The Trend in

ENGINEERING

UNIVERSITY OF WASHINGTON COLLEGE OF ENGINEERING NEWSLETTER / **SPRING 2020**

FROM THE **DEAN**

I hope this message finds you and your loved ones healthy and well. In this uncertain time, I am grateful for our engineering community and the ways we are supporting each other while applying our engineering skills to one of the greatest challenges our society has ever faced.

Across the College, researchers have pivoted — in some cases literally overnight — to apply ongoing and pre-existing work to the fight against COVID-19, while others immediately went to work on new projects. As I write, engineering labs and makerspaces are being used to 3D print face masks and test materials for protective equipment for frontline health-care workers. Our community has been volunteering, donating supplies and partnering with UW Medicine. A few of these projects are highlighted in this issue, and you'll hear about many others in the coming months.

As you are aware, we have moved to remote instruction. Our instructors have handled this challenge impressively. In a short amount of time they have shared resources, adapted, adjusted, iterated and innovated — in short — they have been outstanding engineers. You may wonder how engineering education goes remote. Our fantastic faculty have developed new ways to deliver high-quality instruction, including mailing at-home lab kits to students and utilizing video to demonstrate hands-on ideas and projects. While we are eager for the days of in-person collaboration, we and our students are learning new approaches and skills that will serve us well in the future.

Times of challenge remind us of our mission to develop outstanding engineers and ideas that change the world. Thank you for being a part of our community. Together we will get through this.

Nancy Allbritton, Ph.D., M.D.
Frank & Julie Jungers Dean of Engineering

2020 Diamond Awards

The College of Engineering honors eight alumni and friends for their outstanding achievements.

Allen D. Israel '68 B.S. Mechanical Engineering; '71 MBA; '78 J.D.
Principal, Foster Garvey PC
DEAN'S AWARD

James "Jim" Skaggs, '59 B.S. Mechanical Engineering
CEO and Chairman, Aminex Therapeutics
DISTINGUISHED ACHIEVEMENT IN INDUSTRY

Jane Grande-Allen, '98 Ph.D. Bioengineering
Professor and Chair, Bioengineering, Rice University
DISTINGUISHED ACHIEVEMENT IN ACADEMIA

Greg Newbloom, '11 M.S., '14 Ph.D. Chemical Engineering
Founder and CEO, Membrion, Inc.
ENTREPRENEURIAL EXCELLENCE

Scott Roberts, '74 Ph.D. Chemical Engineering
Retired Vice President, Royal Dutch Shell
and
Catherine Roberts
Co-Founder, Rutherford B.H. Yates Museum
DISTINGUISHED SERVICE

Armon Dadgar, '11 B.S. Computer Science & Engineering
Co-Founder, Co-CTO, HashiCorp
and
Mitchell Hashimoto, '11 B.S. Computer Science & Engineering
Co-Founder, Co-CTO, HashiCorp
EARLY CAREER

Learn more about the individual accomplishments of the 2020 Diamond Award winners at engr.uw.edu/da

Eric Klavins appointed as Electrical & Computer Engineering chair

An electrical and computer engineering (ECE) faculty member since 2003, Eric Klavins is a dedicated educator, receiving the Faculty Innovator Award in Teaching and Learning from the College of Engineering for his work in course development and undergraduate research.

As the director of the Center for Synthetic Biology and the Biofabrication Center, Klavins fosters meaningful partnerships across campus and with industry. As a scientific advisor to two UW-based startups, he has helped build a culture of entrepreneurship in research and education.

In research, Klavins develops synthetic biological systems. His work focuses on genetic circuits, protein engineering, mathematical modeling and laboratory automation. He is the recipient of many professional honors, including an NSF CAREER Award, an Allen Distinguished Investigator Award, an Innovation Award from the UW, an Amazon Catalyst Fellowship and a CoMotion Innovation Fund Award.

Julie Kientz named Human Centered Design & Engineering chair

A faculty member for more than 12 years, Julie Kientz has demonstrated commitment to diversity and mentorship, working to reduce bias in hiring and ensuring inclusive representation on committees. As a leader and advocate for Human Centered Design & Engineering (HCDE), she helped to create both the HCI+D master's program and the Global Innovation Exchange's (GIX) masters of Technology Innovation.

Kientz has served as HCDE's interim chair since September; during that time she co-led the department's strategic planning and visioning process.

In her Computing for Healthy Living and Learning Lab, Kientz focuses on understanding and reducing the user burdens of interactive technologies for health, education and families. Her many honors include a NSF CAREER Award, MIT Technology Review Innovator Under 35, and she has received awards from the College of Engineering for excellence in both research and in teaching.

Steve Kramer Elected to National Academy of Engineering

Civil and environmental engineering professor Steve Kramer has been elected to the National Academy of Engineering, one of the highest professional distinctions in engineering. The academy recognizes individuals who have made outstanding contributions to the field of engineering, from research to practice to education.

Kramer was elected for contributions to geotechnical earthquake engineering including liquefaction, seismic stability and seismic site response. During his 36-year tenure at UW, he has been involved with national and international research efforts and has made research advancements in the areas of liquefaction, seismic slope stability and dynamic soil behavior. Locally, he co-led a study that documented the seismic vulnerability of the Alaskan Way Viaduct and Seattle seawall about 25 years ago.

Kramer is the author of *Geotechnical Earthquake Engineering,* widely recognized as seminal to the industry and responsible for developing the study and practice of earthquake engineering around the world.

HCDE celebrates 30 years

From Technical Communication to Human Centered Design & Engineering (HCDE), the department is celebrating 30 years. Since 1989, the department has graduated 1,770 alumni who have gone on to careers in areas such as technical communication, usability analysis, interaction design, and user experience research and design.

Learn more at **hcde.uw.edu/designing-up/2020/30-year**

For more on the College of Engineering's growing response to COVID-19, visit **engr.uw.edu/coronavirus-information**

Harborview Medical Center Emergency Department nurses wear face shields that resulted from a broad UW collaboration. Photo by UW Medicine

From innovation to delivery

By Brian Donahue and Jackson Holtz

Across campus, 3D printers have been running around the clock to print face shields for health-care workers.

In March, when local craftsman Tim Prestero contacted UW Medicine with an idea and a sense of urgency that matched the health system's needs and the UW's innovative spirit, a speedy cross-campus collaboration went into effect almost immediately.

Prestero was 3D printing horseshoe-shaped strips of plastic as cradles for face shields to protect front-line caregivers from COVID-19. He shared his three-piece prototype — cradle, transparent shield and elastic band — with UW Medicine. A unique feature of his design is that the cradle's prongs accept 8.5×11-inch transparencies like those found at office supply stores. These transparencies become face shields with enough vertical cover that, when properly disinfected, allow nurses to wear the fabric masks that cover their mouth and nose for a whole day instead of just one patient visit.

UW Medicine began to expedite the device's regulatory approval and reach out to 3D printing sites across campus. Labs and makerspaces started printing and assembling the face shields. Much of this work has taken place through the Center for Digital Fabrication, Solheim Additive Manufacturing Lab and residence hall makerspaces. In the College of Engineering, faculty and staff in computer science and engineering and mechanical engineering in particular have been leading these efforts.

Front-line clinicians have been wearing the face shields. "People at the hospital are very excited about them," says Harborview Emergency Department nurse Amy Leah Potter. "We can wipe them clean and let them dry, but we can also change [the transparencies] out if they get scratched or damaged, so it's a lot more reusable. It's incredibly impressive that somebody came up with this to allow us to do our jobs better."

Juggling childcare and remote life

UW researchers are beginning a national study to help families discover technology that helps them successfully navigate home-based learning and combat social isolation. The team has recruited 30 diverse families with children ages 3 to 13 across the country. Each is participating for about 30 minutes a week during the 10-week study. Families will reflect on how the technology they use helps or hinders their lives. In the later part of the study, families will help design new or redesign existing technologies and test prototypes. Most of these activities will be completed as a family, though there may be some caretaker- or child-only activities as well. The researchers will share their results as the study progresses.

Keep up with the project: **medium.com/families-and-tech**

Researchers need your (digital) coughs

For anyone looking for a way to help during the coronavirus pandemic while adhering to stay-at-home and social distancing orders, researchers at the Paul G. Allen School of Computer Science & Engineering have a task for you. The team is developing an app that will allow health organizations to monitor coughs from self-quarantined COVID-19 patients at home. Right now, the researchers need to train the app to recognize coughing sounds, so they are asking for participants who can complete a 15-minute survey to collect coughs and other vocalizations. Participants of all ages are welcome. For the best results, please use a computer or laptop instead of a smartphone or tablet.

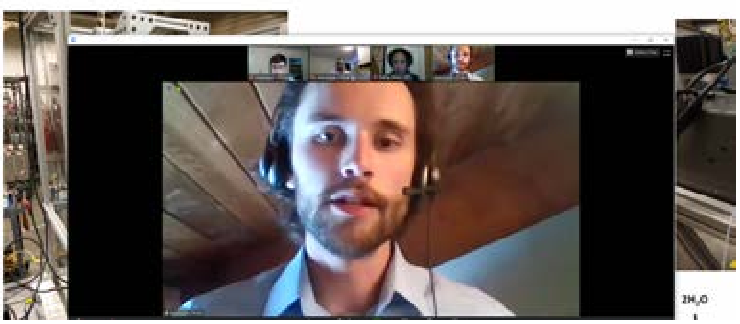
Take the survey: **bit.ly/2UuV5uA**

Student innovation

Virtually and in-person, engineering teams impressed at this spring's health and environmental innovation showcases.

Student teams redefined the term "showcase" at the all-virtual 2020 Alaska Airlines Environmental Innovation Challenge in April as campus activities were moved online. The event, hosted by the UW Foster School's Buerk Center for Entrepreneurship, utilized virtual meeting rooms to connect nearly 200 students and judges. First place went to Aquagga — a team of UW and University of Alaska-Fairbanks mechanical engineering students — for its bolt-on water treatment platforms that destroy toxic water contaminants. Chemical engineering team ElectroSolar Oxygen placed second for developing a sustainable way to produce oxygen from sunlight so clinics in low-resource countries can access oxygen supplies.

Aquagga won a Grand Challenges Impact Lab Best Idea prize, as did Aroyga, a bioengineering team developing an electricity-free washing machine and dryer. And ChocoLED — a materials science and engineering student team — took home a Connie Bourassa-Shaw Spark prize for using cocoa beans to synthesize light emitters in lighting displays.



Mechanical engineering graduate student Brian Pinkard pitches Aquagga during the 2020 Alaska Airlines Environmental Innovation Challenge (EIC) held in an all-virtual format. Image courtesy of Buerk Center for Entrepreneurship

At the Hollomon Health Innovation Challenge in March, bioengineering team Concentric tied for the second place with their portable screening device for corneal disease. Third place went to Spira, an Allen School student team that created a way to screen for respiratory disease using machine learning. Spira also captured the Kent & Lisa Sacia Digital Health Prize, which goes to health applications likely to be used in practical healthcare situations. Judges awarded the Timmie & Jim Hollomon Best Health Impact Prize and Connie Bourassa-Shaw Spark Award to ElectroSolar Oxygen as well.

Preparing for launch

By Amy Sprague

The A&A CubeSat Team gets ready to send its first satellite into space.

Aeronautics & Astronautics (A&A)'s CubeSat Team has secured a spot in the NASA CubeSat Launch Initiative with their device SOC-i. This is a first for the team, which was founded just two years ago.

A CubeSat is a small satellite — about the size of a loaf of bread — used to carry research projects into space. NASA will assign each selected CubeSat to a planned spaceflight mission. After launch, CubeSats will be released into orbit from a launch vehicle or the International Space Station.

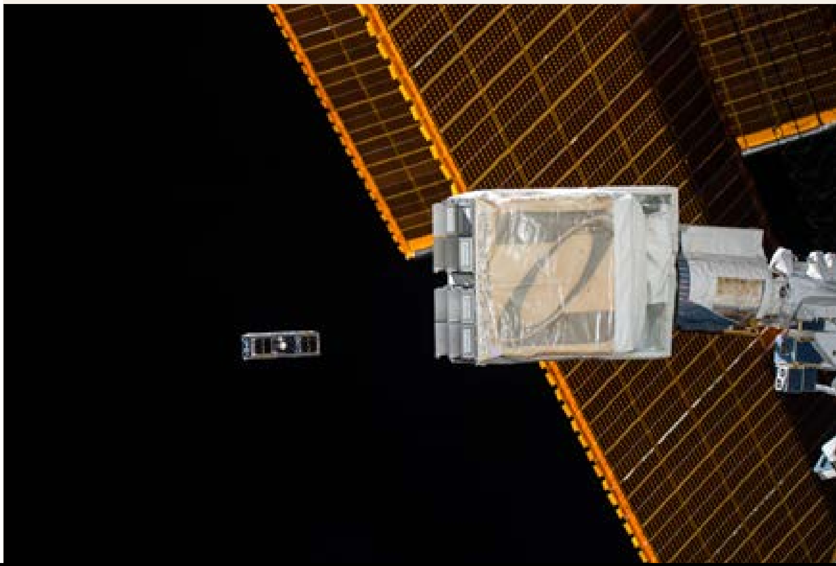
"This award is equivalent to a monetary value of $300,000," says A&A graduate student and team co-lead Charlie Kelly. "NASA will provide all of our launch integration services and effectively guarantee SOC-i a ride to space between 2021 and 2023."

The mission of A&A's CubeSat — the Satellite for Optimal Control and Imaging, dubbed "SOC-i" with a nod toward the Pacific Northwest salmon — will be to demonstrate that it can satisfy two constraints with its orientation control and imaging systems: SOC-i's on-board software will orient its navigation sensors toward the sun at all times for accurate positioning, while keeping its cameras out of the sun to avoid lens damage.

SOC-i follows on the heels of HuskySat-1, which was designed by UW Earth & Space Science's Husky Satellite Lab and deployed on January 31, 2020.

Keep up with the team online at aact.space.

A CubeSat being deployed in space. Photo by NASA



QUANTUM EDGE

THROUGH STRATEGIC PARTNERSHIPS AND THE QUANTUMX INITIATIVE, THE UW AIMS TO BE A LEADER IN THE COMING QUANTUM AGE.

By Sarah DeWeerdt

In October 2019, Google scientists announced they had achieved a long-awaited technological benchmark known as quantum supremacy: They had built a quantum computer capable of performing a calculation that a classical computer could not.

Google's rivals, notably IBM, questioned this claim. "But we're right on the cusp of this tipping point," says Jim Pfaendtner, chemical engineering chair and Associate Vice Provost for Research Computing at the UW. "If it didn't happen in October, it's going to happen soon. And that will just begin to open up a whole world."

A classical computer uses strings of 0s and 1s – binary digits, or bits – to perform calculations. A quantum computer uses quantum bits, or qubits. These represent information in superposition, meaning in multiple states at the same time – such as a digit that is simultaneously 0 and 1. In theory, this gives quantum computers the ability to solve problems that would take too long for classical computers to solve: cracking fiendishly difficult codes, sifting through molecular formulas to identify materials useful for clean energy applications and designing cancer drugs from scratch.

Laying the groundwork

The UW aims to be a scientific leader of the coming quantum age. Pfaendtner co-chairs the steering committee of QuantumX, a UW initiative to stimulate research and teaching on "quantum everything," as Pfaendtner puts it: computing, information science, materials and so on.

The University is also part of the Northwest Quantum Nexus (NQN), a partnership with Microsoft and the U.S. Department of Energy's Pacific Northwest National Laboratory (PNNL). NQN launched in spring 2019 and aims to boost the region's economy by attracting scientists, large-scale funding and scientific collaborations in quantum fields to the area.

The UW's strengths in photonics, materials science, physics and electrical and computer engineering give it an edge in pursuing quantum science. Resources such as the Washington Nanofabrication Facility also help, as does the College of Engineering's culture of interdisciplinary collaboration.

"We see our role as not only the science and engineering research, but also workforce development – the training component. That's what we do best."

Jim Pfaendtner, UW Associate Vice Provost for Research Computing

To program a quantum computer, "You have to come up with entirely new ways of writing software," Pfaendtner says. "And often that must be done within the context of the material that it's made out of. So it's an interdisciplinary problem."

Mo Li, co-chair of the QuantumX steering committee and associate professor of electrical and computer engineering and physics, agrees, "My work definitely involves multidisciplinary collaboration." He is working on quantum transduction, the transfer of information between different types of qubits.

"All of these qubits have their pros and cons," says Li. Some only work at temperatures close to absolute zero, others require very large devices, and so on. "In the future, comprehensive quantum systems probably will involve many [types of qubits]." Li must get them to communicate reliably and efficiently. Specifically, he's developing a mechanical device to aid transduction between superconducting qubits that work at low temperatures and microwave frequencies and optical qubits that work at room temperature and use visible light.

On the optical qubit side, Li is collaborating with Kai-Mei Fu, co-founder of the QuantumX steering committee and an associate professor of electrical and computer engineering and physics. Fu works with qubits that take the form of extremely tiny aberrations, called defects, in ultra-pure diamond crystals. These defects can store information and emit photons that can transmit quantum information, helping to ensure secure communications.

The problem is that Fu's defects only emit the right kind of photons about 3% of the time. Designing a different defect that is more reliable would require simulating countless quantum mechanical interactions inside the diamond crystal. "So ideally you'd be using a quantum computer to do this," Fu says. "But we don't have a quantum computer. If we did, then we'd have the material [that we need] already!"

Fu laughs. "So it's a little bit of a Catch-22 right now. But we're making a lot of progress."

Expanding research and job training

There's lots of basic science to be done in quantum fields. Professor of materials science and engineering and physics Xiaodong Xu is searching for new materials and exploring their quantum properties. Two years ago, he and his team discovered a material that, just a few layers of atoms in thickness, functions as a magnetic semiconductor. Materials with such properties could one day revolutionize cloud computing by enabling both data storage and processing – reducing the size and energy consumption of data centers while increasing their speed.

"I think the exact material we discovered probably will not yet be useful in terms of daily life," Xu says. It only works at extremely low temperatures and is not stable in ambient conditions. "But the principle we demonstrated can be useful." In addition, this type of material can be used to create topological qubits, one option for building a quantum computer.

With plenty of room for such theoretical explorations, the UW's quantum science efforts have a practical and pragmatic side as well. "We see our role as not only the science and engineering research, but also workforce development – the training component," Pfaendtner says. "That's what we do best." That means streamlining graduate education and beefing up undergraduate curriculum. Eventually, the goal is also to develop retraining programs, so that established electrical engineers and computer programmers can add quantum skills to their resumes.

Exactly how all that will be rolled out as part of QuantumX and NQN is uncertain for now. You might say these nascent efforts are currently in a state of superposition. "Anything could happen," Pfaendtner says.

But he expects it to happen fast. "In three to five more years, we'll be able to look back at this year and next year as the ones that were really key."

Support UW Engineering's leading-edge research activities with a gift to the Dean's Fund for Excellence:
giving.uw.edu/engineering-excellence

Exploring the CHANGIN

THE CRITICAL CONNECTION BETWEEN MELTING SEA ICE, POWERFUL WAVES AND ERODING COASTLINES HAS BEEN MISSING FROM ARCTIC RESEARCH. CIVIL AND ENVIRONMENTAL ENGINEERING RESEARCHERS WANT TO FILL THIS KNOWLEDGE GAP.

“Before this we had no coastal observations and limited observations of waves and ice. The Arctic became a natural laboratory for us.”

CEE assistant professor Nirnimesh Kumar

By Brooke Fisher

Photos by John Guillote / OnPoint Outreach

G ARCTIC

Information about the role that waves play in the changing Arctic is rolling in, so to speak, after UW researchers spent a month at sea collecting data.

"It was a successful trip. We measured some sizeable waves in November, which were very late in the season," says civil and environmental engineering (CEE) associate professor Jim Thomson, an oceanographer at the UW Applied Physics Laboratory. "The big waves were coming right at the coast and we think it's changing the coastlines. It was remarkable to quantify that."

On the cover: The research vessel Sikuliaq breaks a path through sea ice.

Previous pages: The vessel prepares to set up for an ice station, which allows researchers to walk on the sea ice to collect samples and drill small holes in the ice to measure thickness.

This page: Researchers take measurements in pancake ice – round disks formed as waves pack together ice crystals.

Opposite page: Researchers prepare to recover and deploy buoys.

The critical connection between melting sea ice, increasingly powerful waves and eroding coastlines has been missing from existing research in the Arctic. To help fill this knowledge gap, a team of researchers including Thomson and CEE assistant professor Nirnimesh Kumar set sail aboard the Sikuliaq, a research vessel from the University of Alaska Fairbanks, in November.

"Before this we had no coastal observations and limited observations of waves and ice," Kumar says. "The Arctic became a natural laboratory for us."

By taking a closer look at the interactions between waves and sea ice and how they contribute to coastal erosion and flooding, the researchers hope to improve the accuracy of climate models, which can be used to inform more strategic climate policy decisions. The researchers are midway through a three-year Coastal Ocean Dynamics in the Arctic (CODA) project, funded by a $1 million grant from the National Science Foundation's Office of Polar Programs.

Pressing problem: Coastal erosion

The role waves play in the erosion of Arctic coastlines is directly related to diminishing sea ice, which is at record low levels, according to the researchers. Sea ice has historically helped to protect the coast from powerful waves and turbulent storms, as more open water can lead to stronger waves as the distance over which the waves travel increases.

"The waves lose energy in the presence of ice when they interact, which is what we were interested in looking at," Kumar says.

With stronger storm systems and associated waves becoming increasingly common, Arctic coastlines are eroding at rates of meters per year. Problems are already starting to impact the local communities that reside along the coast of Alaska, where subsistence hunting and fishing is prevalent.

As part of the project, a small team of researchers visited villages in Alaska last year to present their proposed research to the community and visit schools for K-12 outreach.

"Part of this is to hear from them about the changes they are seeing and learn from them," Thomson says. "They [native Alaskans] talk about it all the time. There is a lot less ice and what ice remains is poor quality, not the kind of thing they can drive snowmobiles on or walk on. There are big changes in the fish that they see and trouble with subsistence hunting; it is affecting them in very day-to-day kinds of ways."

Gathering data at sea

With temperatures as low as minus 15 degrees Celsius, which is relatively warm by Alaska standards, the researchers collected data at three primary sampling sites: Icy Cape, Flaxman Island and Jones Island, located along the northern coast of Alaska where the Beaufort Sea meets the Arctic Ocean. At each site, samples were collected at specific distances from the coast.

"These sites were representative of the coastline that we want to study and the larger system," Thomson says. "We were far enough away from subsistence hunting to not interfere with the local populations."

The 10 members of the research team took turns being "on watch" for eight-hour shifts. They continuously monitored equipment and collected data using custom instrumentation, including autonomous buoys equipped with cameras, built by Thomson's group at the UW Applied Physics Laboratory.

The researchers measured waves, turbulence and also quantified ice concentrations after scooping up pieces of ice from the water. They also collected data from satellite images that showed ice extent and collaborated with the U.S. National Ice Center, which provided daily updates on ice levels. Not surprisingly, conducting research in extreme conditions had its challenges.

"The buoys started to become ice balls," Thomson says. "We had to do a lot of repeat deployments to de-ice them and put them back in the water."

Forecasting the future

Back on dry land, the researchers are now analyzing data to better understand how waves gain and lose energy depending on ice coverage. They are contributing to an open source modeling system, using test cases for the northern Alaska coastal zone to forecast future conditions and enhance climate scenario assessment and related policymaking.

"We will incorporate waves and ice and have that all in one framework to make better forecasts," Thomson says. "These were treated separately in the past."

Next fall, the researchers plan to conduct more analysis in the Arctic. Same ship, same region, different data.

Watch the researchers discuss the technology they used to capture data, give ship tours and more: iceinmotion.com/live

INTRODUCING AuraRing

The ring and wristband combination is a tracking system that uses magnetic fields to report precise finger movement.

By Sarah McQuate

With continuous tracking, AuraRing can pick up handwriting — potentially for short responses to text messages. Photo by Dennis Wise / University of Washington

UW researchers have created AuraRing, a ring and wristband combination that can detect the precise location of someone's index finger and continuously track hand movements. The ring emits a signal that can be picked up on the wristband, which can then identify the position and orientation of the ring — and the finger it's attached to.

"We wanted a tool that captures the fine-grain manipulation we do with our fingers — not just a gesture or where your finger's pointed, but something that can track your finger completely," says Eric Whitmire, who completed this research as a doctoral student at the Paul G. Allen School of Computer Science & Engineering.

AuraRing could help people send messages on smartphones, play games and more, the team says.

"Because AuraRing continuously monitors hand movements and not just gestures, it provides a rich set of inputs that multiple industries could take advantage of," says Allen School and electrical and computer engineering professor Shwetak Patel. "For example, AuraRing could detect the onset of Parkinson's disease by tracking subtle hand tremors or help with stroke rehabilitation by providing feedback on hand movement exercises."

AuraRing is composed of a coil of wire wrapped 800 times around a 3D-printed ring. A current running through the wire generates a magnetic field, which is picked up by sensors on the wristband. Based on what values the sensors detect, the researchers can determine where the user's finger is located.

"To have continuous tracking in other smart rings you'd have to stream all the data using wireless communication. That part consumes a lot of power, which is why a lot of smart rings only detect gestures and send those specific commands," says electrical and computer engineering doctoral student Farshid Salemi Parizi. "But AuraRing's ring consumes only 2.3 milliwatts of power, which produces an oscillating magnetic field that the wristband can constantly sense. In this way, there's no need for any communication from the ring to the wristband."

With continuous tracking, AuraRing can pick up handwriting — potentially for short responses to text messages — or allow someone to have a virtual reality avatar hand that mimics their actual hand. Because AuraRing uses magnetic fields, it can track hands even when they are out of sight, such as when a user is on a crowded bus and can't reach their phone.

"We can also easily detect taps, flicks or even a small pinch versus a big pinch," Salemi Parizi says. "This gives you added interaction space. For example, if you write 'hello,' you could use a flick or a pinch to send that data. Or on a Mario-like game, a pinch could make the character jump, but a flick could make them super jump."

Beating heart tissue in space

By Leila Gray

Part of the Tissue Chips in Space program, this study measures how microgravity affects human heart muscle.

Space exploration takes a toll on the human heart — both cardiac function and rhythm can change. To learn how space affects heart muscle, a Tissue Chips in Space project launched to the International Space Station (ISS) in March.

The scientific payload consisted of compact devices, a bit larger than cellphone cases, holding beating heart tissue grown from stem cells. Two flexible pillars support the tissue, allowing it to contract freely.

The devices also house a novel invention from the UW, which automatically senses and measures the contractions of the tissues, reducing the time astronauts will need to spend on this study. The flexible pillars contain tiny magnets, explains mechanical engineering (ME) graduate student Ty Higashi, one of the inventors. When the tissue contracts, the position of the embedded magnets changes, and the motion can be detected by a sensor, he says. That information is then sent down to a laboratory on Earth.

The experiment ran aboard the ISS for a month before returning to Earth for further analysis. Next up: A related space-based experiment will test interventions that could offset potential changes in heart muscle during extended space missions.

"The space program is looking at ways to travel longer and farther," says ME professor Nathan Sniadecki, one of the project's leads. "To do so, they need to think about protecting their crews. Having treatments or drugs to protect astronauts during their travel would make long-term space travel possible."

ME graduate student Ty Higashi, left, and bioengineering postdoc Jonathan Tsui, center, work with researchers at NASA to prepare heart tissues for launch. Photo courtesy of Devin Mair

investigating FAKE news

By Sarah McQuate

Researchers study how people investigate potentially suspicious posts on their own Facebook and Twitter feeds.

It can be difficult to tell what's real and what's not on social media platforms. Users are encouraged to investigate potentially suspicious posts before engaging with them, but how do people do this?

"We wanted to understand what people do when they encounter fake news or misinformation in their feeds. Do they notice it? What do they do about it?" says Allen School associate professor Franziska Roesner.

Her research team watched 25 participants scroll through their Facebook or Twitter feeds while a Google Chrome extension secretly added debunked content on top of some of the real posts.

"We made sure that all the posts looked like they came from people that our participants followed," says Allen School doctoral student Christine Geeng.

Participants had various reactions to encountering a fake post: Some outright ignored it, some took it at face value, some investigated whether it was true, and some were suspicious of it but then chose to ignore it.

While this study was small, it provides a framework for how people react to misinformation on social media, the team says. Now researchers can use this as a starting point to seek interventions to help people resist misinformation in their feeds.

"There are a lot of people who are trying to be good consumers of information and they're struggling," Roesner says. "If we can understand what these people are doing, we might be able to design tools that can help them."

WHAT'S IN Puget Sound?

By Sarah McQuate

A new technique casts a wide net for concerning chemicals.

The waters of Puget Sound support many species, including mussels, salmon and killer whales. But researchers know that runoff from land in the urbanized areas might contain chemicals that could harm these creatures, even if it's not always clear which chemicals are the most harmful.

Existing methods track specific chemicals of known concern. Until recently, however, there was no way to find out what other potentially harmful compounds might be present in the water.

Using a new "non-targeted" approach, researchers at the UW and UW Tacoma screened samples from multiple regions of Puget Sound to look for other concerning chemicals.

"Our method allows us to detect hundreds to thousands of chemicals at once in a single sample. It determines a compound's mass really accurately," says Edward Kolodziej, an associate professor in civil and environmental engineering and UW Tacoma's division of sciences and mathematics.

The team identified 64 chemicals never detected before in this waterway. Eight chemicals were at potentially hazardous concentrations that will need further investigation:

- Two vehicle-related contaminants found in tires and other sources
- The antidepressant drug Venlafaxine
- Two herbicides, including an aquatic one used for controlling weeds and algae
- Two chemicals found in plastics
- A persistent, well-studied chemical called PFOS, known to be harmful to humans and animals

These chemicals were localized to specific "hot spots" in Puget Sound, and most of them weren't always present in different samples from the same site. This is in contrast to other chemicals found in almost all of the samples but deemed less of a concern, such as the artificial sweetener Splenda and a drug used to treat seizures and bipolar disorder.

The next step, the researchers say, is to dive into what these data mean for marine life in the nearshore, specifically in shellfish and salmon. The team also hopes to continue to investigate the eight concerning chemicals and better understand the hot spots.

"Everyone thinks chemicals hit the ocean and disappear because there's so much water in the ocean that the concentrations go way down," Kolodziej says. "But if you took the concentration of a chemical in wastewater effluent or storm water, it's not like you can just divide by total water volume of Puget Sound, and that's the concentration you'd detect in Puget Sound. The concentration in the nearshore is a lot higher because there hasn't been enough time for mixing to occur. So exposure levels for aquatic organisms in the nearshore can be much higher than you might expect."

Powering the future of transportation

By Owen Freed

UW energy storage researchers work with Nobel laureates to build a better battery for electric vehicles.

Billions of people rely on lithium-ion batteries to power devices like cellphones, laptop computers and pacemakers. The technology is one of the most influential inventions of our lifetimes, and its major innovators — John B. Goodenough, M. Stanley Whittingham and Akira Yoshino — were recognized with the 2019 Nobel Prize in Chemistry. But work is far from finished on the most pressing applications for these rechargeable batteries — electric vehicles. So, UW Clean Energy Institute researchers and Nobel laureates Goodenough and Whittingham are collaborating to build a better battery for electrified transportation.

In 2016, the U.S. Department of Energy formed Battery500, a national research consortium to build a smaller, lighter and less expensive lithium-based battery for electric vehicles. Five universities, including the UW, Whittingham's and Goodenough's home institutions, and four national laboratories are in the consortium led by the Pacific Northwest National Laboratory. Chemical engineering and materials science and engineering professor Jun Liu directs the program.

Battery500 aims to more than double the amount of energy that a lithium-based battery can store for its weight — the goal is a 500 watt-hours per kilogram (Wh/kg) battery that can be charged and discharged over 1,000 times. The consortium has made significant progress, creating 350 Wh/kg batteries that can be cycled over 200 times while maintaining acceptable levels of charge. By partnering with Goodenough, Whittingham and other scientists, the team hopes to achieve the next energy storage breakthrough.

A UW battery class hosts Stan Whittingham. Photo courtesy of the Clean Energy Institute

BREAKTHROUGHS

Advancing rocket engine fuel efficiency

Although a new rotating detonation engine promises to make rockets more fuel-efficient, lightweight and less complicated to construct and launch into space, currently it's too unpredictable to use. UW aeronautics and astronautics researchers have recently developed a mathematical model that describes how these engines work. Now, with this information, engineers can develop tests to improve these engines, making them more stable and usable.

Cells consult with neighbors

Scientists and physicians have long known that immune cells migrate to an infection site, which individuals experience as inflammation. Working with partners at Northwestern University, UW chemical engineering researchers have uncovered evidence that this gathering is not just a consequence of immune activation: Immune cells count their neighbors before deciding whether or not the immune system should kick into high gear.

Democratizing air pollution data

UW civil and environmental engineering researchers have helped launch a first-of-its-kind public database providing access to information about air pollution concentrations and economic damages. Available for free at www.cases.us, the database offers modeling and policy analysis tools that estimate various human health impacts from emissions.

Breaking the capillary barrier

The miniscule nature of capillaries — 10-50 times thinner than a strand of hair — has been a major obstacle in studying blood vessel diseases like malaria and sickle cell anemia. UW bioengineering, chemical engineering, biology and pathology researchers have collaborated on a design strategy that lets them engineer capillaries, finally breaking a key barrier in advancing this research. Using these capillaries, the team found key differences between how healthy blood cells and those infected with malaria behave.

Read more research **news at engr.uw.edu/news**

ACCELERATING Innovation

By Chelsea Yates

Through the UW's Jones + Foster Accelerator program, early-stage student startups grow their vision into sustainable companies.

A startup's first six months can determine whether or not it will survive. Conducting market research, producing a manufacture-ready prototype, licensing intellectual property, developing a solid business plan, engaging investors and building a customer base are just some of the steps involved in the beginning. It's a process that can be as messy and unpredictable as it is exciting and inspiring, and for those not fluent in business it can seem like an entirely new language.

For students who are serious about growing their ideas into companies, the Jones + Foster Accelerator Program has been an invaluable campus resource. Offered through the Arthur W. Buerk Center for Entrepreneurship in the Foster School of Business, the program provides mentorship and workshops to early-stage startups during those decisive first six months. Upon successful completion, each startup is eligible to receive up to $25,000 in seed funding.

For engineering students, this immersion into entrepreneurship can help propel their startups toward a sustainable future.

"Students come to the UW prepared to innovate and eager to solve society's grand challenges, yet helping them develop professionally as entrepreneurs is not a part of engineering curriculum," says College of Engineering Associate Dean of Academic Affairs Brian Fabien. "Therefore, programs like this one are essential for helping our students develop their entrepreneurial mindset, achieve their career objectives, get hands-on experience and mentorship, and make an impact on the community."

The Trend recently connected with members of two 2019-20 Accelerator teams, AeroSpec and Kadama, to learn how the program has helped move their technologies toward business.

AeroSpec: Real-time air quality analysis

A childhood friend with asthma inspired mechanical engineering (ME) doctoral student Jiayang (Joe) He to study air quality. Working in ME professor Igor Novosselov's lab, He developed a small wearable sensor to detect the composition and density of chemicals in the air — two factors that determine if air is clean or polluted.

Shortly after, He met Sep Makhsous, an electrical and computer engineering graduate student who had ideas for ways to make the sensor provide real-time feedback. That way, anyone wearing the device — which they named AeroSpec — could get immediate analysis of the air they were breathing.

Makhsous saw AeroSpec's market potential. They entered the Buerk Center's innovation competitions and were invited to pitch their product to the Accelerator for a coveted slot in the program. Eight teams were selected, including AeroSpec.

"With other innovation competitions, the goal is to demonstrate potential," Makhsous explains. "With the Accelerator, it's to create a sustainable company. You're not competing against other teams; you're competing against yourself."

Makhsous and He created undergraduate research positions to support device development, and they began rethinking their customer base. "Our original plan focused on individuals with specific health concerns, but once in the Accelerator we started considering who else might benefit," He says.

That exploration led them to manufacturing companies, where their device could be used to help monitor the air quality in factories.

Kadama: On-demand tutoring service

Before transferring to the UW in 2016 to complete his computer science degree, Amin Shaykho and his friend Marwan El-Rukby began working on an app to allow users to request and provide on-demand services like housework, yardwork and tutoring.

"It started as an idea for how college students could make extra money," Shaykho (BS CS '18) explains. "But we realized it could be much more — like Craigslist for service but faster and with background checks."

At the UW, Shaykho formed a team to develop and market the app, which he and El-Rukby named Kadama ("service" in Arabic). Like AeroSpec, they were accepted into the 2019-20 Accelerator cohort.

"It can be tempting to focus on the fun stuff and push back the challenges of a startup, but our dream to impact the community made us feel accountable," Shaykho says. "Our team is young — some are working our first full-time jobs, others are finishing bachelor's degrees — so there are lots of competing commitments. The program helped us prioritize projects, create team strategy and manage stress."

Once in the Accelerator, each team receives $1,000 for early-stage expenses and is matched with five to six experienced coaches — local entrepreneurs and investors who help students set measureable business milestones. Over the next six months, students meet regularly with their mentors, attend business development workshops and networking events.

"Setting milestones with our mentors was a game-changer," Shaykho reflects. "Our coaches helped us see the value in narrowing in on one market: tutoring. Current tutoring options can be expensive and difficult to schedule at times that work for students and parents, so we decided to focus on this service and get it right."

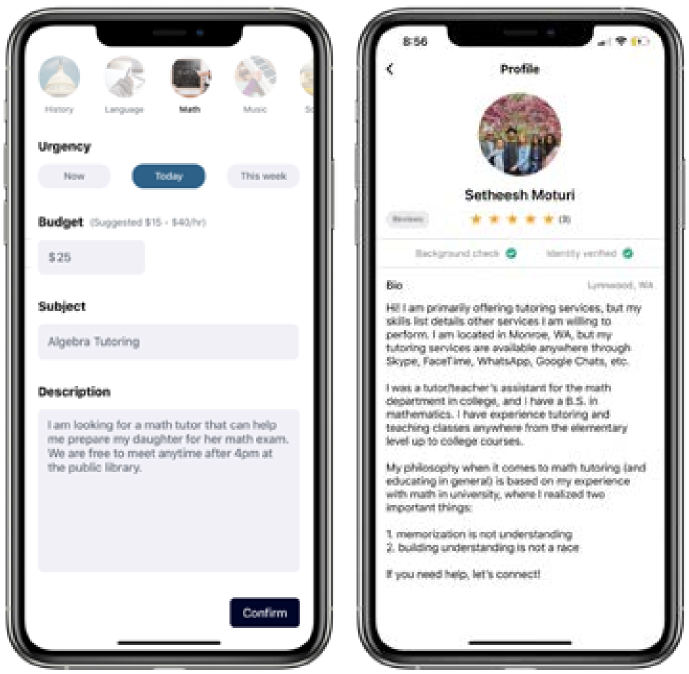
From idea to business

At the program's end, the Accelerator's committee determines if milestones have been met and the teams' coaches recommend if seed funding should be awarded.

Last month, AeroSpec and Kadama completed the Accelerator and each received $25,000 — the maximum award to grow their businesses.

AeroSpec plans to further test and refine their data analysis platform while working with The Boeing Company through UW CoMotion to pilot their device. Kadama plans to implement backend changes to accommodate more users. Eventually they want to expand to Android (currently the app is available for iPhones).

"Just three years ago we were students dreaming up an app and now we're living that dream and using it to help people in our community," Shaykho says. "This whole experience has been incredible!"



This page: Kadama allows users to request tutoring anytime at a price they're comfortable with. Requestors and tutors set and agree to payment, scope of work, timing and location using the fee-free app. Images courtesy of Kadama

Opposite page: AeroSpec is a small device equipped with sensors to detect the composition and density of chemicals in the air so individuals can receive immediate analysis of the air they're breathing. Photo by Mark Stone / University of Washington

FINDING the SWING

At the UW, graduate student Sam Kolovson has integrated her passions for sports and research through a project that aims to improve how college athletic programs use tracking technology.

In rowing, the feeling of being in nearly perfect synchronization is referred to as "swing" — everyone moves in unison, and the boat glides steadily, gracefully at top speed between the pulls of the oars. It requires determination and dedication for a team to achieve swing. It hinges on balance: If one rower pulls too hard or another falls out of rhythm, swing is broken.

Human Centered Design & Engineering (HCDE) doctoral student Samantha (Sam) Kolovson understands this well. As an undergraduate at the University of Massachusetts Amherst, she competed on the NCAA Division I Women's Rowing Team while pursuing her bachelor's degree in computer science. To do both well, she says, required balance.

Kolovson has maintained a focus on balance in her research at the UW, where she's exploring how tracking technology and data are used in college sports. Increasingly, college athletic programs are using wearable devices like Fitbits and WHOOP bands that can monitor students' steps, heart rates and sleep to keep their athletes competitive and healthy. However, Kolovson and her research team were concerned about the effect this could have on college athletes' privacy. So they've been working with athletes and coaching staff to better understand the implications of relying on tracking data and identify how to design more equitable tracking systems.

The Trend's Chelsea Yates recently spoke with Kolovson about this research and how being a student athlete helped set her up for success in it.

How did you balance being a computer science student and a competitive rower as an undergraduate?

In some ways, rowing and computer science were similar: Each presented me with difficult challenges, and overcoming them was so rewarding. The euphoria of finishing a race made me forget any pain I felt during it; similarly, the excitement of getting code to work made me forget spending an hour on it only to realize I was missing a semicolon.

But as a computer science major, I had tough classes. It was a lot to balance with 20 or so hours of rowing each week. Being a student-athlete provided structure and routine to otherwise loosely structured college life, which helped me plan time to work efficiently. I also spent time with my rowing teammates and friends, which gave me irreplaceable social, emotional and mental balance.

Tell us about your HCDE research. How did you get involved?

HCDE professors Kate Starbird, Sean Munson and David McDonald had begun exploring the use of tracking technology in college athletics before I arrived on campus. But they needed someone to lead it. Kate reached out to me to see if I'd be interested in working with them. Of course I was – I couldn't believe that an opportunity so aligned with my background and interests could exist!

To build the project, I started by defining research questions. I conducted a literature review, then designed a study and submitted the required paperwork for doing research with human subjects. I set up interviews with coaches and trainers. I also led a directed research group in which HCDE undergraduates and student-athletes worked together to design, conduct and analyze athlete interviews about the use of tracking data. We reported on interviews with 11 athletes and 11 staff members from three college athletics programs.

How has your experience as a student-athlete impacted this research?

I can really see both sides of it. I understand how this data can be beneficial, but I also see the potential pitfalls of collecting it. Giving trainers access to a student's step count, sleep patterns or heart rate can be helpful when an athlete's recovering from an injury. But it also might feel like an invasion of privacy. This raises questions about power dynamics; in some cases, students may not feel like they have a choice about sharing their data.

Athletic staff feel pressure to use tracker data to get a competitive edge, but this technology is so new that there aren't any best practices to follow. What our research team hopes to do is help athletic programs and athletes develop ways to use these systems that work for everyone.

What are some of your team's findings and recommendations so far?

We've learned that students aren't always aware they're providing data and that staff doesn't always communicate how they use the data they've collected. Also, data alone doesn't give a full picture of how athletes are feeling. We suggest that pitfalls may be avoided if staff review tracking data with athletes instead of using it privately or with other staff to make decisions, and if athletes have more say over how their data is tracked and used.

What's one of the biggest challenges in this work?

Being able to communicate our research to academic audiences and college athletic communities alike. The research community is familiar with human-computer interaction, and coaches and athletes know how college sports work, but these groups don't necessarily understand each other's worlds. So a lot of what I'm trying to do is translate our findings in ways that make sense to both.

Support graduate student research like Sam's by making a gift to the Dean's Fellowship Fund: giving.uw.edu/engineering-fellowship

Opposite page: HCDE graduate student Sam Kolovson draws from her experiences as an undergraduate rower to inform her doctoral research. Photos by Mark Stone / University of Washington

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