that really extended through the valley and saturated the sediments and, thus, made them susceptible to liquefaction and flowslides."

To investigate the major landslides in the Palu basin through geomorphic analyses, the GEER team gathered data by conducting ground surveys, which included measuring faults and the depths of cracks, and capturing photographs and drone images of the post-earthquake topography.

Researchers also used satellite imagery of pre-earthquake topography and models created from the data to assist in their analysis. Montgomery designed overhead map images in ArcGIS that illustrated their conclusions, Gallant says.

In addition, the team also gathered eyewitness accounts of the incidents from residents, an effort led by Gallant. Hutabarat, now a postdoc at U.C. Berkeley, served as a translator. Their stories, coupled with photos and videos they shared with researchers, provided the GEER team insight into the origin and progression of each landslide and subsequent destruction, all of which "contributed a lot to everything we discovered," Gallant says.

The team shared their findings with Palu City, Sulawesi and other Indonesian officials, then expounded on them for scientific reports over the years.

The likelihood of another earthquake in Sulawesi the scope of the 2018 catastrophe is unlikely to occur in Gallant's lifetime, he says, but the area — and Indonesia overall — is still susceptible to earthquake, tsunamis and other seismic activity. Places in the U.S. possess similar soil conditions and reliance on irrigation systems. If these places experience an uptick in residents as the population grows, Gallant says his research could help reduce landslides and other disasters, or mitigate their damage, by changing land use and enhancing infrastructure.

Gallant says he has used his earthquake reconnaissance research for education, particularly working with graduate students to build on it with new studies. Peta Fifield, who recently graduated with a master's degree in civil and environmental engineering, worked with Gallant for her thesis, "Comparison of land use and flowslide incidence in Palu Valley following the 2018 Mw 7.5 Palu-Donggala earthquake." His research also bolstered investigations into soil desaturation by Ph.D. student Babak Mahmoodi.

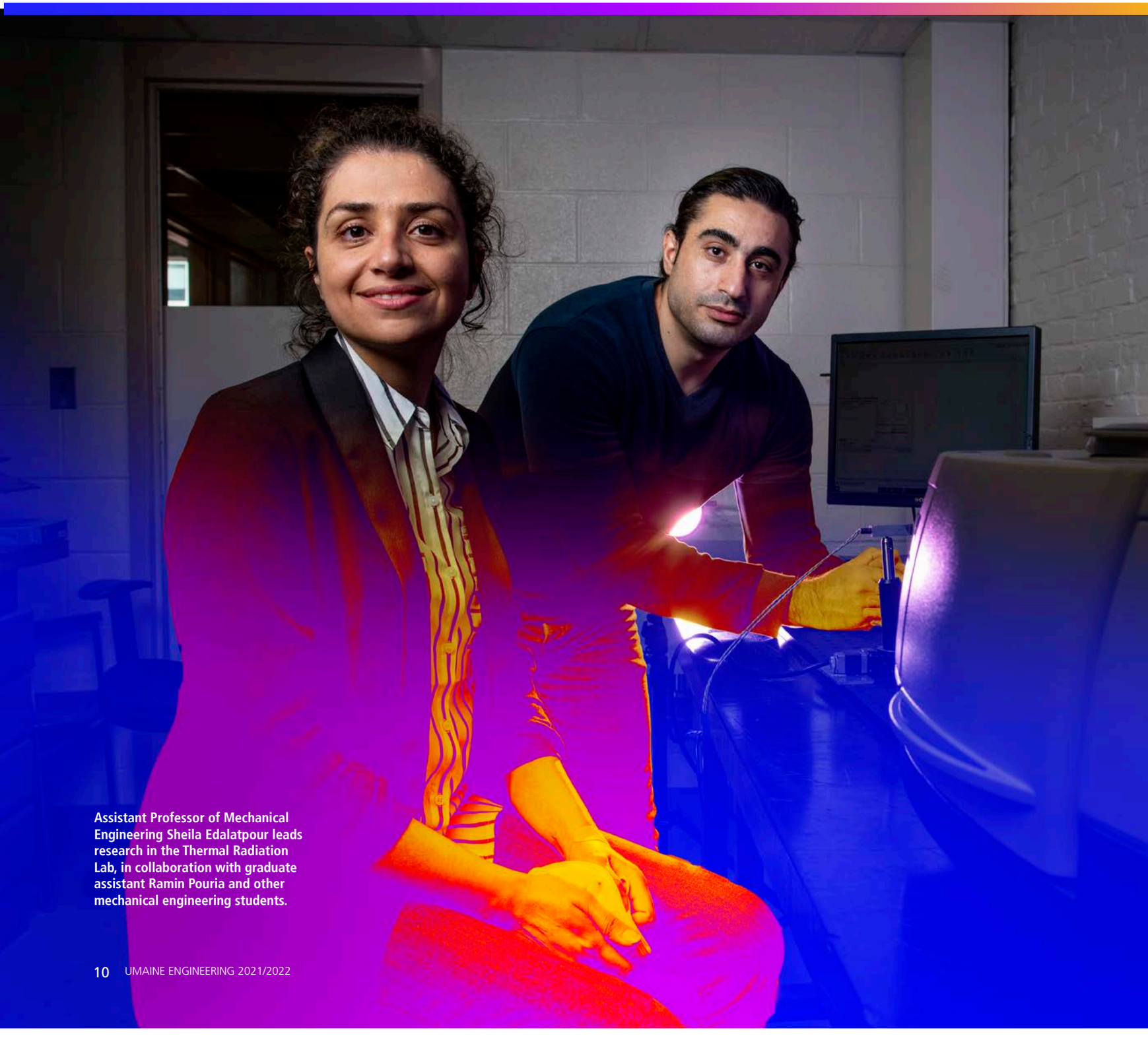
Gallant's teaching earned him a 2021 Faculty Mentor Impact Award during Maine Impact Week, one of two recipients from the College of Engineering this year.

The Palu-Donggala earthquake will not be the last Gallant plans to investigate. He says he hopes to join other reconnaissance missions and help other communities navigate and adapt to these disasters.

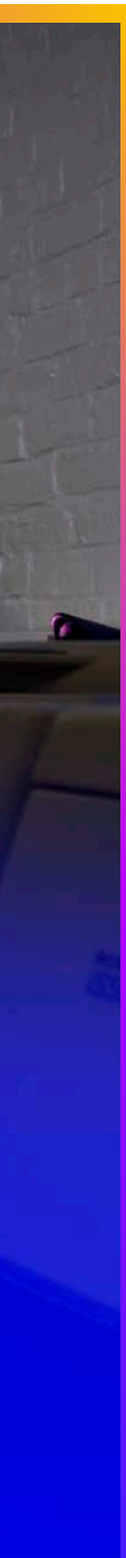
"The work is helping us learn from the disaster," Gallant says. ◆

At the quantum level

Sheila Edalatpour studies the magnitude, spectrum spatial coherence and polarization of thermal radiation from atomic-scale materials



Assistant Professor of Mechanical Engineering Sheila Edalatpour leads research in the Thermal Radiation Lab, in collaboration with graduate assistant Ramin Pouria and other mechanical engineering students.



Components the size of a few atoms, known as quantum materials, can enhance how technology functions and manages its heat. However, little is known about how heat is emitted and exchanged in quantum materials in contrast with their more common counterparts, three-dimensional bulk materials.

Sheila Edalatpour, an assistant professor of mechanical engineering at the University of Maine, is studying how the emission of heat changes when the materials involved are quantum-sized, or when they are separated by a gap of the same size as one or multiple atoms. The proposal earned her an intended amount of $526,858 from a National Science Foundation CAREER Award, the organization's most prestigious award for early career faculty. The funding is jointly allocated by NSF's Thermal Transport Processes Program and the Established Program to Stimulate Competitive Research (EPSCoR).

Optical and electronic properties can differ between bulk and quantum materials, and therefore, so can how they transfer radiated heat, according to Edalatpour. Determining how material size affects thermal radiation, energy emitted from heated surfaces and transferred from one component to another in the form electromagnetic waves, can help engineers design new materials to build more efficient, powerful and reliable devices for energy, computing, health care and other purposes.

"Quantum size effects provide an excellent opportunity for engineering materials with novel thermal properties suitable for energy conservation and conversion technologies such as thermophotovoltaics, solar cells and smart windows," Edalatpour says. "However, we know very little about how thermal radiation from materials is affected as the material size approaches the quantum scale. We plan to elucidate the quantum effects on thermal radiation via a theoretical-experimental study."

The study will involve creating a theoretical framework for how quantum materials radiate and exchange thermal energy, researching the thermal radiation of different types of quantum materials and demonstrating how reducing material size to atomic scales affects the magnitude and spectrum of thermal radiation. Tests will be conducted on zero-dimensional, dot-shaped quantum materials; one-dimensional, line-shaped materials; and two-dimensional, thin film-shaped, materials. Edalatpour will be the first to quantify in exact measurements the magnitude, spectrum, spatial coherence and polarization of thermal radiation from atomic-scale materials.

By expanding scientists' understanding of thermal radiation at the quantum level, her research may help them create new materials with thermal radiative properties that can more effectively transfer heat in nanoscale devices. These materials could fuel technological breakthroughs in thermophotovoltaic waste heat recovery, electronic devices and thermal diodes, all of which can help reduce fossil fuel consumption, according to the UMaine researcher.

Edalatpour also hopes to elucidate how electron tunneling affects thermal radiation. Electron tunneling, when an electron moves through a barrier it cannot typically pass, can occur between two materials separated by a gap of the same size as a few atoms. How the process affects thermal radiation is not fully understood, according to the UMaine assistant professor.

"Radiative heat transfer at the atomic length scale can play a significant role in thermal management of nanoscale and quantum-scale devices such as transistors, ultra-compact circuits, quantum computers, solar cells and medical imagers," Edalatpour says.

Edalatpour will recruit female students and students with disabilities, two groups underrepresented in mechanical engineering, at the high school, undergraduate and graduate levels to assist with the study. She will also seek supplemental financial support to provide research experience for high school teachers from rural Maine. Her work will help create a new course about radiative heat transfer with lecture and lab components.

"By involving high school girls and teachers, we hope to contribute to increasing the number of female students choosing mechanical engineering as their career," Edalatpour says. ◆

Three NSF CAREER Awards in the College of Engineering

This academic year, three College of Engineering faculty members received National Science Foundation CAREER Awards, the organization's most prestigious award for early career faculty.

Sheila Edalatpour, assistant professor of mechanical engineering, is studying how the emission of heat changes when the materials involved are quantum-sized, or when they are separated by a gap of the same size as one or multiple atoms.

Lauren Ross, assistant professor of hydraulics and water resources engineering, is improving scientists' understanding of how estuary shape, river discharge and tides influence fresh and saltwater mixing.

Thomas Schwartz, associate professor of chemical engineering, is advancing his ongoing dissection of the Lebedev process. A well-known, multistep chemical reaction is used to make butadiene from biomass-derived ethanol, but little research has been conducted on the Lebedev process at the molecular level.

Rising star

UNIVERSITY OF MAINE civil and environmental engineering senior Madeline Blair of Nazareth, Pennsylvania received a Society of Women Engineers (SWE) award this year as a current and future leader.

The SWE WE Local 2021 Rising Star Award is presented to members with less than two years of experience, and who have demonstrated outstanding community engagement and leadership, and academic achievement.

Blair is a UMaine Presidential Scholar and Dean's List student who was valedictorian of University of Connecticut College of Pharmacy Class of 2019 and captain of the UConn Swimming and Diving team.

Since joining the UMaine community in 2019 as a transfer student, she has interned with Maine companies Gorrill Palmer Consulting Engineers in South Portland and Pike Industries in Sidney, and served as an inspector for the Maine Department of Transportation. On campus, Blair also has been a student worker at the Advanced Structures and Composites Center. She is a teaching assistant in the Department of Civil and Environmental Engineering, a member of Delta Zeta Sorority and All Maine Women, and president of the UMaine Club Swim team.

Her community service includes STEM education presentations and outreach to University of Maine Cooperative Extension 4-H and the 2020 Engineering Expo.

When she graduates in May 2022, Blair plans to work as a practicing engineer in either the transportation or structural fields, and pursue a professional engineer license. ◆

Two alums who changed our world

Colby Chandler

COLBY CHANDLER '50, former chair and CEO of Eastman Kodak, passed away in March. Chandler grew up in Farmington, Maine. He graduated from the University of Maine with a degree in engineering physics and joined Kodak that same year as a quality control engineer. He was named company president in 1977, and served as chair and CEO from 1983–1990. Chandler received the UMaine Alumni Association Career Award in 1975 and an honorary doctorate from his alma mater in 1979. He also was presented the 4-H Alumni Gold Key Award in 1989 and is in the Francis Crowe Society Hall of Fame. Chandler was honored with the Stillwater Presidential Achievement Award in 2005. Chandler and his wife of more than 70 years, Jean Chandler, established the Dr. David J. Batuski Excellence Fund for Physics Education at the University of Maine Foundation.

Henry Saunders

HENRY SAUNDERS '50, former president and owner of Saunders Brothers Inc., his family's longtime business, passed away in February. Saunders grew up in Westbrook and earned his degree in mechanical engineering from UMaine. His lifelong dedication to education led him to endow three UMaine professorships: The Henry W. Saunders Distinguished Professorship in Forestry, The Kenneth Warren Saunders and Henry W. Saunders Professorship in Engineering Leadership and Management, and The Marjorie H. Saunders and Leslie Saunders McManus Professorship in Leadership and Management. The Francis Crowe Society member received multiple awards in his career, including a UMaine Alumni Association Black Bear Award in 2000, the 2012 Outstanding Alumni Award from the Alumni Chapter of Southern Maine and the Stillwater Presidential Achievement Award in 2015. ◆

The Maine College of Engineering, Computing and Information Science Undergraduate Engineering Education Working Group is led by alums Barbara Hamilton and Clif Greim. Photo by Kathy Rice

Tomorrow's students

Two alums lead undergraduate engineering focus of the Maine College of Engineering, Computing and Information Science

In fall 2020, the Harold Alfond Foundation made an historic investment in Maine and its people that included a $240 million challenge grant to the University of Maine System to bring transformative change to the state's largest educational, research, innovation and talent development asset. As part of UMS TRANSFORMS, a $150 million multi-university Maine College of Engineering, Computing and Information Science (MCECIS) is cooperatively led by the University of Maine, including a $75 million commitment from the Harold Alfond Foundation with a match obligation of another $75 million.

The UMS TRANSFORMS MCECIS initiative is led by UMaine College of Engineering dean Dana Humphrey; professor and UMaine School of Computing and Information Science director Penny Rheingans; dean and professor of the University of Southern Maine College of Science, Technology, and Health Jeremy Qualls; and University of Maine at Augusta interim president and provost Joseph Szakas. It seeks a statewide solution that will provide additional undergraduate engineering and computing programs at UMaine and USM; UMaine graduate engineering and computing programs offered in Portland; expanded pathways into the statewide college from all University of Maine System universities, community colleges, and K–12; and new opportunities for shared programs, interdisciplinary structures and partnerships.

One of the initiative's working committees, MCECIS Undergraduate Engineering Education, is led by UMaine alumni Barbara Hamilton and Clif Greim.

Hamilton, based in Freeport, Maine, is senior director of process technology at Packaging Corporation of America. In this role, she coordinates automation and process control resources for large capital projects. Prior to joining PCA, Barbara held positions in both operations and business development with Siemens Energy, ANDRITZ Automation, and Emerson Automation Solutions. Her career in the pulp and paper industry includes engineering management, project management, and process control engineering with the Fitch Company, Champion International, International Paper and Union Camp. Barbara chaired the University of Maine Pulp and Paper Foundation Board and serves on its Executive Committee. She is a current member of the UMaine Board of Visitors and the College of Engineering Dean's Advisory Council. Hamilton received a UMaine degree in chemical engineering in 1982.

Greim served as president and CEO of Harriman for 12 years until his retirement in 2020. Prior to 2008, he was the director of mechanical engineering at the Auburn, Maine architectural firm, leading the design of energy-efficient and sustainable building systems. Greim is president of Frosty Hill Consulting, board chair of the Maine State Chamber of Commerce and vice chair of the Educate Maine board. He also is a member of the College of Engineering Dean's Advisory Council. Greim received a UMaine degree in mechanical engineering in 1980.

We asked them to reflect on what MCECIS could mean for the future of undergraduate education in engineering, computing and information science, and the difference it could mean for workforce development to meet needs in Maine and beyond.

What do you see as the potential — and the promise — of MCECIS?

BH: The potential and the promise of MCECIS is to provide the outstanding engineering, computing and information science talent, both in quantity and quality, that Maine needs to thrive. Superior education is the best way to promote innovation and economic stability. What excites me about this initiative is the possibility of recruiting unique engineering, computing and information science talent from all over the state and beyond. How many bright young minds can we attract by making an engineering and computing education more accessible, more relevant, and more tailored to the needs of both students and the Maine economy?

CG: This is a Systemwide offering that will allow students to participate in and transfer to from any UMS campus. The promise of an enhanced curriculum, including new, leading-edge studies, whether it be in artificial intelligence, cyber sciences, sustainable energy/energy storage or bioengineering, will attract new learners, campus partners and potential resources not known to the university currently.

What difference will MCECIS make in undergraduate engineering, computing and information science education?

BH: MCECIS will leverage the strengths of the existing campuses and promote collaboration. It will remove administrative barriers and provide opportunities for learning that will serve Maine engineering, computing and information science students and Maine businesses. All students will have had the opportunity to participate in research and/or cooperative work as undergraduates. Employers will recognize a MCECIS graduate as a sure bet, someone who will bring immediate value to the organization.

CG: Industry-leading education partnered with national and global company priorities are offered through our institution. Experiential learning, opportunities for co-ops, internships and industry access for professional careers in high demand are here at the university. Flexibility of learning location and credit transfers will be offered to students as their interests in particular areas of engineering and computing studies become more focused.

A decade from now, how will undergraduate engineering, computing and information science education look in Maine as a result of MCECIS?

BH: A decade from now, MCECIS will graduate twice as many engineers, and computing and information science experts as are currently matriculating from the University of Maine System. This diverse group will have an education built on a strong technical foundation and enhanced by multidisciplined experiential learning. They will be highly sought after by potential employers, all of whom appreciate their skills, creativity and strong work ethic.

CG: A decade from now, experiential project learning with multiple disciplines collaborating together will be commonplace. Global challenges will drive a nimble and market-ready engineering, computing and information science curricula in an industry-leading, advanced education, with location flexibility, intern/co-op opportunities for all MCECIS students, regular engagements with national and global companies sharing ideas and challenges. Faculty will be leading many of these efforts, building on the reputation earned and other institutions looking to UMaine as a leading partner in other areas of research and learning. ◆

Keeping score

Student engineers update, restore Fort Fairfield scoreboard

Devices see landfills sooner these days. Thanks to cheaper materials, planned obsolescence and a consumer demand for the latest and greatest, gadgets like phones and printers either fail faster or are trashed too soon with little thought.

University of Maine engineering students Ally DiFilippo and Miles Martin scorn the disposability of modern implements. That's why for their senior capstone project, they are restoring and modernizing a more than half-century-old scoreboard from Fort Fairfield, Maine, giving it new life and purpose.

"I like the idea of marrying history and technology," says DiFilippo. She is a double-major in electrical and computer engineering with a robotics minor from Essex Fells, New Jersey. "We're doing this for them so they can have a piece of their history back, but as engineers, we get to see the history ourselves. We get to see how people historically designed these old pieces of engineering."

The town plans to use the 3-by-2-foot green scoreboard as a traditional clock for the basketball court inside the community center, its original home.

To revitalize the scoreboard for its new use, DiFilippo and Martin will need to gut and overhaul it with modern technology, including a 12-hour analog clock to replace the 8-minute timer and four LED dot matrix panels in lieu of the network of lightbulbs previously used to display scores. Martin says if time allows, he and DiFilippo plan to program the LED panels to show points and countdowns, restoring its functionality as a scoreboard. Despite all the internal reworking, the scoreboard will predominantly maintain its exterior aesthetic, save a new clockface provided by Fort Fairfield.

The two seniors plan to install two stepper motors that will control the hour and minute hands for the 12-hour clock. The motors vibrate and can create a loud noise in a metal scoreboard, DiFilippo says, so they plan to install felt or plastic washers or other soundproofing tools.

The mechanisms of the repurposed scoreboard, which may include its original buzzer, will be controlled by a Raspberry Pi microcomputer.

The students' capstone advisor, Nuri Emanetoglu, an associate professor of electrical and computer engineering, said the credit card-sized, single-board computer can connect to the internet to provide the time, send messages and binary code alerts, and grant scroll displays.

However, internet connectivity exposes the scoreboard to the potential risk of hacking. Martin, a computer engineering major now in his fourth year as a member of the UMaine Cybersecurity Team and his third year as an officer of the club, will digitally lock down the Raspberry Pi to protect the scoreboard from digital malfeasance. Both Martin and DiFilippo also will need to ensure the scoreboard will be durable against physical threats, such as people accidentally hitting it with balls, which will rely on DiFilippo's hardware background.

"We have a pretty similar workflow, and our differences complement each other," Martin says. "There's always been good collaboration and cooperation between us."

The request to redesign the scoreboard came from Kevin Senal, parks and recreation director for Fort Fairfield. He says the scoreboard was first installed when the building was erected in 1952 as an armory for the National Guard. The old scoreboard was retired decades later when the high school donated new ones in 1978 and 1986, and it has sat in the basement for more than 30 years.

Senal says he stumbled upon the old scoreboard three years ago while touring the complex at the start of his job. Since then, he strived to find someone who would make it operational once more. In spring 2020, Senal got his wish when DiFilippo and Martin decided to take on the assignment, which they learned about from an email of project ideas to capstone students from Emanetoglu and lecturer Andy Sheaff.

"I'm a huge fan of nostalgia, things that bring back memories for people," Senal says. "We as a community — especially the leadership here now and the staff here now — we're all about progress and moving forward, but we're also not opposed to holding onto the past."

DiFilippo and Martin predict that they will spend 500 hours in the fall 2021 and spring 2022 semesters modernizing the scoreboard. They plan to provide Fort Fairfield with their finished product in the spring, and possibly travel there to assist with installation.

Martin says they have multiple stretch goals for the project that all depend on time and funding. Possible additional enhancements include blinking lights that tell seconds, error messages and short words, one letter per matrix panel.

The historic aspect of the Fort Fairfield scoreboard restoration makes it stand out as a capstone project, which Emanetoglu says "makes it fun and interesting."

> "We're doing this for them so they can have a piece of their history back, but as engineers, we get to see the history ourselves."
>
> Ally DiFilippo

For their senior capstone project, Ally DiFilippo and Miles Martin are restoring and updating the technology in a half-century-old scoreboard from Fort Fairfield, Maine.

It also presents atypical challenges for UMaine seniors, he says, such as converting the power supply from alternating to direct current, replacing light bulbs with digital displays and navigating the limitations necessary to preserve the old-fashioned characteristics of the board.

Like much of the work conducted by UMaine students and faculty, DiFilippo's and Martin's endeavor also satisfies the needs of one of Maine's many municipalities, another reason why both students say they wanted to pursue it.

"It's a nice public service our department gets to do," Emanetoglu says. "It's important for UMaine to be engaged with the state community."

Fort Fairfield native Peter McKenney also looks forward to seeing the scoreboard repurposed. McKenney, who graduated from UMaine in 1971 with a mechanical engineering degree, chaired a committee of high school classmates to write the book "Honoring Their Service: Stories of Fort Fairfield High School Class of 1967 Military Veterans," which depicts the experiences of the 45 titular veterans, of which he is one, and includes a history of the town and the National Guard battery and armory.

The town partnered with the National Guard to build a basketball court in the armory, McKenney says. The facility went into service in 1953, and it was ready for basketball games in 1954. The high school lacked a sufficient court at the time, so it hosted games at the armory. McKenney says he remembers watching games there as a child. It was there until 1963 when the town finished erecting a new high school with a better gym.

The original scoreboard, the only one in the facility in the early 1950s, was "very simplistic" with "very little information on it," McKenny says, but he believes it's still worth saving.

"I think it's great for all of us to have some visual reminder of the way life was, back decades earlier, and think about the different perspectives of life: where did we come from? What did our parents and grandparents go through?" McKenney says. "What markers am I going to leave behind?"

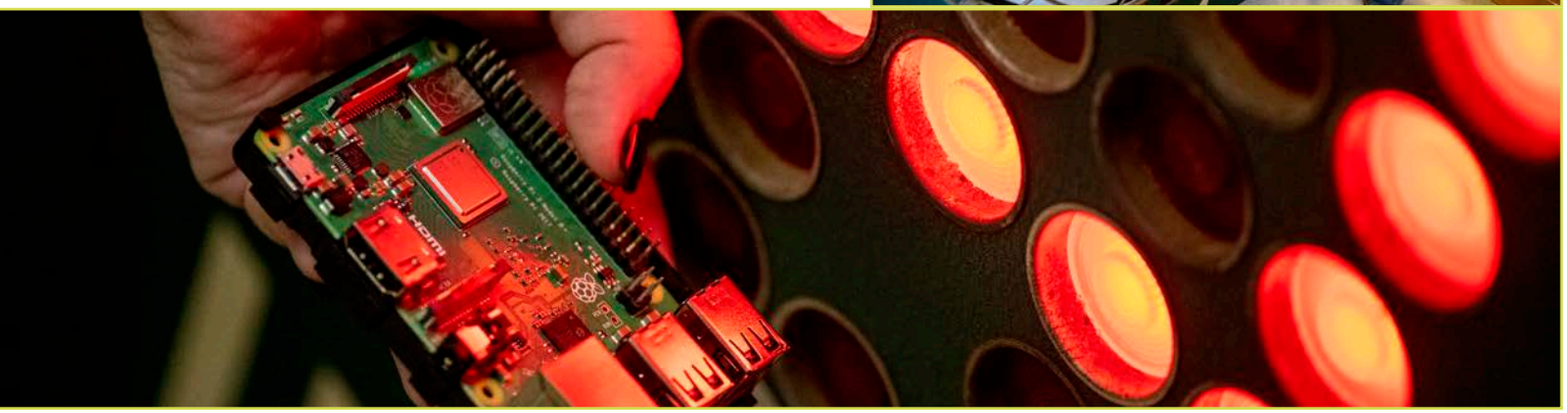
After she completes the project this year and the 4+1 program for a master's in data science engineering next year, DiFilippo says she hopes to work full time for the MITRE Corporation, a nonprofit that works with governments to tackle information technology, information security and other related problems. Both DiFilippo and Martin served as interns for the organization's Enterprise, Computer and Information and Security division; "the IT for the IT," she says.

Martin says he hopes to teach electrical and computer engineering to middle and high school students after he graduates from UMaine. He envisions creating a mobile lab or enrichment center to transport from school to school.

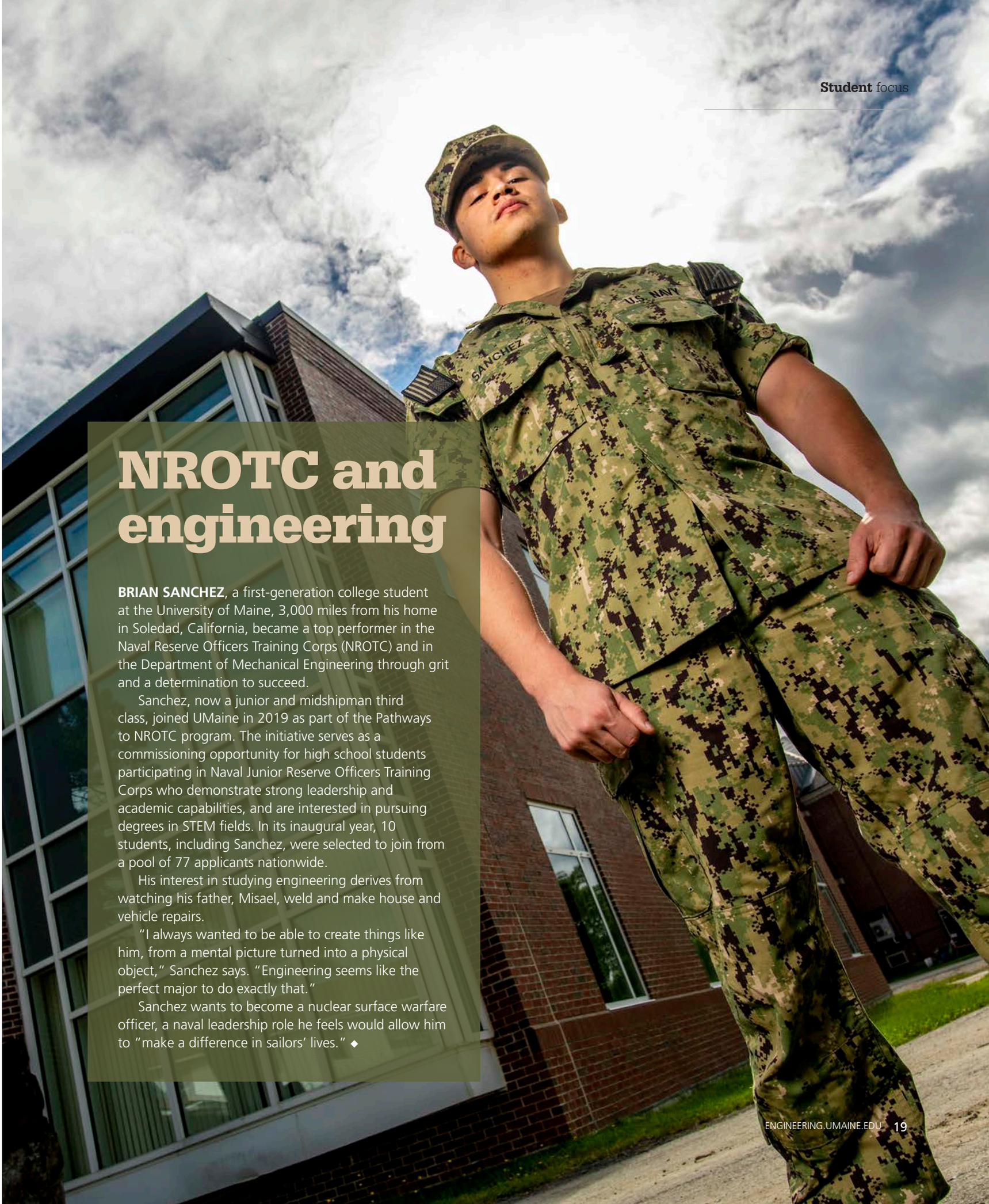
"I think it would be very edifying," Martin says. "I love to teach, and I love working with people."

Restoring the scoreboard will provide DiFilippo and Martin skills and assurances that will help them with their future careers and endeavors. The project, however, is not just a stepping-stone for them. They are taking extra steps to make certain the scoreboard serves Fort Fairfield for years to come, such as creating troubleshooting instructions so town workers can maintain it. The additional work will be hard, but "worth it," Martin says.

"One big aspect of this project is to make sure it outlives us," DiFilippo says. ◆



Modernizing the scoreboard will include installing a 12-hour analog clock with two stepper motors to replace the 8-minute timer and four LED dot matrix panels in lieu of the network of lightbulbs that once displayed the scores. The board will be controlled by a Raspberry PI microcomputer.



NROTC and engineering

BRIAN SANCHEZ, a first-generation college student at the University of Maine, 3,000 miles from his home in Soledad, California, became a top performer in the Naval Reserve Officers Training Corps (NROTC) and in the Department of Mechanical Engineering through grit and a determination to succeed.

Sanchez, now a junior and midshipman third class, joined UMaine in 2019 as part of the Pathways to NROTC program. The initiative serves as a commissioning opportunity for high school students participating in Naval Junior Reserve Officers Training Corps who demonstrate strong leadership and academic capabilities, and are interested in pursuing degrees in STEM fields. In its inaugural year, 10 students, including Sanchez, were selected to join from a pool of 77 applicants nationwide.

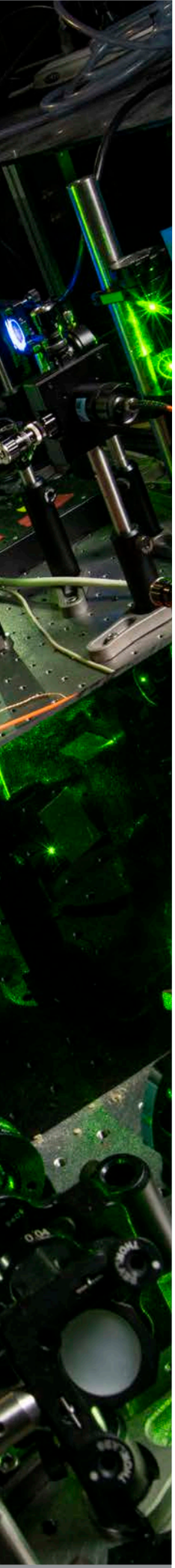
His interest in studying engineering derives from watching his father, Misael, weld and make house and vehicle repairs.

"I always wanted to be able to create things like him, from a mental picture turned into a physical object," Sanchez says. "Engineering seems like the perfect major to do exactly that."

Sanchez wants to become a nuclear surface warfare officer, a naval leadership role he feels would allow him to "make a difference in sailors' lives." ◆

Better views

Innovative microscope system provides insights into COVID-19 spike protein



In the Hess lab, fluorescence photoactivation localization microscopy is enabling research advances in COVID-19 and influenza viruses.

Influenza research is well-suited to physics research, because protein clustering is central to the virus life cycle. Measuring clusters in different ways and understanding how they're evolving are critical in advancing treatment therapies.

In the last two decades, advances in super-microscopy led by the Sam Hess lab at the University of Maine have resulted in new insights — and sights — of influenza particle surface spikes. The surface structures of spike proteins are where the body's immune response to the virus begins.

Now, in the SARS-CoV-2 pandemic, what Hess and his undergraduate and graduate students have learned about surface spikes on virus particles is contributing to our understanding of the COVID-19 spike protein. The spike protein from the influenza virus is hemagglutinin (HA); the spike protein from the coronavirus is called S. Basically, the spike proteins on the surface of the virus stick or bind to cells in the respiratory tract. Spikes also allow the virus to enter through a process called membrane fusion.

Membrane fusion depends very much on clusters of the spike protein. Hess has been studying that process of how the clusters form, looking at how the host cell might play a role in generating those clusters and investigating, ultimately, how to disrupt that process.

"These clusters are crucial for the infection process, yet nobody knows why they arise," says Hess. "There were some theories at that time when I first came to UMaine about why clusters of viral proteins occur. Our data showed those theories to be wrong, which didn't make me very popular. It did lead us to ask new kinds of questions.

"When the coronavirus pandemic started, I realized we'd probably have to find some new ways to fight the new virus," he says. "There were some similarities and differences that I noticed between the SARS coronavirus and the influenza virus. I thought of using our molecular microscopes to look at similarities and differences between those two. We've been looking at two of the most important proteins involved in the beginning of infection — the spike proteins."

In 2005, Hess and UMaine professor of chemical and biomedical engineering Michael Mason led the development of a breakthrough microscope system called FPALM (fluorescence photoactivation localization microscopy) to image cells with membranes that contain the HA spike protein. Prior to such super-microscopy, it wasn't possible to create images of molecules on a small enough scale to test the biological models that predict how they may be organized. FPALM shattered the resolution limit of lens-based microscopes, known as the diffraction barrier, that had existed for more than a century.

The FPALM system, which uses photoactivatable dyes to identify individual molecules and separate them at the nanometer scale, was one of four groundbreaking advanced microscopy techniques that were able to achieve such single-molecule imaging capabilities in the mid-2000s. Indeed, announcements of the 2014 Nobel Prize in Chemistry honored three recipients and cited other researchers involved in similar pioneering research, including Hess.

FPALM technology is now used in UMaine research in toxicology and muscular dystrophy. In virology, it has led to not only a better view of spike proteins, but also their cytoplasmic tail, which seems to interact with host cell components connected to signaling.

Parts of those spike proteins mutate fairly rapidly over time, interfering with the function of the immune system to recognize that structure as dangerous and attack it, says Hess. That's one reason influenza vaccines have to be reformulated annually.

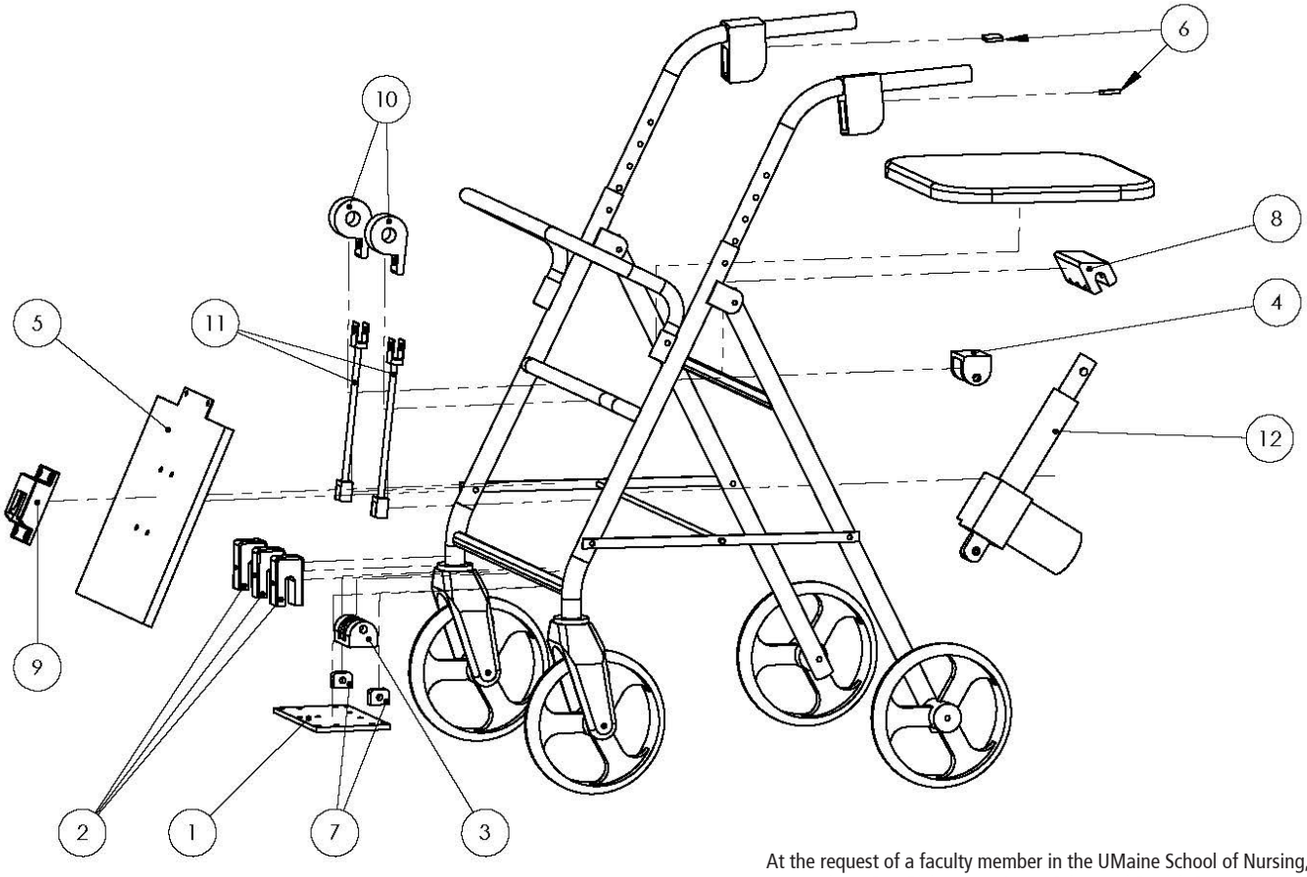
However, there's a portion of the spike proteins — the tail inside rather than on the surface of the virus — that does not change very quickly. "That," Hess says, "is what we're going after."

> "We've been looking at two of the most important proteins involved in the beginning of infection — the spike proteins."
>
> Sam Hess

"People overlook this tail," Hess says. "It's inside the cell. It doesn't seem to have any role in the lock and key mechanism of entry, but certain sequence elements are always there. We noticed when we expressed one of these spike proteins in a cell that there were some interactions between the tail and some of the host cell components. Then we started thinking about how we could disrupt that interaction — interfere with the function of the spike protein. Looking at that interaction and trying to figure out if there are drugs that could break that up, that's been a thrust of our research for a few years."

The result could be a new class of drugs that blocks this interaction between the spike protein and the host cell, disrupts those clusters of the spike proteins, and stops the virus from entering the host.

"The way viruses are mutating and the way sometimes you get breakthrough infections, having a backup (drug therapy) to help when an infection does occur is a real urgent need right now," says Hess. ◆



At the request of a faculty member in the UMaine School of Nursing, MET students Ben Richardson, Lucas Scher and Patrick Sugar designed and fabricated a lift device to improve the functionality of a bariatric rollator.

A lift up

MET students design a medical device to enhance mobility

Collaboration is key to the success of any engineering project, according to University of Maine faculty members Brett Ellis and Peter Howorth.

Ellis, an associate professor of mechanical engineering technology, and Howorth, a lecturer in mechanical engineering technology, teach MET 464 and 465, the required capstone courses for majors. Together they have more than four decades of industry experience, including product design and development.

"We teach the students that they must understand the needs of the customer before they begin to design something," says Howorth. "If you don't understand the question you can't expect to get the right answer."

Ellis notes that communicating with people outside of the discipline of engineering is a critical skill.

"Engineers spend a significant amount of time working with nonengineering professionals," Ellis says. "We are better engineers when we learn how to communicate clearly."

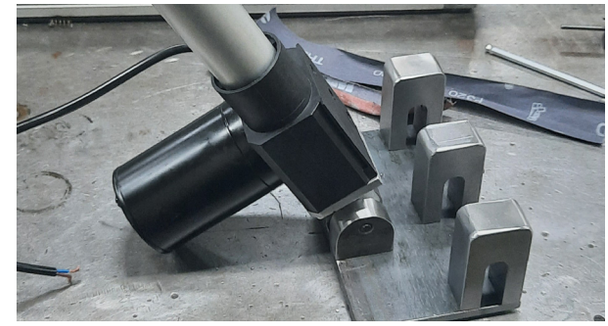
With this collaborative approach and a volunteer "client" from UMaine's School of Nursing, in 2020–21 three MET students designed and built a new medical device, a bariatric rollator lift, for their capstone project. Benjamin Richardson, Lucas Scher and Patrick Sugar partnered with nursing faculty member Susan Tardiff, Ellis and Howorth to develop a lift system that could be operated safely by a patient or caregiver, could lift up to 500 pounds, and could be added to a readily available walker on wheels known as a rollator.

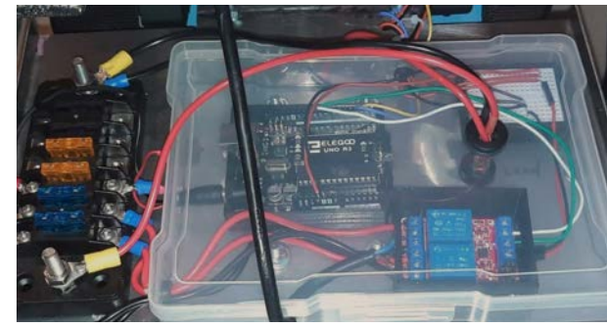
While ultimately enhancing mobility for patients who cannot easily transition from sitting to standing, a viable lift design could also reduce the risk of caregiver back injuries by as much as 50%, according to the students. Scher proposed the rollator lift as the group's capstone project because he has a family member who could use this type of device.

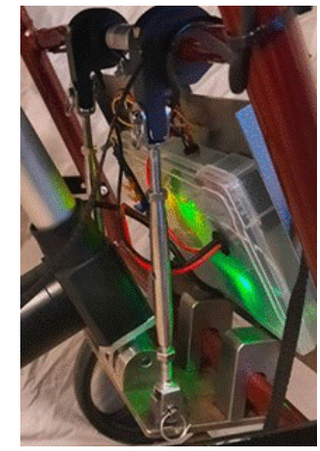
The group designed a device that is easily added to an "over-the-counter" walker, featuring a protected battery power source to achieve a lift angle of 40 degrees in approximately 15 seconds.

Tardiff, who has previously worked with MET students to approve designs for a pill crushing device, embraced her role as the client in this project, validating design parameters and making suggestions along the way.

"I was the client that hired an engineering firm to develop a







The capstone project focused on creating a system capable of lifting up to 500 pounds. The team's work involved machining plate clamps and assembling the actuator and plate, and developing the electrical system engaged at the hand control of the device.

product for me," Tardiff says. "Then I provided feedback that reflected my expertise as a nurse, since engineers do not generally have expertise in patient safety."

She says she enjoyed the process and particularly the collaborative relationship, including witnessing how engineers approach a problem, which often varies greatly from that of nursing students. But Tardiff also recognized similarities, such as how students struggle with time management and communications.

"I think that was one of the biggest learning curves for the students — being sure to communicate early and often with other disciplines that are just as busy as they are," Tardiff says.

Howorth concurs, noting that the team working to develop the bariatric rollator had "real customer conversations," where the students took on an engineering workplace role to understand their client's needs.

Previous capstone design successes include development of a soft robot in 2017–18 with chemical and biomedical engineering students and faculty members Caitlin Howell and Karissa Tilbury; the 2017–18 restoration of the pneumatic organ at the Unitarian Universalist Society of Bangor with direction from MET faculty member Keith Berube; and production of a propane-electric hybrid go-kart by MET and electrical engineering technology students in 2016–17, also under Berube's direction.

Tardiff, Ellis and Howorth all tout the value of interdisciplinary projects and learning.

"Engineers must meet multiple, often competing requirements from a variety of stakeholders," Ellis says. "Interdisciplinary capstone projects expose MET students to the challenges they will face in industry.

"Although 21st-century challenges — the pandemic, global warming and the desire to improve the quality of life for all people — are great, UMaine MET graduates are learning the skills they need to thrive in a changing world." ◆

One of the top in technology

Melinda Conroy's talents gain national recognition

Melinda Conroy advocates for herself and doesn't shy away from demonstrating her talents. Through ambition and networking, along with the skill and knowledge needed to make connections, the University of Maine alumna forged an upward career path from a research assistant to an electrical engineer designing data centers for Ebay. Her ascent and abilities have caught the eyes of many, including a national technology magazine.

Mission Critical Magazine, which features the latest news and resources for data centers and critical facilities, earlier this year named Conroy one of its Top 25 Women in Technology. According to the publication, the inaugural recipients broke through the glass ceiling to earn high-ranking positions at data centers and other critical industries, while also clearing a path "so others can follow their lead." Publisher Mike Murphy wrote that these women "have forged a place in this industry and helped to make it an essential resource."

"I was very excited and humbled," Melinda says. "It's a very exciting award to receive having only eight years' experience in the data center industry."

In a Q&A with the publication, Conroy said data centers and other technology industries should introduce more diversity, equity and inclusion efforts to ensure that "work environments, business models and leadership structures" can "work for and reflect everyone." Increasing diversity by recruiting more women, people of color, LGBTQIA+ individuals and people from other underrepresentated backgrounds provides an opportunity for growth in the industry, she said.

"You may expect someone to notice your hard work, but you need to advocate for yourself," Conroy says. "Don't be afraid to know your qualifications and strengths, and present them to those who are in leadership."

At UMaine, Conroy received a bachelor's degree in electrical engineering in 2009. After graduation, the South Portland native worked as a power systems engineer for RLC Engineering. She interned there in her senior year. Her father, David, and her uncle, Brian, both currently work for the firm. During her tenure at the company, she conducted system impact studies for power systems in Maine and Canada and consulted operators.

In 2013, Vanderweil Engineers in Boston hired Conroy as an electrical

All in the UMaine engineering family: Ryan Boles, Class of '24; Kevin Conroy, Class of '16; Melinda Conroy, Class of '09; and Brian Conroy, Class of '86. Photos by David Cleaveland

engineer, where she helped design electricity systems for data centers erected in retrofitted buildings and at greenfield and brownfield sites. She then worked for Harley Ellis Devereaux, also in Boston, as an electrical engineer and associate from 2018–20. Now she works for Ebay, the culmination of 12 years of hard work and self-advocacy as an electrical engineer, eight of which she had dedicated to data center design.

UMaine provided opportunities for Conroy to develop some of the skills she needed to excel in the engineering field, she says, including networking, collaboration and professional writing. She credits two sensor research internships with preparing her for her career.

In her sophomore year, Conroy helped researchers and graduate students create and categorize new films for sensors in the Laboratory for Surface Science and Technology (LASST) in Barrows Hall, now known as the Frontier Research Institute for Sensor Technologies (FIRST). She returned to the lab in her junior year to assist with a study exploring how the shape of surface crystals on sensors affects their operations, particularly by helping create and test patterns of electrodes on various crystal sensor surfaces. The National Science Foundation funded both endeavors.

On both projects, Conroy says she collaborated with her favorite faculty member: George Bernhardt. She says Bernhardt was "an amazing teacher" who was always willing to help students, even outside of class and office hours.

"I was really fortunate to get the two internships," she says. "I think they really prepared me for being in the workforce."

Conroy comes from a family of successful engineers. Her uncle, Brian Conroy, graduated from UMaine in 1986 with an electrical engineering degree. He worked at Central Maine Power for 33 years, then joined RLC Engineering, where he is manager for power system studies.

Two of his three children went on to attend and graduate from UMaine, including his son Kevin, who also earned a bachelor's degree in electrical engineering in 2016. He now works as a project manager for the contractor PTAG, where he helps oversee solar power facility integration as a contractor for Central Maine Power. In addition, Kevin owns an interconnection and renewable energy consulting firm, Energized Grid Solutions.

Now a new generation of Conroys and extended family members has enrolled at UMaine, including Ryan Boles, a cousin of Melinda and Kevin, who is a sophomore in electrical engineering.

Discovering Melinda's accolade inspired Ryan, and he says he hopes to achieve the same work ethic, motivation and positive attitude that she and other family members exhibit.

"We're her number one fans and her biggest supporters," Kevin says. "I hope we can add to the list of accolades and accomplishments in the workplace." ◆

Tour guide

Dean Dana Humphrey shares views of Ferland EEDC that opens next year

Editor's note: College of Engineering dean Dana Humphrey has long been talking about the importance, need and value of the $78 million Ferland Engineering Education and Design Center. But since the virtual groundbreaking for the facility in April 2020, he has given hundreds of "tours," both virtually and on-site, rain or shine, from the sidewalk nearest the construction. Ferland EEDC, which will welcome students in fall 2022, is one of his many favorite subjects, especially to prospective students and their parents. We asked him to give us an excerpt from one of those tours — a vivid walk-through in narrative that gets to the potential of this next chapter in UMaine engineering.

The $78 million Ferland Engineering Education and Design Center will transform engineering education at the University of Maine. When completed in August 2022, it will become the heart of engineering. The most important feature is the Student Project Design Suite, which is nearly half of the first floor. It will have 48 workbenches, each assigned to a group of students for a semester or a year. This is where they will build their hands-on projects.

Each bench features lockable storage for student teams and will be surrounded by fully equipped fabrication shops. There will be shops for biomedical engineering, electronics, 3D printing, vehicles, metal, wood and composites. Students will go out to the shops to fabricate components, and then return to their benches for assembly and debugging.

Alex Friess, associate professor of mechanical engineering, says this state-of-the-art project suite will significantly increase our capability to provide experiential education across all engineering programs, and represents a vast improvement of the educational experience for not only our senior students, but throughout the curriculum.

All engineering students, from first-year to graduate students, who have completed basic safety training can use the Design Suite. This will be the best space of its kind in the Northeast.

Ferland EEDC will be a magnet for engineering students and faculty. There is a two-story commons with comfortable seating for work and collaboration. Given that food has universal attraction, UMaine Dining will have a location for drinks, snacks and grab-and-go sandwiches.

Two massive south-facing windows will bring the sun into the commons. A door leads from the commons to an outside plaza. Twelve student meeting rooms strategically placed throughout the building can be reserved online for group work and tutoring sessions.

There is informal seating along "Main Street" on the second and third floors. Engineering student clubs have a large meeting room on the second floor. This is a "corner office" with windows on two sides. A skylight the length of the building will stream natural light through all floors, making them warm and inviting.

Given all the features of the building, it is expected that every UMaine engineering student will be in the building at least once a day for classes, meetings, labs or a cup of coffee.

The building is the new home of mechanical engineering, housing its department, faculty and grad student offices. Two second-floor teaching labs serve the needs of both mechanical engineering and mechanical engineering technology.

There is a rooftop lab where students can conduct real-life experiments with solar trackers and wind turbines. A first-floor tool room with metal lathes and milling machines is critical for hands-on learning for mechanical engineering technology students. This replaces the Machine Tool Lab that was razed to make way for Ferland EEDC.

Biomedical engineering is moving from Jenness Hall to the third floor of Ferland EEDC. Half of this floor is research labs with specialized facilities for tissue culture, optics, instrumentation, chemistry and biomechanics.

Assistant professor of biomedical engineering Karissa Tilbury says that she has "nerdy giddiness" when thinking about the capabilities that these labs will provide for faculty, graduate students and undergraduates. A state-of-the art biomedical engineering teaching lab has support labs for tissue culture, microscopy and instrumentation. Biomedical faculty and graduate students have offices on the third floor.

Ferland EEDC respects our past and looks toward the future. It is connected to Boardman Hall by a bridge. Exterior signage from the Machine Tool Lab will be installed on a wall in the mechanical engineering technology tool room.

The outside of the building is faced with brick to make a connection to the surrounding facilities, but it has modern windows for a look to the future. The building is designed to allow mechanical and biomedical engineering to double in size so that we can increase the number of engineering graduates to help meet the needs of Maine and beyond.

The building serves not just engineering, but the entire campus. There are five collaborative classrooms set up for active learning that will be used by classes from all majors.

The campus Welcome and STEM Outreach Center will be on the north end of the first floor. Campus tours for prospective students will start here. There will be offices for UMaine Admissions and for STEM outreach through 4-H and UMaine Cooperative Extension.

Making the Ferland EEDC a reality has been a team effort. The state of Maine provided $50 million in funding for the project. More than 500 donors contributed more than $25 million in private gifts.

Donors who contributed $1 million or more are: James and Eileen Ferland, Harold Alfond Foundation, Gustavus and Louise Pfeiffer Research Foundation, Packaging Corporation of America, Abbagadassett Foundation, and Pratt & Whitney.

The creativity of the design team of WBRC Architects Engineers and Ellenzweig is evident throughout the building. They brought great ideas to the table and incorporated suggestions from faculty, staff and students, resulting in a building that will be a point of pride for all Black Bears.

Construction of the building is overseen by Consigli Construction. They are giving UMaine an outstanding project that is on time and on budget. UMaine Facilities Management also has been part of every step of making this project a reality.

A particular point of pride is that 78 UMaine graduates have been part of this building's design and construction. This building is becoming a reality because of Black Bears working to serve the needs of future Black Bears and for the entire state of Maine. ◆

Pendse named Distinguished Maine Professor

HEMANT PENDSE, an internationally recognized leader in forest bioproducts research, is the University of Maine 2021 Distinguished Maine Professor.

The annual Distinguished Maine Professor Award honors a UMaine professor who exemplifies the highest qualities of teaching, research and public service. It is sponsored by the University of Maine Alumni Association and its Classes of 1942 and 2002.

Since joining the university in 1979, the professor of chemical engineering and chair of the Department of Chemical and Biomedical Engineering has spearheaded innovative research that has earned two patents, produced 82 publications, given more than 200 technical papers and garnered $17 million in external funding. He also has yielded new economic opportunities for Maine through his work on forest bioproducts.

Students know Pendse as an educator who challenges them to think critically, provides clear and concise lessons, is always willing to help, and dedicates himself to their success.

Pendse founded the Forest Bioproducts Research Institute in 2010, and serves as its director. FBRI aims to identify the logistic, scientific, economic and policy factors that would allow forest-based products to be made at a commercial scale and inspire the creation of a biorefinery in Maine.

Under his leadership, FBRI built the nation's first pilot-scale plant for manufacturing nanofibrillated cellulose, or nanocellulose. The institute earned $48 million for various projects, $17 million of which is attributable to Pendse's efforts.

FBRI developed and secured patents for its breakthrough thermal deoxygenation process (TDO) for making biofuels for jets and marine engines, and for its process to create advanced materials like nanocellulose. Pendse was instrumental in scale up to continuous pilot operations that benefit researchers and private business alike.

Pendse's research interests involve pulp and paper manufacturing, colloid systems, particulate and multiphase processes and sensor development. During his studies, he has developed forest biorefinery pilot-scale industrial process systems, an ultrasonic slurry characterization system, a laboratory instrument for particle surface charge characterization in concentrated colloids and an online particle size distribution sensor system for concentrated slurries. He also has developed multiple theories and methodologies to assist in particulate systems characterization and processing

His numerous awards include the 2009 College of Engineering Ashley Campbell Award, 2012 Genco Award from the University of Maine Pulp and Paper Foundation, and the 2012 UMaine Presidential Research and Creative Achievement Award.

Pendse's record of public service includes advising the Municipal Review Committee, a group of 115 Maine cities and towns united to tackle solid municipal waste problems; and serving on the Economic Development Assessment Team, Maine Innovation Economy Advisory Board, the Governor's Wood-to-Energy Taskforce and more.

He and FBRI also have collaborated on the Forest Opportunity Roadmap/Maine (FOR/Maine), a public-private partnership seeking new markets for wood products and bolstering technological innovation to support new commercial uses for wood. He has served on the Corporate Advisory Council for Nelson Industries, Stoughton, Wisconsin, and the Transport & Energy Processes Division of the American Institute of Chemical Engineers (AIChE) in various capacities. ◆

MEE Salutatorian

DREW BENNETT'S LinkedIn page says it all: "I am an Education Technical Services Engineer at PTC (and loving it!)."

Bennett, who is from Brewer, Maine, graduated with a degree in mechanical engineering and a minor in robotics from the University of Maine in May 2021 and was the university's Salutatorian. As an education technical services engineer at PTC in Boston, he works with teachers, students and STEM organizations to implement the company's software technology.

At UMaine, Bennett received Mid-South Engineering scholarships and the Thomas P. Hosmer Scholarship. Throughout his time on campus, he served as an undergraduate research assistant in the Advanced Manufacturing Center. Last year, he also was a manufacturing intern with General Electric in Bangor and was an education application engineering intern with PTC.

On campus, Bennett was president of Black Bear Robotics and of the UMaine NASA Robotics Mining Challenge Team. He noted that it was the trip to the JFK Space Center in Florida as part of the NASA Robotics Mining Challenge Team that encouraged him "to dive deeper into the field of design engineering."

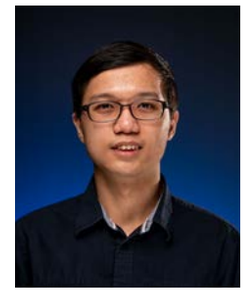
In the community, Bennett mentors youth robotics teams.

The opportunities for student success at UMaine are "both unique and endless," Bennett says. "There are so many different research opportunities, internships, and on-campus jobs that allow students to explore their passions and find success in the fields they care about." ◆

2021 Outstanding Graduating Students

Jordan Miner of East Baldwin, Maine was the Outstanding Graduating Student in the College of Engineering. She was a biomedical engineering major with minors in electrical engineering and bioinstrumentation. Miner was a Maine Top Scholar who received two fellowships from the Center for Undergraduate Research to study Duchenne muscular dystrophy. She was a student researcher collaborating in the laboratories of professors Karissa Tilbury and Clarissa Henry. Miner presented and published her research findings, and received best poster honors at the 2019 Northeast Symposium on Biomedical Optics. She also participated in three internships at IDEXX Laboratories and NASA Goddard Space Flight Center. On campus, Miner was a peer tutor and a leader in the Biomedical Engineering Club. She was captain of the Fastpitch Club that won the 2019–20 New England East conference championship. Miner is pursuing a Ph.D. in biomedical engineering at UMaine, focused on cancer research.

Vilgot Larsson of Stockholm, Sweden was an Outstanding Graduating International Student in the College of Engineering. The civil engineering major had a concentration in environmental engineering. The scholar-athlete was a member of the men's basketball team. He was a member of the Swedish National Team in the summers through 2019 and at UMaine was involved in community volunteering initiatives. Larsson plans to pursue a career in environmental engineering.



Khoa Kieu of Da Nang City, Vietnam was an Outstanding Graduating International Student in the College of Engineering. The chemical engineering major received multiple scholarships during his years at UMaine, including the Roger B. Hill Engineering Scholarship. He participated in a chemical engineering co-op at Verso Paper in Jay in 2019. On campus, he worked in Dining Services, and as a teaching assistant and peer tutor. He plans to pursue a career in chemical engineering as a process or production engineer.

New faculty

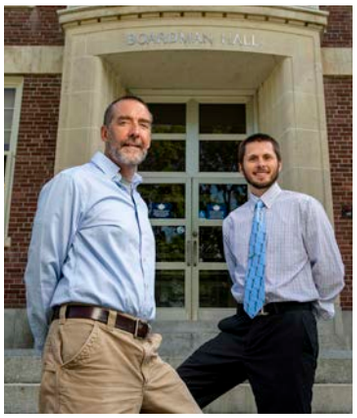
VIJAY DEVABHAKTUNI
Norman Stetson Professor and Chair of the Department of Electrical and Computer Engineering
Ph.D., Carleton University
Specialty: computers and data for decisions

VIKAS DHIMAN
Assistant Professor of Electrical and Computer Engineering
Ph.D., University of Michigan
Specialty: mobile robotics, autonomous vehicles, computer vision, safe control

PETER HOWORTH
Lecturer of Mechanical Engineering Technology
BEng(Hons), Brunel University
Specialty: leveraging professional experience to support entrepreneurship and small business development

AMRIT VERMA
Assistant Professor of Mechanical Engineering
Ph.D., Norwegian University of Science and Technology
Specialty: offshore wind turbine technology

LUIS ZAMBRANO-CRUZATTY
Assistant Professor of Civil and Environmental Engineering
Ph.D., Virginia Tech
Specialty: geotechnical engineering, geomechanics, soil-water-structure interaction, sediment mobility



Inaugural professorships

Bill Davids has been appointed the inaugural Russell S. Bodwell Distinguished Professor, and Andy Goupee has been appointed the first Donald A. Grant Professor of Mechanical Engineering.

Davids, a professor of civil and environmental engineering, joined UMaine in 1998. He received a bachelor's and a master's of civil engineering from UMaine in 1989 and 1991, respectively, followed by a Ph.D. from the University of Washington in 1998. He worked as a structural engineer for Sverdrup Corporation from 1991–94. Davids recently completed a nine-year term as chair of the Department of Civil and Environmental Engineering. The professorship was created by Russell S. Bodwell, UMaine civil engineer Class of '44, who went on to found the engineering firm Henderson and Bodwell.

Goupee is an associate professor of mechanical engineering. He received a bachelor's, master's and Ph.D. in mechanical engineering from UMaine in 2003, 2005 and 2010, respectively. He also worked as a research engineer for the Advanced Structures and Composites Center from 2010–14. Goupee joined the UMaine faculty in 2014. The professorship was created in honor of department chair emeritus Donald Grant, who taught at the University of Maine from 1956–2020. Goupee was one of Grant's students. ◆

Dagher receives first Academic Pioneer Award from American Composites Manufacturers Assn.

Habib Dagher, executive director of the University of Maine Advanced Structures and Composites Center, is the inaugural recipient of the 2021 Academic Pioneer Award from the American Composites Manufacturers Association (ACMA). Dagher and the Advanced Structures and Composites Center team were honored in person at ACMA's Membership Awards Ceremony and Reception on Oct. 18 in Dallas.

New in 2021, the Academic Pioneer Award recognizes individuals in academia with original, visionary and innovative ideas that have been scientifically investigated, tested and demonstrated to advance composites technology.

"I am humbled and honored to have been selected as the first recipient of the Academic Pioneer in Composites Award from the ACMA," Dagher said. "This award belongs to the exceptionally talented team of faculty, staff and thousands of students who have worked at the Advanced Structures and Composites Center over the past 25 years. One of our core values at the center is teamwork, that none of us is as smart as all of us, and this award is for the ASCC team."

The Academic Pioneer Award recognizes Dagher's leadership in advancing next-generation composite materials that are lighter and more durable, with a smaller carbon footprint. Examples include the award-winning composite arch bridge system known as Bridge in a Backpack, the commercialized composite bridge girder system known as GBeams, the Modular Ballistic Protection System that has been fielded by the U.S. Department of Defense, the Mark V.1 U.S. Navy Seals all-composites vessel, and the patented VolturnUS floating wind turbine technology that has attracted over $150 million in private and public investment. ◆

Gårder edits International Encyclopedia of Transportation volume

Internationally recognized traffic roundabout expert Per Erik Gårder, a University of Maine professor of civil and environmental engineering, has edited "Transportation Safety and Security," one of seven volumes in the 2021 edition of the International Encyclopedia of Transportation published by Elsevier.

The encyclopedia, which includes more than 600 articles, incorporates diverse views on nine themes related to modern-day transportation: Transport Modes; Freight Transport and Logistics; Transport Safety and Security; Transport Economics; Traffic Management; Transport Modelling and Data Management; Transport Policy and Planning; Transport Psychology; and Sustainability and Health Issues in Transportation.

As the safety and security volume editor, Gårder commissioned more than 100 articles from diverse scholars to offer an interdisciplinary cross-section that incorporates the latest safety findings from the fields of engineering, operations research, human factors and sociology. International researchers representing varied social perspectives contributed to the encyclopedia to facilitate innovative problem-solving and to delineate global best practices in transportation safety.

Gårder also contributed three articles to the encyclopedia: "Planning for Safe and Secure Transport Infrastructure," "Bridge Safety" and "Nominal Safety," and drafted the introduction to the volume he edited.

The volume will be the go-to reference material for researchers and practitioners, and editing the safety and security volume of the encyclopedia reflects Gårder's stature as a leading global scholar, says Shaleen Jain, chair of the UMaine Department of Civil and Environmental Engineering. ◆

HELPING MAINE GROW A DIVERSE, EQUITABLE WORKFORCE

In 1989, the Margaret Chase Morrill '43 Civil Engineering Scholarship Fund was established at the University of Maine Foundation in honor of Margaret Chase Morrill, UMaine's first female civil engineering graduate.

Christine Born Johnson, Class of 1982, B.S. Civil Engineering, consistently contributed to this endowed fund since it was initiated by emeritus professor and provost John Alexander with an unrestricted gift from a grateful parent. Johnson retired from a successful career in the telecommunications industry, and serves as president of the Portland Club of UMaine Alumnae. Johnson also is an incorporator member of the University of Maine Foundation and a member of the Stillwater Society.

One of the goals of the UMS TRANSFORMS campaign is to double the number of degrees granted in engineering, computing and information science to provide the technical workforce and innovations that are critical to moving Maine's economy forward. Scholarships to recruit and retain underrepresented groups such as women in engineering, computing and information science help Maine grow a more diverse and equitable workforce. Public and private investments in these disciplines across the University of Maine System will help to garner a $75 million match from the Harold Alfond Foundation.

For more information about giving to the UMS TRANSFORMS campaign, please contact Patricia Cummings, Diane Woodworth or Matt Mullen at the University of Maine Foundation, **800.982.8503 or 207.581.5100.**

"My UMaine engineering degree prepared me well to analyze problems and find solutions, which led me to an interesting and well-paid career. One in 10 of my engineering classmates was a woman, now it is one in four. We can still do more to encourage women to pursue engineering and computing as a way to take on challenges and innovate solutions in a wide range of industries to best meet the needs of our society."

Christine Born Johnson '82

UNIVERSITY of MAINE FOUNDATION

Two Alumni Place
Orono, ME 04469-5792
207.581.5100 or 800.982.8503

75 Clearwater Drive, Suite 202
Falmouth, ME 04105-1445
207.253.5172 or 800.449.2629

umainefoundation.org • umainefoundation@maine.edu • umaine.edu/transforms

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College of Engineering
5796 AMC, Room 200
Orono, ME 04469-5796

CHE ACADEMIC EXCELLENCE

Chemical engineering sophomore Ingrid Plant of Hampden, Maine is one of 131 UMaine Pulp and Paper Foundation scholarship recipients enrolled at the university this academic year. ◆