ZERINA KAPETANOVIC – AN OUTSTANDING ALUM

Recent UW ECE graduate Zerina Kapetanovic (Ph.D. '22) received this year's Yang Research Award for her dissertation focused on enabling low-power communication for environmental sensing systems.

THE UNIVERSITY OF WASHINGTON DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING'S ANNUAL MAGAZINE

THE INTEGRATOR

2022

ZAP ENERGY

ENGINEERING SUSTAINABLE FUSION ENERGY

QUANTUM CONNECTIONS

NEW GRADUATE CERTIFICATE IN QUANTUM INFORMATION, SCIENCE & ENGINEERING

ELECTRICAL & COMPUTER ENGINEERING

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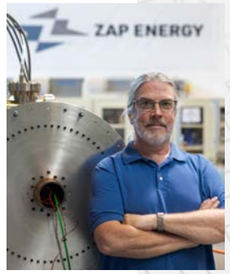

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Zerina Kapetanovic tests a radio experiment in the Chinook Bend Natural Area, outside of Carnation, Washington.

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The Integrator

MAGAZINE

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OUR MISSION

At UW ECE, we cultivate innovation and inspire through high-impact research. We educate and develop tomorrow's leaders to solve the world's most pressing challenges.

UW ECE's position as a top-ranked electrical and computer engineering department provides our faculty and student body with a vibrant learning culture. Students receive a robust education through a strong technical foundation, group project work and hands-on research opportunities. Our faculty work in dynamic research areas collaborating with academia, industry and government institutions.

UW ECE continues to lead in cutting-edge science and technology while advancing socially-responsible innovation. Our innovation ecosystem is critical in promoting an entrepreneurial mindset in our teaching, and is strengthened through diverse partnerships that address complex global challenges in health, energy, technology and the environment.

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LETTER FROM **THE CHAIR**

"UW ECE is making a positive and profound impact on our students, communities, nation and world."

— ERIC KLAVINS, PROFESSOR AND CHAIR

Dear UW ECE Community,

Our nation is beginning to move out of the COVID-19 pandemic and back to some sense of normalcy. So, despite continuing challenges and turbulent events on the national and world stage, UW ECE students, faculty and staff press on, finding innovative ways to collaborate and gather together. For example, this year, for the first time ever, we honored three classes at our annual Graduation Ceremony, welcoming back graduates from 2020 and 2021 to join the Class of 2022. The event was our first in-person Graduation Ceremony since 2019, and it featured UW ECE alumna Diane Jurgens as keynote speaker. You can read more about Diane and her outstanding career in this issue of The Integrator.

We have been reminded once again of the importance of innovation as we work toward a future where hybrid formats for most of our classes and events will be the norm. Signature events such as the Lytle Lecture Series already are presented both in-person and online. And many of our courses are now providing in-person experiences with virtual components. Enhancing even more events and courses with online features is on the horizon for us. Ongoing efforts in this area demonstrate our commitment to develop and implement technology to improve lives, widen access to education and form strong foundations for success.

We are also working hard to expand diversity, equity and inclusion at UW ECE. In cooperation with the UW College of Engineering's recently established Office of Inclusive Excellence, we successfully funded and implemented four DEI initiatives this year and welcomed Professor Denise Wilson as this year's Associate Chair for Diversity, Equity, and Inclusion. We continue to work with the College, University and our partners and collaborators in the community to establish new outreach programs and develop technology that includes and benefits all.

As I am sure you are aware, female engineers are underrepresented in our field; however, the cover story for this issue of The Integrator is about Zerina Kapetanovic, an outstanding alumna who recently graduated from UW ECE. Zerina is the recipient of this year's Yang Research Award, among several other distinguished honors, and she has secured a position as an assistant professor of electrical engineering at Stanford University. Her work and accomplishments are a shining example of the high caliber of our students and alumni.

Photo by Mark Stone | UW Photo

Establishing and maintaining academic excellence is one of the primary reasons why our Department attracts and retains exceptional students like Zerina. Read in this issue about recent advances in curriculum development for our bachelor's degree program. Plus, learn about a new graduate certificate program in quantum information science and engineering, which is being led by Professor Kai-Mei Fu. Students and faculty are also leveraging our academic excellence to make significant research advances, partnering with industry to lead the way toward finding solutions to some of the world's most pressing problems. Learn in these pages about Research Professor Emeritus Brian Nelson and his startup Zap Energy, which is building on UW research and employing students and alumni to develop a nuclear fusion reactor that promises to generate clean, affordable and sustainable energy.

2022 was a year marked by saying goodbye to old friends and welcoming new ones among our faculty. This year, we honored and celebrated the retirements of four longtime faculty members — Howard Chizeck, Bruce Darling, Yasuo Kuga and Ming-Ting Sun. All are leaders in their respective fields and leave a strong and moving legacy of impact and service. They will be greatly missed, but we wish them all the best for their future endeavors. Looking forward, I am excited to welcome seven new faculty hires who are experts in a wide range of areas such as quantum computing, mobile and wireless sensing, analog and digital circuit design, biosystems and wearable robotic devices, applied mathematics and data science, robotics and machine learning, and the development of technology-driven strategies for socio-economic development. These faculty represent some of the best new talent in the world, and I am very pleased that they have chosen to join our Department. You can learn more about them in the "Spotlights" section of this magazine.

UW ECE is making a positive and profound impact on our students, communities, nation and world. To our donors and alumni, I am very grateful for your continued engagement with and support of the Department, which helps to make possible many of the advances and accomplishments described in this magazine. As always, it is my honor to serve as Department chair. I look forward to continuing our work together developing the future of technology and the next generation of electrical and computer engineers.

Eric Klavins
Professor and Chair
UW Department of Electrical & Computer Engineering

Boeing student tour

UW ECE students Fernando Bejar Aguilera, Nakseung Choi, Moska Jamali, Kejin Li, Khoa Nguyen, Andrew Pan, Alyssa Vallester, Wenxuan Yang, Xuanlong Zhao; Department Chair Eric Klavins; and Boeing representatives Rohit Duggal and Angela Li pose for a photo inside of an aircraft cargo area during their tour of the Boeing facility in Everett, WA.

Text by Sharon Dana | UW College of Engineering

BOEING AND UW ECE HAVE A LONGSTANDING RELATIONSHIP, AND THANKS TO BOEING'S FOCAL PROGRAM, THAT RELATIONSHIP IS GROWING DEEPER AND STRONGER.

Angela Li, Boeing Executive Focal for UW ECE, is an alumnus and leads efforts to connect Boeing with the Department. Along with three deputy focals, also alumni, Angela and the team facilitate research connections, propose capstone projects, highlight hiring opportunities and arrange student engagement activities with Boeing geared toward UW ECE students and faculty.

Over the summer, Deputy Focal Rohit Duggal arranged a Boeing tour for nine UW ECE students. The students visited the Everett factory and the Boeing Electrical Systems Responsibility Center, where Boeing builds complex wiring bundles for production airplanes. Students also got a chance to learn over lunch about different ECE-related jobs and potential career paths at Boeing.

The team is sponsoring a capstone project for the 2022–23 academic year titled, "MBSE Threat Trees" and will connect with students throughout the year to provide career advice and share opportunities at Boeing.

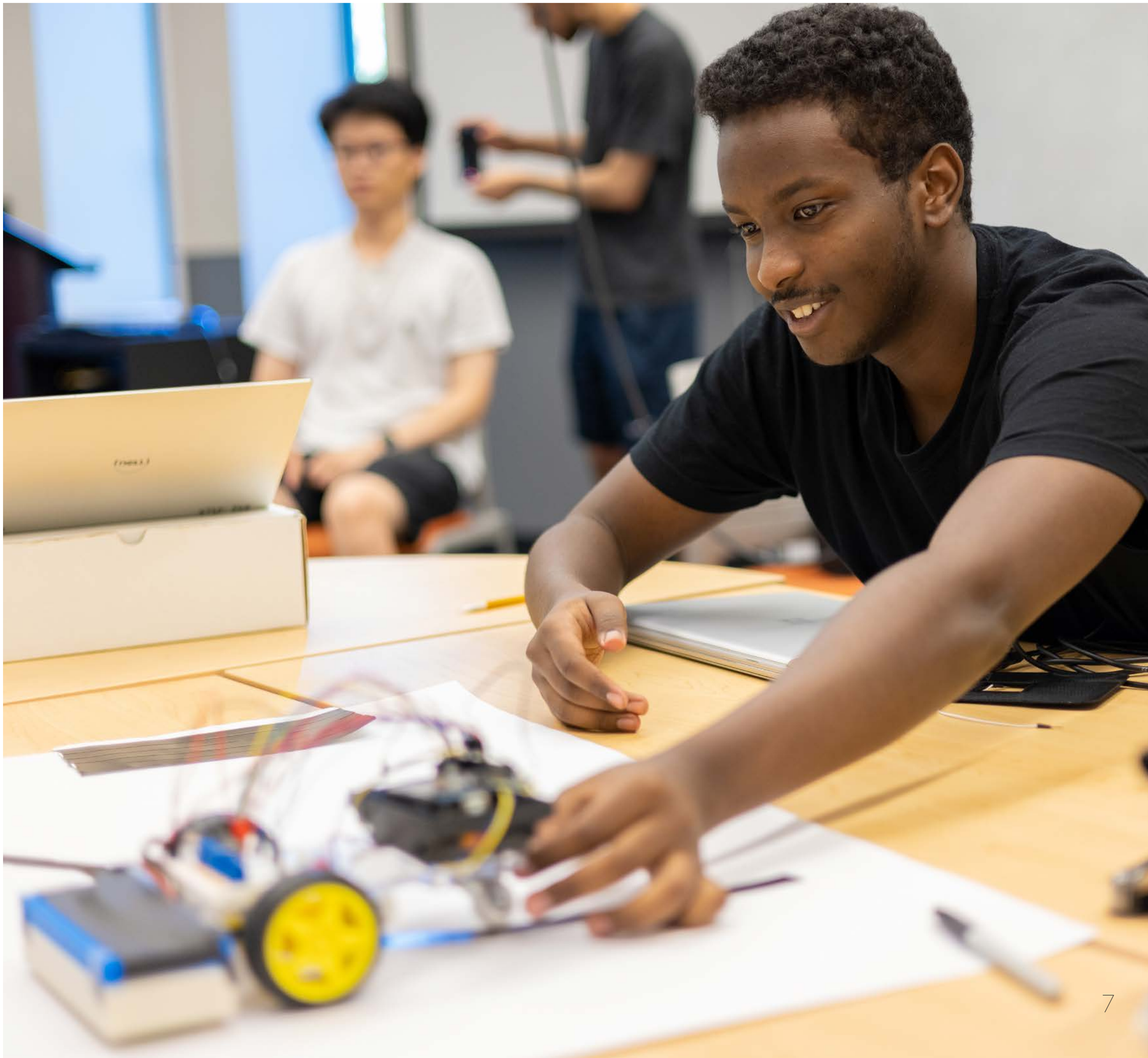
Photos by Craig Prince | Boeing

A new undergraduate degree program reflects cutting-edge research and provides greater flexibility for students.

UW ECE LAUNCHES

new BSECE degree

STARTING AUTUMN QUARTER 2022, the University of Washington Department of Electrical & Computer Engineering (UW ECE) began a four-year transition toward offering a Bachelor of Science in Electrical and Computer Engineering (BSECE) rather than a Bachelor of Science in Electrical Engineering (BSEE). This evolution of undergraduate curriculum and degree offerings is aimed at better reflecting recent changes in electrical and computer engineering, as well as ongoing studies and research at UW ECE in cutting-edge areas such as neural engineering, sustainable energy, quantum computing, data science, photonics and nanotechnology. The move will also allow the Department to provide greater flexibility for students and enable it to respond more nimbly to advances in technology.



UW ECE undergratuate student Abdul Adam demonstrates his team's self-tracking robotic car in Associate Teaching Professor Tai-Chang Chen's 'Making, Breaking, & Hacking Stuff' course, offered as part of the new BSECE curriculum.

FLEXIBLE VERSATILE ADAPTABLE

(Clockwise from right) UW ECE undergraduate students Danielle Debaste, Greg Joyce, Moska Jamali and Matthew Garcia-Medina

"I am thrilled at the prospect of providing new academic opportunities and greater flexibility for our undergraduate students studying electrical and computer engineering," said UW College of Engineering Dean Nancy Allbritton. "This reinvention of curriculum by UW ECE faculty, in partnership with academic and industry advisers, is stellar. They have simply done an amazing job of creating a framework for students that is aligned with the latest advances in engineering, while providing students with maximum flexibility to achieve their goals."

In 2018, UW ECE changed wording within its name from "electrical engineering" to "electrical and computer engineering" to better illustrate the breadth and depth of the Department and acknowledge the tight integration that exists today between computing and electrical engineering. The Department is also consistently ranked as one of the top 20 schools for electrical engineering in the country. The new BSECE degree program reflects this high caliber of education and closely aligns the undergraduate curriculum with the Department name.

"Electrical engineers have been working with and building computers for years, and because of how the field has evolved, we now expect our graduates to be highly knowledgeable and proficient in computing," said UW ECE Professor and Chair Eric Klavins. "The new BSECE degree program is part of a larger set of changes our Department has made over the last few years to ensure our students are fully prepared to achieve their goals and empower them to have the kind of positive impact on society that you'd expect from those graduating from one of the best electrical and computer engineering departments in the country."

The transition from the existing BSEE to the new BSECE degree program will occur gradually over time, beginning with direct-to-college and transfer students entering the UW College of Engineering autumn quarter 2022. Beginning autumn quarter 2024, the BSECE will be the only degree available for undergraduate admission. The final BSEE degree is expected to be awarded in 2026.

MAKING STUDENT-CENTERED CHANGES

Both the existing BSEE and the new BSECE offer students access to outstanding faculty and interdisciplinary learning environments with opportunities for in-depth study and internships in a wide array of focus areas such as biosystems, computing and networking, data science, photonics and nanotechnology, power and energy systems, robotics and controls. But a key difference between the two programs is that the BSECE will offer students flexible academic pathways through which to gain their degree, whereas the BSEE offers a more structured approach to undergraduate curriculum.

Students pursuing the new BSECE degree will have the flexibility to seek broad knowledge of the field or to focus on one or more specific areas. The program also enables the Department to better meet student demand for popular courses. Enrollment can be factored into which courses are offered and when they will be available. This will allow students to have the capacity to pursue minors or even consider double degrees that might offer greater versatility in careers after graduation.

"The key words I would use to describe the new BSECE are 'flexibility, versatility and adaptability,'" said UW ECE Associate Professor and Associate Chair for Education Payman Arabshahi. "The program provides students with greater flexibility in their academic pathways, versatility for their futures after graduation, and it is highly adaptable to changes in the field and developments in new technology. We at UW ECE are fully committed to our students' success, and this new degree program will provide outstanding support and opportunities for their future."

Learn more about this new undergraduate degree program on the BSECE webpage:

Congrats.

CLASSES OF 2020, '21 & '22!

THE UW DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING honored the graduating classes of 2020, 2021 and 2022 at a celebration event held on Wednesday, June 8 from 7 to 9 p.m. The event took place in the Alaska Airlines Arena at Hec Edmundson Pavilion and was presided over by UW ECE Professor and Chair Eric Klavins. This was the first in-person graduation ceremony held by UW ECE since 2019 and the first ever honoring graduates from three different classes in one event. Graduation ceremonies in 2020 and 2021 were held virtually because of health and safety concerns arising from the COVID-19 pandemic. The class of 2022 was made up of 345 graduates, which included 17 receiving doctoral degrees, 96 receiving master's degrees and 232 bachelor's degree recipients. Congratulations to all!

Class of '22

345
TOTAL GRADUATES

17
DOCTORAL DEGREES EARNED

96
MASTER'S DEGREES EARNED

232
BACHELOR'S DEGREES EARNED

uw ece

Graduation 2022

2022 **GRADUATION SPEAKER**

Diane Jurgens

(BSEE '85, MSEE '86)

Jurgens with UW ECE Professor and Chair, Eric Klavins, outside of the Alaska Airlines Arena Hec Ed Pavillion.

> **Diane's leadership in technology and innovation has had significant global impact. She truly is one of our most outstanding alumni."**
>
> — ERIC KLAVINS
> UW ECE PROFESSOR AND CHAIR

The Department was proud to welcome UW ECE alumna Diane Jurgens (BSEE '85, MSEE '86), as guest speaker for our 2022 graduation ceremony. Jurgens has over three decades of experience as an international business and technology leader, and she is currently Executive Vice President and Chief Information Officer at the Walt Disney Company.

"Diane has had an impressive number of achievements over her career, and her leadership in technology and innovation has had significant global impact," Klavins said. "She truly is one of our most outstanding alumni, demonstrating how a person can achieve their dreams with a degree from our Department serving as their foundation."

At Disney, Jurgens oversees the company's global Enterprise Technology team whose purpose is to connect, empower and protect the Disney magic. This includes digital transformation, user experience, core platforms, networking operations, cloud and data engineering, and cybersecurity.

Before joining Disney in October 2020, Jurgens was based in Singapore as Chief Technology Officer for Broken Hill Proprietary, or BHP, a multinational mining, metals and petroleum company. There, she was responsible for the technology strategy and transformation to enable BHP's vision to bring people and resources together to build a better world. Her leadership at BHP was recognized in 2018 by AFR Magazine, which named her as one of Australia's top five technology influencers for turning BHP from a 'fast follower' into a digital leader.

Over her career, Jurgens has held senior executive positions and led technology teams in 25 different countries — driving innovation on a worldwide scale. Her roles prior to BHP include 10 years in China as President and Managing Director of Shanghai OnStar Telematics and Chief Information Officer for General Motors' international operations. Early in her career, she held a number of executive leadership and engineering roles at Boeing. She has received numerous awards recognizing her leadership abilities, including a 2013 Magnolia Award from the Shanghai Government Office of Foreign Affairs for making a significant contribution to the city's economy, business environment, international relations, community development and management standards. Most recently, Jurgens was named one of the top 10 women in technology in the U.S. by Technology Magazine.

In addition to her long list of accomplishments, Jurgens has deep expertise in telematics, intelligent transportation systems, cybersecurity, data science, robotics, machine learning, the Industrial Internet of Things (IIoT), advanced sensors and artificial intelligence. She is also an advocate for STEM education and neurodiversity programs.

Jurgens encouraged graduates to "remember yesterday — the support from people and effort it took to earn a UW ECE degree, to live for today — valuing every moment and lesson along the way, and to dream of tomorrow — to be imaginative and dare to think big." Those who attended the event were appreciative of this uplifting message, which was delivered by an exceptionally accomplished alum who has a wealth of knowledge and leadership experience to share from a global perspective.

ZERINA **KAPETANOVIC**

an outstanding alum

Zerina Kapetanovic (Ph.D. '22) has received the 2022 Yang Research Award, among other honors, and secured a tenure-track faculty position at Stanford University.

Kapetanovic (right) and UW ECE doctoral degree candidate Shanti Garman (left) set up an experiment inside the UW's Sylvan Grove.

UW ECE CONGRATULATES recent graduate Zerina Kapetanovic (Ph.D. '22), who received this year's Yang Research Award for her dissertation focused on enabling low-power communication for environmental sensing systems. She developed and applied this research toward improving agricultural methods through the Microsoft FarmBeats program. Kapetanovic received the honor at the annual UW ECE Awards ceremony, which was held June 2 at the Paul G. Allen Center Atrium on the UW campus.

In late August, Kapetanovic also received the UW Graduate School's Distinguished Dissertation Award in Mathematics, Physical Sciences and Engineering. The award recognizes outstanding and exceptional scholarship at the doctoral level. Kapetanovic earned her bachelor's, master's and doctoral degrees from UW ECE, while conducting research on topics such as finding new methods for passive wireless communication under supervision of her adviser, UW ECE Professor Joshua Smith. She is currently in a year-long appointment as a postdoctoral researcher at Microsoft Research. In September 2023, she will join Stanford University as an assistant professor of electrical engineering.

"Receiving the Yang Research Award is exciting. It's validating that the research I am doing is innovative and impactful, which is a great feeling," Kapetanovic said. "The grad school award is also a high honor, and I'm really excited to start at Stanford next year. There are many great collaborators there, they have several climate-related initiatives and a new school for sustainability, which is very relevant to my own research."

The Yang Research Award was established by successful entrepreneur and former UW ECE faculty member Andrew T. Yang. Yang has been one of the most influential people in the electronic design automation industry for nearly three decades, and he is known for being a visionary in both research and entrepreneurship. The purpose of this award is to recognize and encourage outstanding doctoral student research contributions to the field of electrical engineering. The award goes to one qualifying student per year and is open to all doctoral degree candidates in UW ECE. Receiving the Yang Research Award is considered a high honor and helps to create career opportunities for the recipient.

UW ECE MENTORSHIP AND INTERNSHIPS LEAD TO SUCCESS

Kapetanovic credits much of her academic success to Smith, who is the Milton and Delia Zeutschel Professor in Entrepreneurial Excellence at UW ECE, a professor in the Paul G. Allen School of Computer Science & Engineering, and head of the Sensor Systems Laboratory at the UW. He is an internationally recognized leader in development of new types of sensor systems with applications in robotics, health care and the Internet of Things (IoT).

"Josh is awesome. I definitely don't think I would have been as successful as I am without his advice and support," Kapetanovic said of her adviser. "I think what's really nice about Josh and the work he does is that he is interested in so many different areas. He looks at things from many perspectives, and that has influenced the way in which I approach my own research."

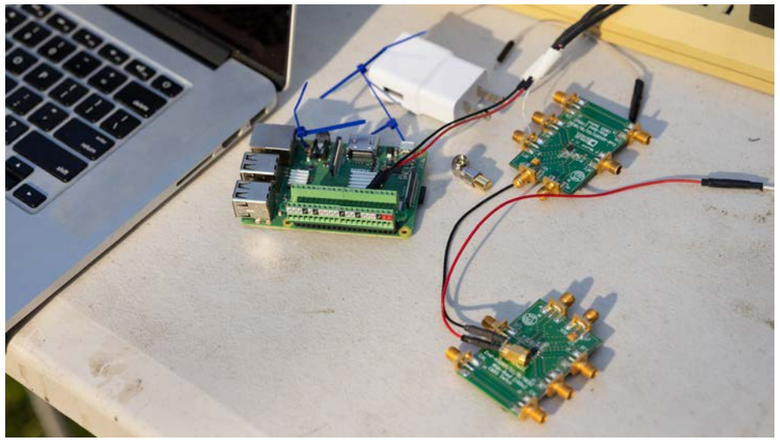
In Smith's lab, Kapetanovic made significant contributions to development of innovative wireless and backscatter communication techniques, battery-free sensors, and inexpensive low-power communication and IoT systems. Throughout graduate school, she worked to apply these new technologies in the real world through her internships at Microsoft, which were supervised by Ranveer Chandra, the company's managing director for research for industry and chief technology officer of agri-food. Kapetanovic noted that, like Smith, Chandra was a mentor for her throughout graduate school, teaching her ways to look at problems from several different perspectives and encouraging creative approaches to presenting her work. Kapetanovic's research related to Microsoft's FarmBeats program — which aims to use collection of precise environmental data, such as soil temperature and moisture level, to help increase farm productivity — gained notice by the company and by the public. In 2020, she was awarded a Microsoft Research Dissertation Grant to help further support her work in this area. ⟶

KAPETANOVIC TESTED THE passive wireless communication system she developed at a variety of sites around the Puget Sound. Here, she is setting up testing equipment outside of Carnation, Washington, in the Chinook Bend Natural Area.

UNLIKE EXISTING PASSIVE WIRELESS and backscatter communication systems, Kapetanovic's prototype does not depend on a radio signal to send and receive information. Instead, her device uses a byproduct of electrical resistance in its circuitry called "Johnson noise" to enhance energy-efficiency and transmit a wireless signal.

> "From the beginning, it was clear that Zerina was something special."
>
> — Scott Hauck
>
> Gaetano Borriello Professor for Educational Excellence

(RIGHT) KAPETANOVIC TESTING HER WIRELESS communication device in Sylvan Grove on the UW campus. (Center) examples of the RF prototype Kapetanovic developed in the lab of UW ECE Professor Joshua Smith. (Bottom) testing the prototype in the field.



While at UW ECE, Kapetanovic also contributed to paving the way for other female engineers. Along with her lab mate, Shanti Garman, and with the support of UW ECE faculty and staff, Kapetanovic co-organized the inaugural "WomXn at the Forefront of ECE Research (WAFER)," an annual event highlighting outstanding female engineers, which is aimed at cultivating a more inclusive environment. Kapetanovic noted that in Smith's lab there were several female engineers, and she always felt welcomed and included at UW ECE. But she also said she realized this wasn't everyone's experience in electrical and computer engineering, which is a traditionally male-dominated field. So, she co-organized this ongoing event to help ensure inclusiveness at UW ECE over the long-term.

"It has been such a delight to work with Zerina from the time she was an undergraduate through her doctoral degree," Smith said. "She is fearless about taking on technical challenges, works incredibly hard, and is a wonderful colleague and mentor to other students. I have also been impressed by the entrepreneurial spirit she brings to diversity, equity and inclusion at UW ECE, imagining and implementing successful new programs. I am so excited to watch the next steps in her meteoric rise as she establishes her own research lab as a faculty member at Stanford!"

UW ECE DOCTORAL degree candidate Shanti Garman, assisting Kapetanovic with her research in the field.

PREPARING FOR A FUTURE AT STANFORD

Today, Kapetanovic is looking forward to joining Stanford University. She said that Smith, other faculty and staff in the Department, and in particular, Professor Scott Hauck helped to prepare her for this new faculty role.

"I've received support in so many ways at UW ECE that helped to prepare me for the job application process, which also prepared me to start the job at Stanford. I've had a lot of great examples around me," Kapetanovic said. "For instance, Professor Scott Hauck. I really love the way he teaches and being able to learn from him in that regard because I taught EE 271, which is the course that he developed. Having that opportunity at UW ECE helped me to realize more that I enjoy teaching."

When asked what it was like to mentor and work with Kapetanovic as an educator, Hauck noted her exceptional abilities as a student and as an instructor.

"From the beginning, it was clear that Zerina was something special. At UW ECE, she has been a quiet force, eager to learn and go above and beyond what's required," Hauck said. "Toward the end of her UW career, when we needed an EE 271 instructor, we were incredibly fortunate to have Zerina run the class for us. She did an awesome job teaching, just like she has done in everything she has undertaken here. Normally, I'd say that a person would be lucky to land such a great position at Stanford. However, I think Stanford is lucky to have a rising star like Zerina as a new faculty member."

At Stanford, Kapetanovic's lab will focus on low-power wireless communication and sensing, and IoT systems. This research work has a wide range of potential applications across many different fields. Kapetanovic said that her lab would be emphasizing sustainable technology and finding ways to apply new innovations to achieve immediate impact — a similar approach to what she did with FarmBeats — while still finding ways to help address major societal issues, such as climate change.

"I'm really passionate about taking these types of technologies and using them to help solve issues related to climate change, but my long-term research goal is to get us to the point where we can actually have battery-free, resilient, and potentially biodegradable sensors that are reliable," Kapetanovic said. "If you think about all these different types of industries, whether it's manufacturing or healthcare, agriculture — if you want to improve productivity or make any of those industries more sustainable, you need to rely on data. You need lots of data, and that's where these sensors come into play and IoT systems in general."

UW ECE professors Scott Hauck (left) and Joshua Smith (right).

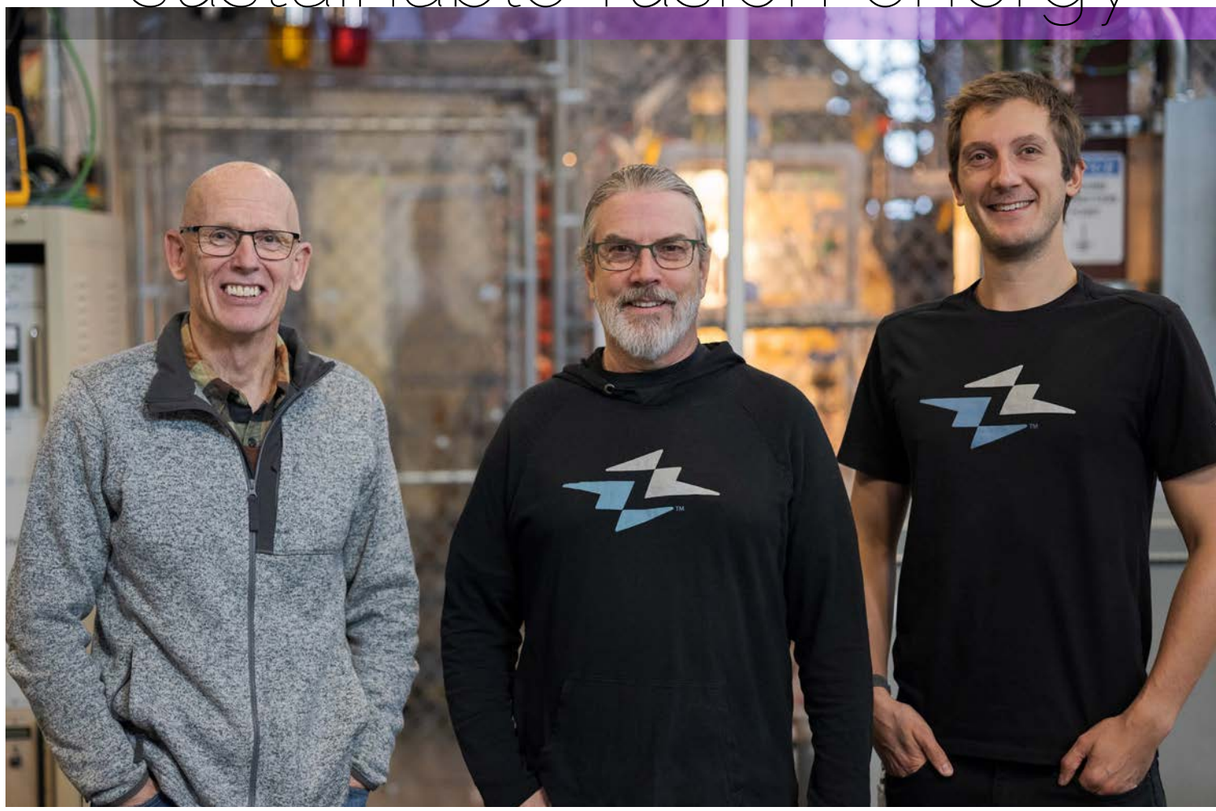
Kapetanovic is currently hiring graduate students for her lab at Stanford University. Visit her website for contact information and to learn more about her research:

www.zerinakapetanovic.com

> "Receiving the Yang Research Award is exciting. It's validating that the research I am doing is innovative and impactful, which is a great feeling."
>
> — Zerina Kapetanovic

ENGINEERING

sustainable fusion energy



Originating from UW research, Zap Energy is a company on its way to making sustainable energy from nuclear fusion a practical reality

Photo courtesy of Zap Energy

Update: *This article was first published on the UW ECE website in November 2022, and on December 13, 2022, the Lawrence Livermore National Laboratory announced that their research team was the first in the world to achieve scientific energy breakeven in their nuclear fusion platform. This was a tremendous accomplishment; however, LLNL's system was primarily designed for science, rather than as a device to power the nation's electrical grid. LLNL Director Kim Budil suggested, "...a few decades of research on the underlying technologies could put us in a position to build a power plant." In contrast, Zap Energy uses a much more efficient and compact approach to producing fusion that's geared toward the ultimate goal of commercially viable fusion energy. If successful, this unique approach positions the company to bring fusion energy to the electrical grid within a much shorter time frame. Read on to learn more.*

WHEN MOST PEOPLE HEAR THE WORDS "nuclear power," it is nuclear fission that first comes to mind — often represented in the news by pictures of massive, concrete power plants and cooling towers. This type of energy production is capable of producing enormous amounts of electricity from splitting atoms, and it is considered by the U.S. Department of Energy to be a clean, sustainable power source.

However, this method of generating nuclear energy is not without serious downsides. The types of nuclear power plants we are familiar with are expensive to construct and politically difficult to build because of ongoing environmental and public safety concerns. These power plants generate waste that remains highly radioactive for hundreds, or even thousands, of years and must be put into safe storage. Partial plant meltdowns have occurred in places such as Three-Mile Island, Pennsylvania and Fukushima, Japan, seriously damaging surrounding areas, and in some cases, such as Chernobyl in Pripyat, Ukraine, rendering them completely uninhabitable for humans. And as the world has recently been reminded in the Russia-Ukraine conflict, nuclear power plants can become wartime targets.

That is why for decades, scientists and engineers have been working toward developing nuclear fusion, which does not have these downsides and differs from fission in many important ways. The first and perhaps most fundamental difference is that nuclear fission splits heavy elements, such as uranium, into lighter ones to generate energy. Whereas nuclear fusion is a process of combining — or fusing — lighter elements, such as deuterium, into heavier ones. Both processes yield millions of times more energy per mass of fuel than other conventional power sources such as burning coal, oil or gas. But fusion can create almost four times more energy per mass of fuel than fission. Fusion is

UW ECE Research Professor Emeritus Brian Nelson (center) is co-founder and chief technology officer of Zap Energy, a UW spinout that seeks to bring nuclear fusion power to the electrical grid. The company's 80+ employees include UW ECE alumnus Steve Zwaller (left) and UW ECE Professional Master's Program student Daniel Garratt (right).

also carbon-free, produces virtually no radioactivity as compared to fission and it can be generated within a much smaller reactor. Fusion also promises to be an inexpensive form of energy production because its fuel source, hydrogen isotopes, are found in water and are vastly abundant in our world's oceans.

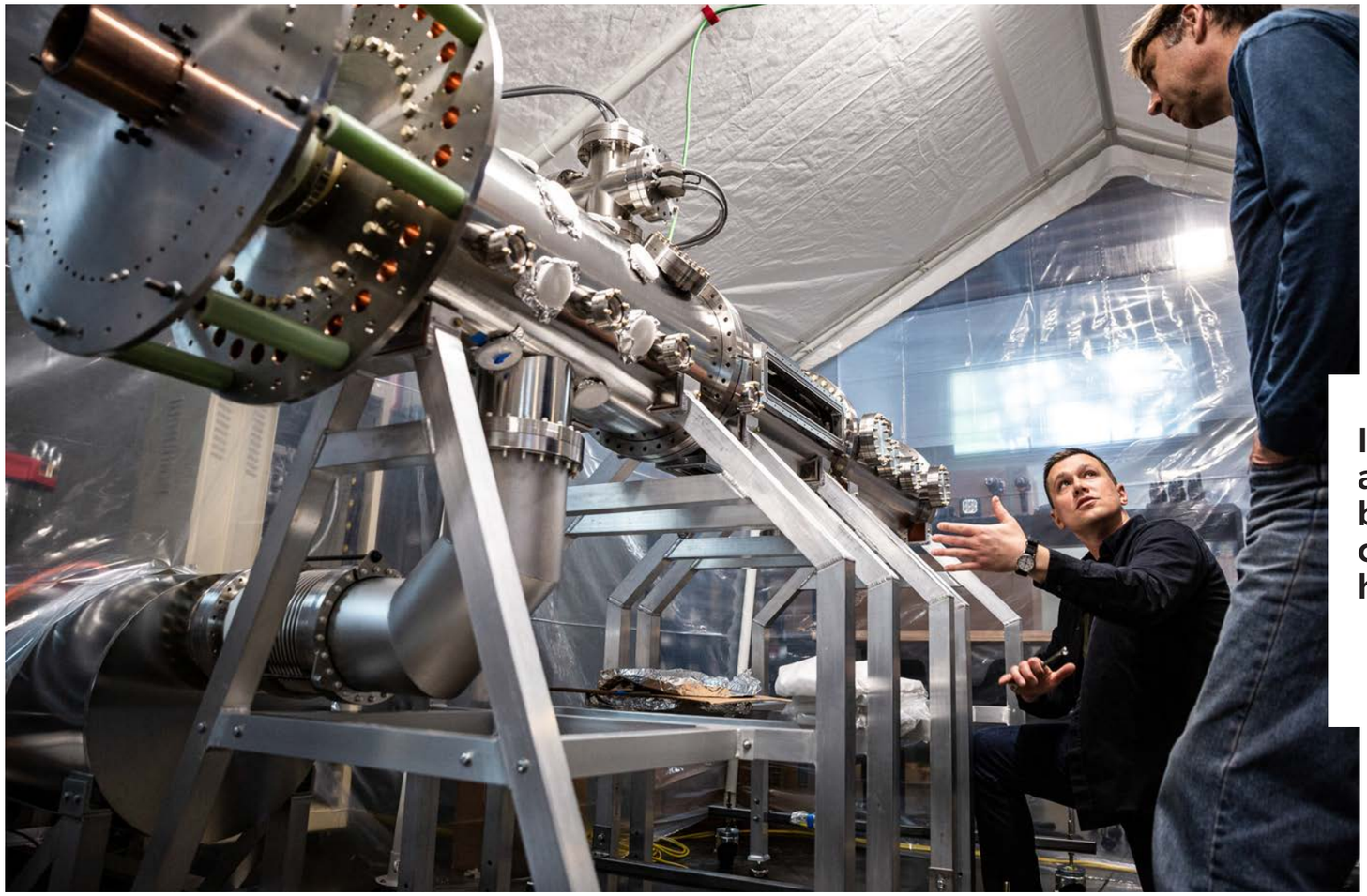
Now, because of recent advances in technology and the growing threat of climate change, the race is on to make nuclear fusion power a practical reality, and UW spinout Zap Energy is well-positioned to come out ahead. The company, co-founded in 2017 by UW ECE Research Professor Emeritus Brian Nelson, UW Aeronautics & Astronautics Professor Uri Shumlak, and entrepreneurial investor Benj Conway, is in the midst of building an affordable, compact and scalable fusion reactor. Their unique approach promises to be one of the most commercially viable solutions to achieving nuclear fusion power because of technology they developed at the UW in cooperation with researchers at Lawrence Livermore National Laboratory.

"Our goal is to bring fusion power to the electrical grid," said Nelson, who is chief technology officer at Zap Energy. "We have a different approach than the mainstream, and I don't know how you could compete with the simplicity of our reactor. If we are successful, and I think we will be, this promises to offer real hope for humanity, a way to significantly address climate change and replace fossil fuels."

Zap Energy is working hard toward that goal. The company has offices in Mukilteo and Everett, Washington, where over 80 employees, including UW ECE Professional Master's Program student Daniel Garratt and UW ECE alumnus Steve Zwaller (BSEE '84), are developing reactor prototypes and bringing Nelson's vision to life.

"I've been able to directly apply what I've learned in every class I've taken so far at UW ECE to my work here," said Garratt, who is a high-voltage research engineer for Zap Energy. "I think nuclear fusion is going to be the sort of thing people won't notice changing their lives until it has already done so. But it will have an undeniably positive effect on people's lives and the planet."

"The potential of what this could do for the world motivated me. I read about what the company was doing, and it was a no-brainer. I decided to join," added Zwaller, a senior facilities manager at Zap Energy who postponed his retirement so he could become part of the startup. "I'm really into sustainability. Knowing that we're going to come up with a low or carbon-free power source, that did it for me."



Zap Energy employees working on development of the company's FuZE-Q reactor. Most approaches to nuclear fusion today are using building-sized devices that contain huge magnets or lasers. In contrast, Zap Energy's device is compact, which makes it attractive to public utility companies and more practical for widespread, real-world implementation. ***Photo courtesy of Zap Energy***

> **"If we are successful, and I think we will be, this promises to offer real hope for humanity."**
>
> — Brian Nelson
>
> UW ECE Research Professor Emeritus, Zap Energy Co-founder and Chief Technology Officer

ZAP ENERGY'S APPROACH TO FUSION

A nuclear fusion reactor mimics natural processes in stars like our sun, where gravity fuses together hydrogen atoms to create helium, producing light and generating enormous amounts of energy. Engineering fusion has been likened by some to 'creating a star in a bottle.' Huge amounts of heat and pressure are involved, and therein lies one of the key reasons why nuclear fusion has proven to be so challenging for scientists and engineers to produce. Generating sustained fusion reactions in a system that creates more energy than it requires to operate, and capturing that energy in an efficient way, has proven over the years to be confoundingly difficult.

The two main approaches to nuclear fusion today either use magnetic fields to confine and compress a plasma gas to the point where fusion occurs, or use lasers to heat hydrogen isotopes in a contained environment, generating shock waves that trigger fusion. A number of huge devices and facilities have been built to this end, such as the ITER tokamak in southern France and the National Ignition Facility in Livermore, California, but as of yet, none have been able to generate more power than what was required to create the fusion reaction itself.

Zap Energy is taking a different approach. Rather than using large magnets or lasers, they have developed a compact device that uses pulses of electrical current traveling along a central column. This creates a strong magnetic field that confines, compresses and heats plasma to the point of generating fusion. In engineering, this method is considered a "Z-pinch" because the electrical current pinches the plasma along the Z axis of a normal, three-dimensional graph. A Z-pinch plasma flow is prone to instability, but the device compensates for that by producing a plasma flow that varies across the column radius — an approach Zap Energy calls "sheared-flow stabilization." It's akin to traveling in the middle lane on the freeway and being unable to change lanes because of cars zooming past on both sides.

"Z-pinch has long been an appealing way to achieve nuclear fusion, but for many years researchers considered Z-pinch's plasma instabilities to be an insurmountable challenge," said Shumlak, Zap Energy's chief science officer, in a June 2022 press release. "We've shown through both simulation and experiment that sheared flows can stabilize fusion plasmas, and that the stability should extend to a commercially viable scale."

This unique approach keeps plasma compressed and fusion reactions confined for longer periods of time than previous

AN ARTIST'S RENDERING OF THE FUSION reaction that takes place within Zap Energy's FuZE-Q reactor. This device uses pulses of electrical current traveling along a central column, which creates a strong magnetic field that confines, compresses and heats plasma to the point of generating fusion. ***Illustration courtesy of Zap Energy***

Z-pinch models have been able to achieve. And that puts what scientists and engineers call 'scientific breakeven' — where energy input equals the device's energy output — within reach for the company. Achieving breakeven, both scientifically and from an engineering standpoint, will be key for Zap Energy to realize its vision of bringing fusion power to the electrical grid.

HOPE FOR HUMANITY

The company's new Fusion Z-pinch Experimental reactor prototype, known as FuZE-Q, is currently under development to bring Zap Energy closer to that breakeven goal. This new system is being optimized for the high levels of electrical current needed to reach the equivalent of scientific breakeven. The company estimates that it will need to produce 650kA (kiloamperes) of electrical current to achieve this. Last year, they reached 500kA, which was a big accomplishment, and the limit of their hardware capabilities at the time.

"FuZE-Q is the fourth generation of Z-pinch device that we've built and is undoubtedly the most ambitious," Nelson noted in the company's recent press release. "We designed it to be versatile, resilient and tunable in lots of ways that will be critical as we ramp to higher currents, temperatures and densities.

Looking forward, one of the most important goals for the company will be to confirm through experiments and demonstrations that their Z-pinch technology remains stable as it is subjected to higher amounts of electrical current. Nelson said that he is confident their equipment will meet that test and confirm simulations that predict the plasma will maintain its stability. Then, the next step after achieving scientific breakeven will be to build another reactor capable of surpassing engineering breakeven, where the power generated by the device substantially exceeds what is needed to produce the fusion reaction. If things go as planned, the company aspires to reach that goal by 2026.

"We are aiming, through nuclear fusion, to quickly get a non-carbon producing, clean form of electrical energy on the grid, one that has nearly limitless fuel available," Nelson said. "The economic and environmental benefits will be huge, and because fuel is virtually limitless and easy to access, fusion holds the potential to reduce political strife between nations. It could even power space travel someday. Our device is compact, scalable and mass-producible. With those things in mind, nuclear fusion is a realistic hope for humanity, and I believe it is the future."

High-voltage research engineer and UW ECE Professional Master's Program student, Daniel Garratt.

Senior Facilities Manager and UW ECE alumnus, Steve Zwaller. ***Photo by Andy Freeberg | Zap Energy***

I've been able to directly apply what I've learned in every class I've taken so far at UW ECE to my work here."

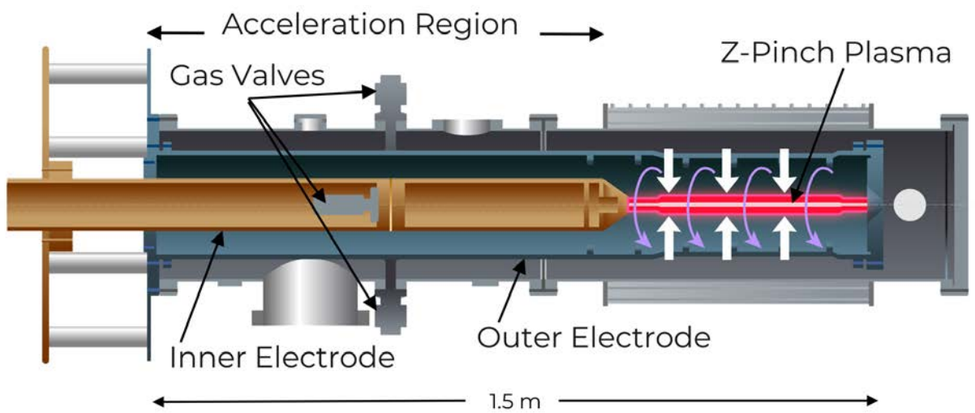
— Daniel Garratt

Zap Energy High-Voltage Research Engineer, UW ECE Professional Master's Program student

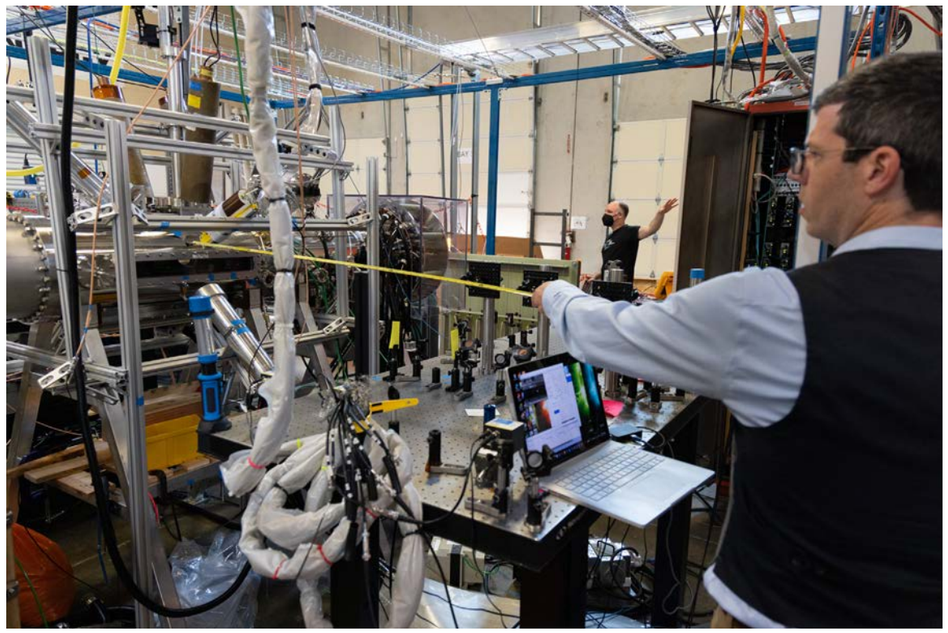
Learn more about UW ECE Research Professor Emeritus Brian Nelson on his UW ECE bio page:

Find more information about Zap Energy on the company's website.

AN ILLUSTRATION SHOWING THE INNER WORKINGS of Zap Energy's FuZE-Q reactor. Deuterium gas is injected into the acceleration region of the reactor, where electrodes pulse, removing electrons from the deuterium atoms. This creates a plasma, which picks up speed as it moves into the far end of the column (right) where the electrical current generates a strong, stable magnetic field that confines, compresses and heats the plasma — using a method known as a Z-pinch — to the point of generating fusion. *Illustration courtesy of Zap Energy*



Brian Nelson poses with Zap Energy's FuZE-Q reactor.



Zap Energy employees preparing to run tests at the company's headquarters facility in Everett, Washington.

UW ECE SPOTLIGHTS

selected news from UW ECE faculty, students and alumni

(scan QR codes to read full-length stories)

AZADEH **YAZDAN**

Assistant Professor Azadeh Yazdan earned the American Heart Association (AHA) Career Development Award with a promising approach to drive brain repair and recovery following a stroke.

NATHAN **KUTZ**

At the new AI Institute in Dynamic Systems, UW ECE and Applied Mathematics Professor Jose Nathan Kutz is part of a multidisciplinary UW research team at the forefront of artificial intelligence, machine learning and engineering education.

MO **LI**

A multi-institutional, interdisciplinary research team led by Professor Mo Li has found innovative ways of using noise inherent to integrated optoelectronics to enhance the creativity of artificial intelligence.

Li's team has also developed a way of using sound waves to move subatomic quasiparticles known as 'excitons' further than ever before — leading to a faster, more energy-efficient computing circuit.

DANIEL **KIRSCHEN**

Professor Daniel Kirschen was named editor in chief of IEEE Transactions on Energy Markets, Policy and Regulation. This new publication, launched in July 2022, is a peer-reviewed journal containing articles that cover complex topics and issues at the intersection of power systems engineering, energy policy and and market regulation.

Faculty Spotlights

JOSHUA **SMITH**

UW ECE and Allen School Professor Joshua R. Smith was elected into the 2021 class of Fellows of the National Academy of Inventors for his impactful creations in the fields of wireless power, communication, sensing and robotics.

Smith is also the inaugural director of the new UW + Amazon Science Hub, which will advance innovation in core robotics, AI technologies and their applications.

SAJJAD **MOAZENI**

Assistant Professor Sajjad Moazeni was named a recipient of a NSF CAREER award, one of the most prestigious awards in the nation for early-career faculty.

Our UW ECE faculty include:

1 **MACARTHUR** FELLOW

5 **NAE** MEMBERS

7 **SLOAN** FELLOWS

27 **IEEE** FELLOWS

AKSHAY **GADRE**

SERENA **ELEY**

MAHMOOD **HAMEED**

SEP **MAKHSOUS**

Beginning this summer and extending through winter quarter next year, UW ECE is welcoming seven new faculty members who bring a wealth of expertise in a wide range of technical areas and fields of study.

KIM **INGRAHAM**

JUNE **LUKUYU**

NATHAN **KUTZ**

DENISE **WILSON**

Professor Denise Wilson is co-author of "Sex, Gender, and Engineering: Harassment at Work and in School." Wilson will teach a course to go along with the book next spring.

ARKA **MAJUMDAR**

An interdisciplinary research team at the University of Washington, led by Associate Professor Arka Majumdar, was awarded $3.6 million in funding from the National Science Foundation (NSF) to develop a miniaturized imaging device to treat heart attack and stroke.

Majumdar and UW ECE fourth-year doctoral student Zhuoran (Roger) Fang are leading a multi-institutional research team that has developed energy-efficient switches for the next generation of data centers.

Researchers at the UW, including Majumdar, and Princeton University have created micro-sized cameras that produce the highest-quality images and widest field of view for full-color metasurface cameras to date, with great potential to spot problems in the human body and provide sensing capabilities for super-small robots.

GEORG **SEELIG**

Professor Georg Seelig is co-principal investigator and part of a UW-led interdisciplinary team of synthetic biologists that received a 5-year, $15M grant from the U.S. Department of Energy for their work involving the engineering of microbial genomes that transform CO_2 into high-value chemicals.

KAI-MEI **FU**

Professor Kai-Mei Fu was recently named a 2023 Optica Fellow for outstanding contributions to optics and photonics. Fu is being honored for advances in characterization, synthesis, control and device integration of optically-active quantum point defects in crystals.

Professor Maryam Fazel was selected as the first recipient of the Moorthy Family Inspiration Career Development Professorship. At the investiture, she was presented with a framed certificate honoring her as the inaugural recipient.

MARYAM **FAZEL**

HOWARD **CHIZECK**

BRUCE **DARLING**

MING-TING **SUN**

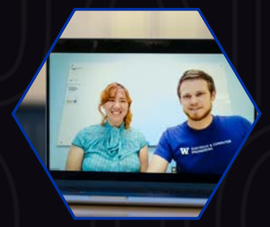
YASUO **KUGA**

We congratulate and offer our deepest gratitude to Professors Howard Chizeck, Bruce Darling, Yasuo Kuga and Ming-Ting Sun, recent retirees who have left an impactful legacy of service.

Student Spotlights

LIBAN **HUSSEIN**

First-year doctoral student Liban Hussein, who works in the lab of Assistant Professor Sajjad Moazeni, was recently awarded an opportunity to take part in the prestigious National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP).



TEAM **ULTROPIA**

Cody Birkland, Amy Swanson and Lloyd V. Dees of Team Ultropia were awarded first place in the 2022 GIX Innovation Competition for their work on a low-energy laundry technology. Their prototype uses ultrasonic energy to clean and dry clothing, significantly reducing energy consumption and making washer-dryer technology more broadly accessible.

CNT RESEARCH FOR **UNDERGRADUATES PROGRAM**

This summer, UW ECE labs hosted five outstanding undergraduate students from across the country who learned about neurotechnology through hands-on, immersive research experiences, courses and workshops. The students were part of a larger cohort placed at labs across the UW campus to take part in the Research Experience for Undergraduates through the Center for Neurotechnology. This 10-week summer program is funded by the National Science Foundation and facilitated by the Center, which is co-directed by UW ECE faculty members Rajesh Rao and Chet Moritz.

AR**UW**

Advanced Robotics at the University of Washington (ARUW), a team of University of Washington students advised by Professor Joshua Smith and Assistant Teaching Professor John Raiti, won their second championship in the North American RoboMaster University League Competition. The event took place at Texas A&M University from June 25–27, with ARUW winning both the standard RMUL competition (3v3) and the Standard Confrontation (1v1).

BOON & CHIEKO **CHAYA**

The Chaya Family Endowed Scholarship, recently established by UW ECE graduate Boon Chaya (BSEE '78) and his wife, Chieko, will recognize and support UW ECE undergraduates from low-income and underprivileged backgrounds.

Alumni Spotlights

VIKRAM **IYER**

Recent UW ECE graduate and Allen School professor Vikram Iyer earned the ACM SIGMOBILE Doctoral Dissertation Award for his creative bio-inspired networking and sensing systems, like Beetlecam — a wireless vision system that can be mounted on live beetles.

BASEL **ALOMAIR**

&

VICTOR **WONG**

Basel Alomair (Ph.D. '11) and Victor Wong (BSEE '89) were named Diamond Award recipients by the UW College of Engineering. The Diamond Awards honor outstanding alumni and friends who have made significant contributions to the field of engineering.

QUANTUM CONNECTIONS

Professor Kai-Mei Fu leads establishment of UW Graduate Certificate in Quantum Information Science and Engineering

THIS FALL, A NEW GRADUATE CERTIFICATE PROGRAM at the University of Washington began training students in an emerging, fast-growing field that blends information science based on principles of quantum mechanics with development of new technologies. The UW Graduate Certificate in Quantum Information Science and Engineering provides students with a robust, interdisciplinary experience that explores how this new field relates to other areas within science, technology, engineering and mathematics. The Certificate program was established by a multidisciplinary faculty group and is directed by Kai-Mei Fu, a professor of physics and of electrical and computer engineering at the UW. Fu led the group in development and implementation of the Certificate curriculum, which was designed to complement and augment students' existing degree programs. Courses are taught by a select number of UW faculty that have a wide range of expertise in the field. The Certificate can be completed concurrently with a master's or doctoral degree, and it prepares students for careers and leadership roles in fields related to development of quantum-enabled technologies.

"The people who tend to be drawn to this program are students who have been hearing about quantum information, realize the impact scalable quantum computing systems can have and want to understand how their discipline can actually help make this impact a reality," Fu said. "If you want to make a difference in this field, then you need a solid base. And if you want to get that base, then you should get the Certificate." →

Kai-Mei Fu in the Suzzallo Reading Room on the UW campus. Fu is the Virginia and Prentice Bloedel Professor of Physics and Electrical and Computer Engineering at the University of Washington.

AS DIRECTOR OF THE QUANTUM Defects Lab, Fu's research focuses on identifying and controlling the quantum properties of point defects in crystals (this page and next), which has potential applications for both information and sensing technologies. In this image, synthetic fog was added by the photographer to help illuminate the laser light being used by the lab.

Photo by Dennis Wise | University of Washington

INTERDISCIPLINARY CURRICULUM FOR GRADUATE STUDENTS

The student cohort pursuing the Certificate is very diverse, being over 35 percent women and bringing together 60 students from five different departments on campus. Most students are research trainees in the National Science Foundation-funded Accelerating Quantum-Enabled Technologies program; however, the Certificate program is open to any UW graduate student who has met the required prerequisites. The program is an especially good fit for students interested in quantum information science who are studying electrical and computer engineering, physics, computer science and engineering, chemistry, or materials science and engineering. The program curriculum is structured to enhance a graduate student's research focus.

"This fall, we have three intro courses in the Certificate program that target the expertise of the people we're training," Fu said. "We have Introduction to Quantum Information Science and Engineering for Chemists and Materials Scientists, which is offered through the chemistry department, Quantum Information offered through the physics department, and Introduction to Quantum Computing taught through the Allen School. All these courses work together, and any one of them can be a student's first introductory course."

Microsoft Azure

Students in the Certificate program will have access to quantum cloud computers through Microsoft Azure, which will allow them to run experiments and explore how real quantum devices behave in practice.

Students in the program will have access to quantum cloud computers through Microsoft Azure, which will allow them to run experiments and explore how real quantum devices behave in practice. They will also gain experience participating in team-based projects that are important to the field and relevant to future employers. Courses that explore cross-disciplinary topics, such as EE 500Q: Quantum Information Science and Engineering Seminar (offered during winter quarter at UW ECE), are at the heart of the Certificate program. EE 500Q provides weekly presentations from quantum scientists across multiple disciplines, covering industry, academia and National Laboratory experiences while exposing students to potential research and career directions. The Certificate program also offers opportunities to make connections with many other people working on quantum-enabled technologies. Fu said that these connections could help students better understand where their own research might fit into a broader picture. Fu added that the projects and teamwork, along with the program courses, help to create a common language between different disciplines.

Fu is director of the Quantum Defect Laboratory at the UW and co-chair of UW QuantumX, which brings together quantum information science and engineering researchers and educators from across campus. Fu's strong network and connections, along with support from colleagues, enabled the Certificate program to be quickly established. (Right) Fu inspecting equipment in the Quantum Defect Laboratory.

Photo by Dennis Wise | University of Washington

"The reason why an interdisciplinary approach to quantum information science and engineering is important is that, right now, there are challenges at every single level of the quantum hardware stack," Fu said. "So, if we think of the materials that are developed that go into the devices, the devices that go into the architecture and that on the architecture you're running software, which is an implementation of some algorithm, you can see how the entire stack is connected. Everything needs to be co-designed and developed together to optimize and maximize performance in these systems."

The need to develop a workforce with interdisciplinary expertise in this emerging field was behind the idea for the Certificate program itself. Fu talked about the growing demand for those with a strong

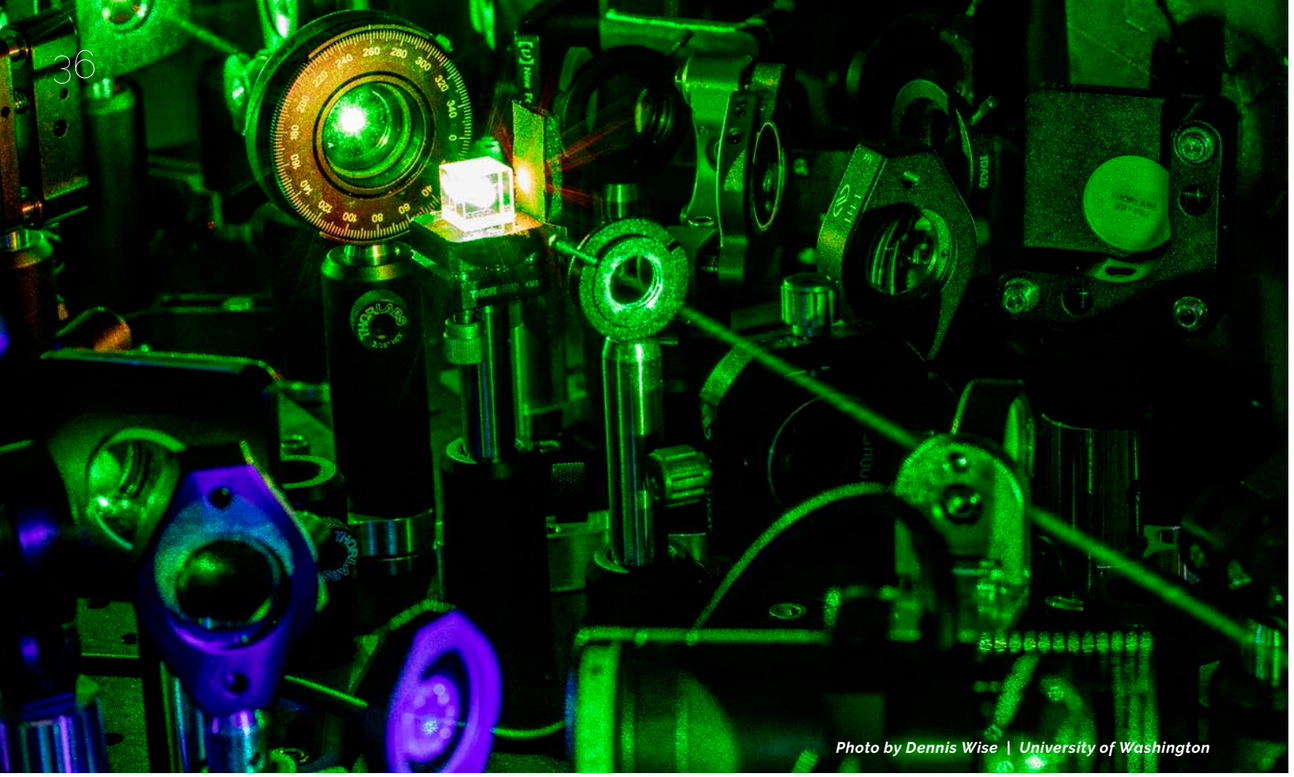


Photo by Dennis Wise | University of Washington

background in quantum information science and engineering and that National Laboratories, in particular, are eager to hire people with skills in this area.

"Potential employers need really good electrical engineers, computer scientists, chemists and physicists that understand quantum information science and engineering," Fu said. "Based on that knowledge, it became clear to me and my colleagues that a certificate program, something that could augment a graduate-level degree and demonstrate expertise connected to the individual's primary research focus, would best serve our students."

TAUGHT BY OUTSTANDING FACULTY AT A WORLD-CLASS UNIVERSITY

To that end, Fu and her colleagues assembled a team of UW faculty who are leaders in their respective areas of expertise to teach this new curriculum. Fu noted the enthusiasm and support across campus for the Certificate, which enabled the program to be quickly established to meet the needs of a rapidly advancing field.

"The University of Washington has very open, curious and bold faculty who are willing and able to expand research directions across different disciplines," Fu said. "Even in universities that have had a strong footprint in quantum for a long time, it's been in specific departments. What is exciting here is that we span a number of University units and departments."

Fu is a faculty member of the Molecular Engineering & Sciences Institute, the Clean Energy Institute and the Institute for Nano-Engineered Systems. These sorts of cross-campus connections, combined with co-chairing UW QuantumX alongside Arka Majumdar, an instructor in the Certificate program who is a UW associate professor of physics and of electrical and computer engineering, provided Fu with a strong network to draw from.

"QuantumX supports research, training and curriculum development in this area," Fu said. "Many of the core faculty in the Certificate program are also active faculty in QuantumX. So, it's all part of a rich ecosystem on campus in quantum information science and engineering."

The Certificate program has received critical support from the UW College of Engineering, which in 2020 launched a cross-departmental faculty cluster hire in quantum information science and technology. The initiative included new faculty hires in the Paul G. Allen School of Computer Science & Engineering, the UW Department of Materials Science & Engineering and the UW Department of Mechanical Engineering. At UW ECE, the cluster hire brought on board assistant professors Sara Mouradian and Rahul Trivedi. Both faculty members are instructors in the Certificate program, and Mouradian will be leading the graduate-level Quantum Information Practicum, which brings students together into teams to work on academic and industry-sponsored projects.

Fu working on equipment in the Quantum Defect Laboratory at the UW.

UW ECE professors Arka Majumdar, Sara Mouradian and Rahul Trivedi (from left to right) are instructors in the Certificate program. Majumdar also co-chairs UW QuantumX alongside Fu, and Mouradian will be leading the graduate-level Quantum Information Practicum, which brings students together into teams to work on academic and industry-sponsored projects.

"I'm excited to teach this capstone course," Mouradian said. "It's rare to have such a hands-on course at the graduate level, and it will be a great opportunity for students to take the information they've learned in the Certificate program and put it into practice while gaining exposure to industry and National Labs."

Fu noted that studies led by the National Science Foundation have shown that participating in smaller, independent team projects early in a doctoral degree program can help to accelerate completion of the degree. So, one of the Certificate program's aims will be to teach graduate students project management and team skills in quantum information science and engineering early in their academic careers. Fu said that there was excitement among faculty about this new capstone course, and combined with other courses in the Certificate program, what will be offered to graduate students overall.

"We've built a really serious program in this area, one that is at the forefront of research and education," Fu said. "Our students will receive a solid foundation, and they are going to go out and make an impact in this field when they graduate."

> **"If you want to make a difference in this field, then you need a solid base. And if you want to get that base, then you should get the Certificate."**
>
> — Professor Kai-Mei Fu

To learn more, visit the UW Graduate Certificate in Quantum Information Science and Engineering webpage on the QuantumX website. UW students interested in and eligible for the program should contact Program Coordinator Madeline Miller for information or to notify intent to pursue the Certificate.

Photo by Dennis Wise | University of Washington

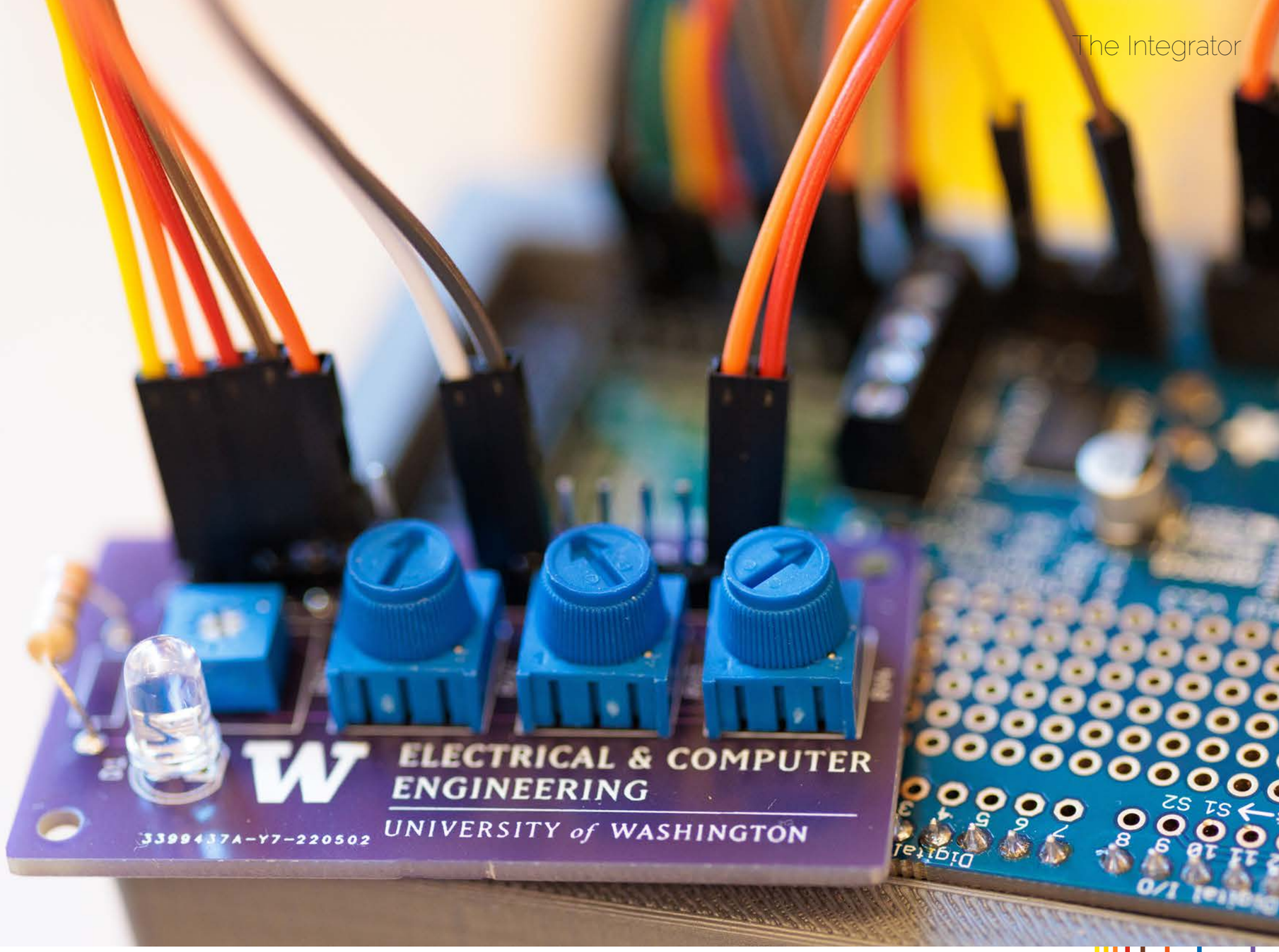
LUNCH AND LEARNS WITH UW ECE LEADERSHIP

COLLOQUIUM AND LYTLE LECTURE SERIES

TOWN HALL EVENTS FEATURING UW ECE FACULTY, STUDENT AND INDUSTRY RESEARCH

ENGINE PROJECT MENTORSHIP

SERVE AS A SPEAKER ABOUT YOUR CAREER IN OUR ONLINE COURSES



STAY CONNECTED WITH UWECE

VISIT US ONLINE FOR MORE INFORMATION:

Jasmine Soh from the "Airframe Health Monitoring System" team, sponsored by Amazon Prime Air

ENGINE Showcase

WEDNESDAY, JUNE 1, 2022

"For me, it is not a Capstone Project, but a life-changing program, because the skills I learned, the knowledge I gained, the environment I experienced, the respect I earned, and of course the friends I made, became fruitful for my life. I'd highly recommend upcoming students take part in this once-in-a-lifetime opportunity."

— Sanskar Naik
Team Joylux

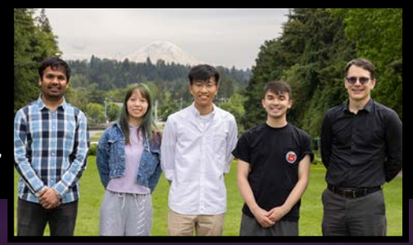
On June 1, UW ECE and the UW College of Engineering hosted in person its seventh annual ENGineering INnovation and Entrepreneurship (ENGINE) Showcase at the Husky Union Building (HUB). It was a delight to invite our industry and campus colleagues to join us as we featured and celebrated the hard work of our students, who soon after graduated to become the next generation of electrical and computer engineers. This year's Showcase featured 48 team projects representing 188 students and covered topics as diverse as digital health, cybersecurity, power systems, machine learning, communications and robotics.

The projects here arise from ENGINE — our engineering entrepreneurial capstone program. ENGINE was created to enable students to work in teams on industry-sponsored projects, and it is the culmination of a student's electrical and computer engineering education. This program, generously endowed by our alums Milton and Delia Zeutschel, is designed to develop students' skills in collaborative system engineering, innovation, entrepreneurship, project management and product development. It is also a way for our industry partners to benefit from the rich innovation culture at UW ECE.

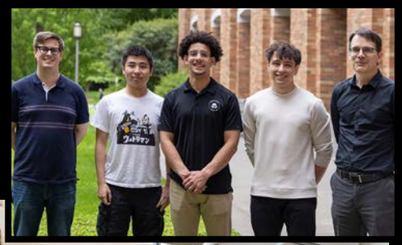
Congratulations to all students on the completion of your incredible final capstone projects!

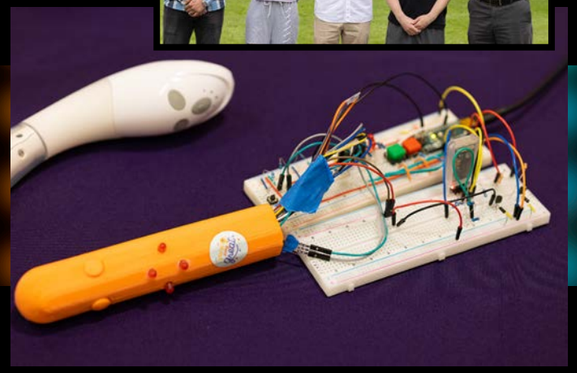
ENGINE teams explain and demonstrate their projects to industry partners in attendance.

Joylux-sponsored team members (left to right): Sanskar Naik, Zirong Ye, Yu Tang Kuo and Toshi Take, with Eric Klavins



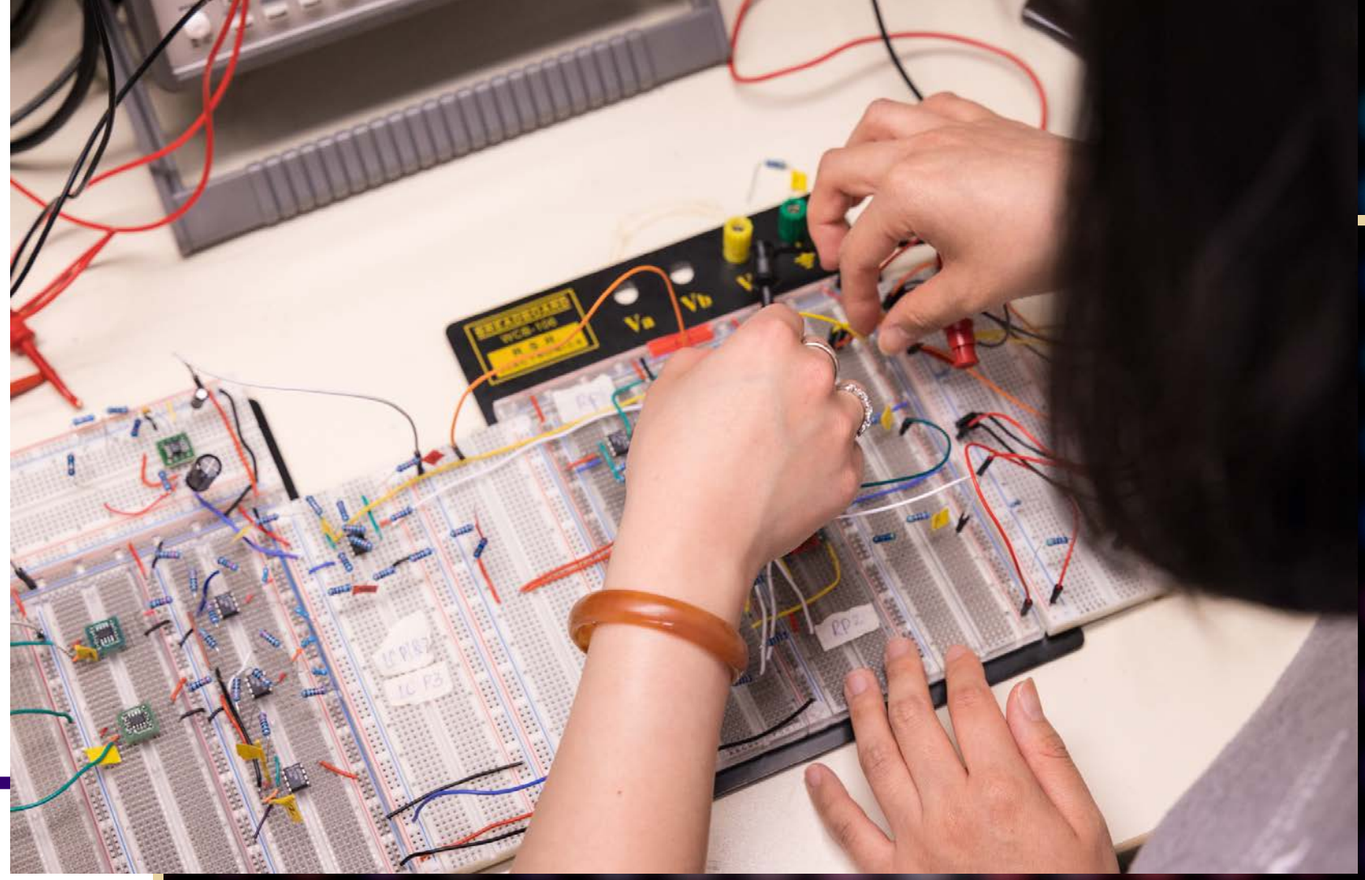
PACCAR-sponsored team members (left to right): Dean Hoover, Yijie Li, Alnur Elberier and Corbin Ferrie, with Eric Klavins

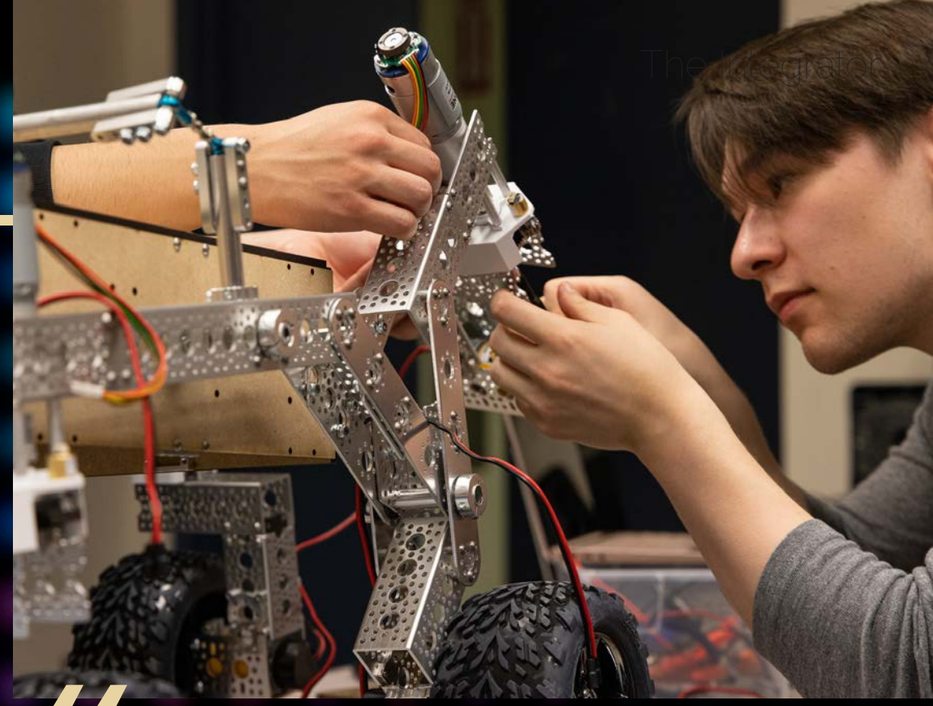




Two teams tied for first place at this year's ENGINE Showcase: "**Value Engineering**," sponsored by Joylux, and "**Robotic Arm for Automating Tester Connection**," sponsored by PACCAR (both pictured above). "**High Frequency Phase Meter**," sponsored by the UW Medical Center, came in second place, while another tie for third place was awarded to "**Wireless Airway Management System for Emergency Medical Applications**," sponsored by Stryker, and "**AI Video Captioning**," sponsored by Wyze. Congratulations to all of these top teams!

FIND OUT MORE ABOUT THE ENGINE PROGRAM AND SEE ADDITIONAL TEAM PROJECT PHOTOS, VIDEOS AND POSTERS:





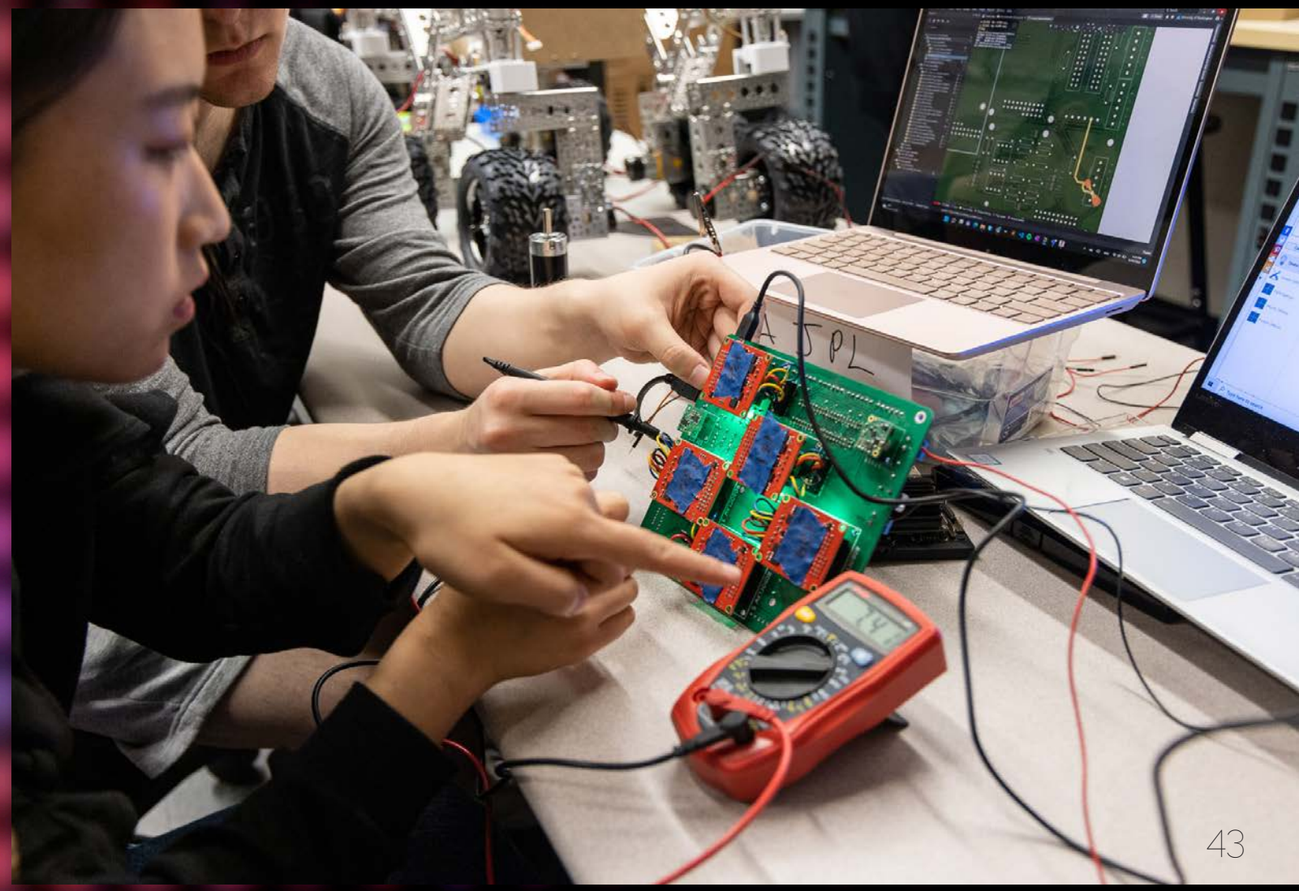
I was very proud to advise this team at UW. They did a great job on a very challenging problem with outstanding results under very tight timelines!" — Dave Laning
Insitu (a Boeing Company)

ENGINE 2022

48
ENGINE TEAM PROJECTS

40
INDUSTRY SPONSORS

188
ENGINE PROGRAM STUDENTS



ENGINE teams run final tests and give demonstrations on the progress of their projects as they near completion.

(Pictured, this page, top) Plugable-sponsored team; (bottom) Insitu-sponsored team; (opposite page) NASA JPL-sponsored team.

Our 6th annual Research Showcase took place virtually on March 10, featuring cutting-edge research projects from UW ECE graduate students. Visitors had a chance to review their posters, speak with the students and their advisers and learn more about the exciting projects underway across the various labs at UW ECE. The Research Showcase was also a perfect opportunity for visiting prospective students to learn more about the Department's research.

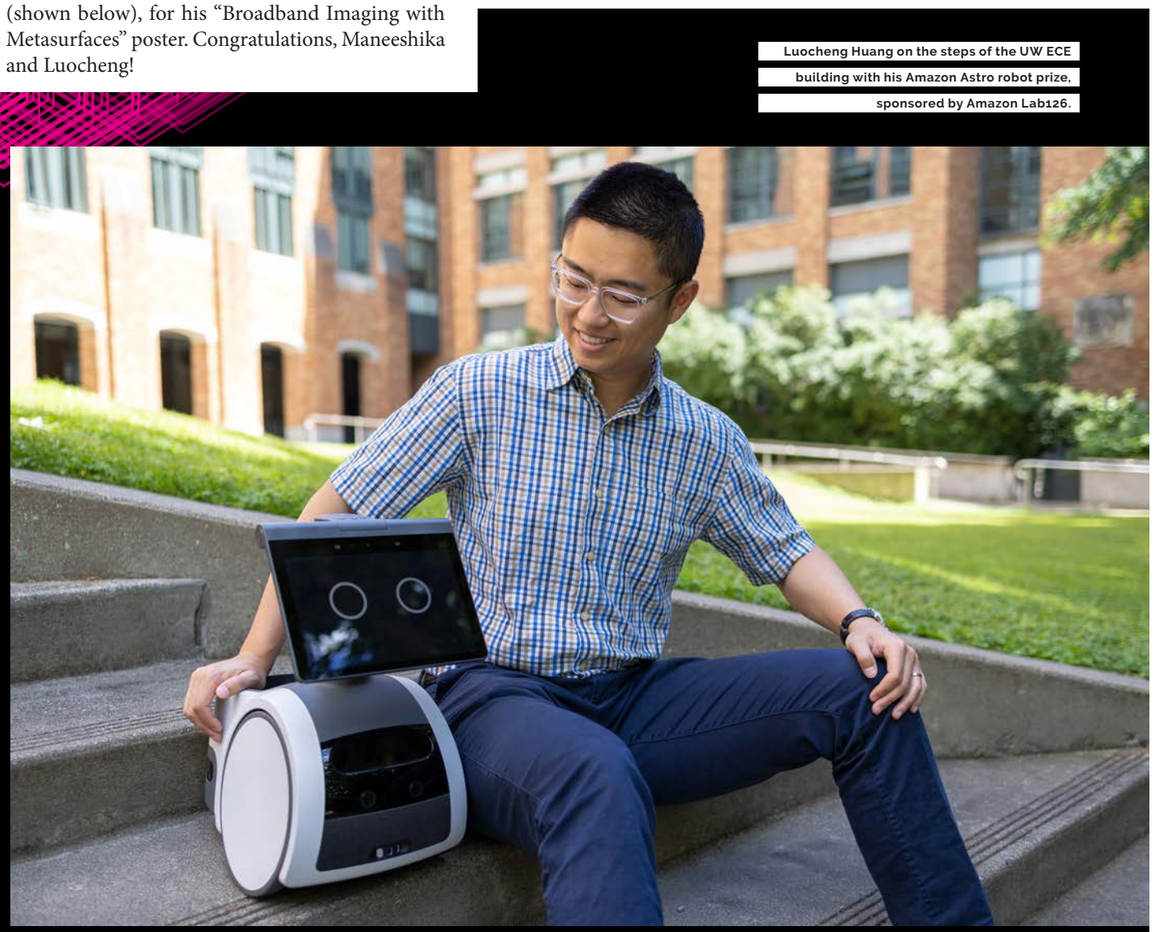
Research Showcase is the Department's premier event for students to showcase the exciting research projects they are working on in labs and groups across all areas of ECE. This event allows our students to present top research in a variety of areas with societal impact. The topics covered include AI, medical device technologies, power and energy, transportation, the environment, wireless communications and more.

The 2022 UW ECE Research Showcase **Travel Grant Winner for Best Foundations Theory Research** was Maneeshika Madduri for their poster, "A Game-Theoretic Model for Co-adaptive Brain Machine Interfaces." The **Amazon Astro Robot Winner for Best Applied Research** was Luocheng Huang (shown below), for his "Broadband Imaging with Metasurfaces" poster. Congratulations, Maneeshika and Luocheng!

LEARN MORE ABOUT RESEARCH SHOWCASE AND SEE ALL OF THE 2022 RESEARCH PROJECT POSTERS:

Research Showcase

THURSDAY, MARCH 10, 2022



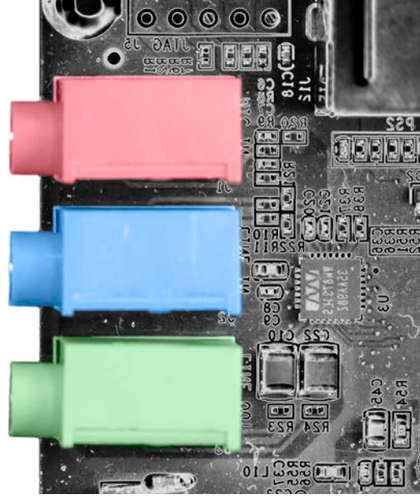
Luocheng Huang on the steps of the UW ECE building with his Amazon Astro robot prize, sponsored by Amazon Lab126.

READ ABOUT CURRENT AND PAST INITIATIVES, APPLY FOR A TRAVEL GRANT, AND SUBMIT NEW DEI PROPOSALS:

DIVERSITY

EQUITY

INCLUSION



DIVERSITY, EQUITY AND INCLUSION AT UW ECE

The University of Washington Department of Electrical & Computer Engineering is committed to diversity, equity and inclusion and expanding access to higher education. The Department works in cooperation with the UW Office of Minority Affairs and Diversity and the UW College of Engineering's Office of Inclusive Excellence to create welcoming and respectful learning environments while promoting access and opportunities for all.

Professor and Incoming Associate Chair for Diversity, Equity, and Inclusion, Denise Wilson. *Photo by Ken Yasuhara*

This year, Professor Denise Wilson was named incoming associate chair for diversity, equity, and inclusion at UW ECE. Wilson fills a vacancy left by Associate Professor Sam Burden, who is currently on sabbatical. Burden led creation of the associate chair position in 2021 and helped to launch a strong framework for DEI efforts within the Department. Wilson is known for her work developing microsensor systems aimed at solving emerging environmental and public health challenges. She is also working toward ending sexual harassment in engineering and is co-author of a new book on the subject, "Sex, Gender, and Engineering: Harassment at Work and in School." She will be teaching a new, DEI-focused course at UW ECE in spring quarter 2023, based on topics covered in the book.

From 2021 to 2022, UW ECE funded and successfully implemented several DEI initiatives, including:

A Vision for Electronic Literacy & Access (AVELA) summer 2022 outreach and community building,

organized and led by AVELA student leaders

AVELA used DEI initiative funds to cultivate a more inclusive campus climate at UW ECE and to help attract, retain and graduate a more diverse student body. This was accomplished by targeting academic resources and opportunities toward underrepresented minority students in partnership with affinity groups such as the National Society for Black Engineers, the Society for Hispanic Professional Engineers, the UW Black Student Union, the Louis Stokes Alliance for Minority Participation and other campus student-focused organizations. By supporting AVELA members in teaching STEM material to other underrepresented minority students in the K–14 grade range, UW ECE was able to help retain current students while also reaching out to the next generation and encouraging them to apply to UW ECE in the future.

DEI Book Club, *led by John Nettles, Assistant Director of Academic and Career Services, Professional Master's Program*

The DEI Book Club, established summer quarter 2022, is open to UW ECE doctoral students, faculty and staff who are passionate about creating inclusive and intentional spaces for historically underrepresented people in the field of electrical and computer engineering. The Club meets once a quarter to discuss a book participants have read that focuses on diversity, equity, inclusion and justice. The group talks about principles learned and how to apply this knowledge to work, studies and the Department as a whole. The Club has already distributed two books to 20 participants: "Emergent Strategy: Shaping Change, Changing Worlds" for summer quarter 2022 and "So, You Want to Talk About Race" for autumn quarter 2022. The Club will meet in December to discuss the autumn quarter book and distribute the winter quarter 2023 book, "Invisible Women: Data Bias in a World Designed for Men."

ECE Student Emergency Support Fund, *led by Whitney Thomas, Academic Counselor - Senior for Undergraduate Programs*

This fund serves as an avenue of financial support for UW ECE students experiencing severe financial hardship. Students may submit requests for unexpected situations, such as health care costs, car repairs, legal fees, travel for family emergencies, stolen goods, and housing and food insecurity. The fund launched in autumn 2022 and has already been able to help students with their financial challenges and persist with their studies.

Engineering CAReS, *led by Professor Denise Wilson*

The Competence, Autonomy, Relatedness Survey (CAReS) project seeks to understand how well basic psychological needs of working engineers are met in the engineering workplace. Funds provided by UW ECE support incentives to complete the survey. In contrast to a majority of workplace surveys that emphasize barriers hindering the advancement of working engineers, the CAReS project focuses on met, unmet and thwarted needs at work. Diving deeper into underlying needs opens up a broader array of potential strategies to build belonging, persistence and productivity in the engineering workplace, especially for those who are underrepresented in engineering disciplines.

We will be soliciting proposals for new DEI initiatives beginning in January 2023. For more information and to view a complete list of past, current and future DEI initiatives at UW ECE, visit the Department's Diversity, Equity, & Inclusion (DEI) webpage or contact Denise Wilson.

(Below) an autonomous tracking robot in UW ECE's Remote Hub Lab (RHLab), led by Associate Teaching Professor Rania Hussein.

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