The IPPE in Engineering

THE UNIVERSITY OF WASHINGTON COLLEGE OF ENGINEERING NEWSLETTER AUTUMN 2015

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DEAN'S MESSAGE

As we embark on a new academic year, I look forward to welcoming our students back to campus. Over the summer we have made significant advances on many exciting initiatives that will positively impact their UW Engineering experience and our community.

I'm pleased to announce the launch of the Career Center @ Engineering (CC@E). Opening to students this September, the new CC@E is designed to help students develop lifelong career strategy skills. The center will also function as a single entry point for employers seeking to hire engineering professionals. You can read more about the CC@E on page six.

Construction continues on the NanoEngineering & Sciences building that is scheduled to open in 2017. The 78,000-square-foot building will be adjacent to the Molecular Engineering & Sciences building and will support the growth of significant engineering research.

To serve growing demand for nanofabrication research services, the UW Board of Regents has approved the renovation of the Washington Nanofabrication Facility (WNF), which is housed in Fluke Hall. The overhaul, scheduled to begin in November, will upgrade basic building systems and roughly double the amount of highly-specialized fabrication space that academics and entrepreneurs increasingly rely on to build innovative devices. The WNF is managed by the college and is the largest publicly accessible nanofabrication facility north of Berkeley and west of Minneapolis. It is an important asset to not only our faculty and students but our local industry too.

Finally, we report an exciting partnership with China's Tsinghua University to develop the Global Innovation Exchange (GIX), a signature initiative in the UW's Innovation Imperative. GIX will pioneer new models of teaching and learning, combine rigorous university research with entrepreneurial know-how, and prepare students to be global thinkers and problem solvers. You can read more about GIX on page three.

The fall quarter is filled with many events including our annual lecture series and, of course, homecoming. I hope to see you on campus soon.

Mike Bragg Frank & Julie Jungers Dean of Engineering

Welcoming a new class of innovators

Seventeen exceptional new faculty members will join the college this year. We highlight two below. Meet them all at www.engr.uw.edu/newfac2015.

Elizabeth Nance

Clare Boothe Luce Assistant Professor, Chemical Engineering

Elizabeth Nance joins us from Johns Hopkins Medical Institutions where she was a postdoctoral fellow in anesthesiology and critical care medicine. Elizabeth integrates engineering, neuroscience and medicine to

develop translational nanotechnology platforms for biophysical probing and imaging biomarker applications in brain disorders. She developed the first nanoparticles that penetrate deep within the brain to improve imaging and treatment of brain ailments such as



cancer, autism, stroke and cerebral palsy. Elizabeth was named by *Forbes* 30 under 30 in Science and Medicine as one of the "most disruptive, game-changing and innovative young personalities in science."

J. Devin MacKenzie

Washington Research Foundation Professor in Clean Energy Professor, Materials Science & Engineering and Mechanical Engineering

Devin MacKenzie will hold joint positions in Mechanical Engineering, Materials Science & Engineering and the Clean Energy Institute. Devin is an expert in emerging electronic materials, including organic

semiconductors, nanomaterials, photovoltaics, thin film batteries and printed and flexible electronics. He co-founded Plastic Logic, a company that introduced the world's first ink-jet printed plastic screen device used in mobile technology. He is the CEO of Imprint Energy,



a startup focusing on flexible batteries and wearable electronic devices, which was recognized as one of the 50 Smartest Companies by *MIT Technology Review* in 2015 and received the Global Cleantech 100 Award in 2014.



UW and Tsinghua University create groundbreaking partnership with launch of the Global Innovation Exchange

In June, the UW announced the development of the Global Innovation Exchange (GIX), a new model for international collaboration in higher education. GIX is part of the UW's Innovation Imperative and is backed by a \$40 million commitment from Microsoft. Microsoft's support of GIX reflects the company's broader commitment to championing engineering. Based in a new facility in the Seattle area, this is the first time a Chinese research university has established a physical presence in the U.S.



GIX is designed to offer students a holistic, project-based learning environment with a global perspective. Starting in fall 2016, the institute's signature 15-month master's degree in technology innovation will link students and professionals, academia and industry, and experts and entrepreneurs. Together, they will work on real-world technological and design challenges such as mobile health, sustainable development and advanced cloud computing. Within a decade, more than 3,000 learners will be working alongside world-class faculty and industry mentors through GIX.

Engineering faculty from multiple disciplines have partnered across campus and led the development of GIX. GIX will build upon our deep and long-standing contributions to tech innovation in a leading-edge experiment to educate students for a new kind of world.

Microsoft dedicates \$10M gift to new UW Computer Science & Engineering building

As part of GIX, Microsoft awarded a \$10 million gift to kick-start a campaign to build a second Computer Science & Engineering (CSE) building on the UW campus.

"This is an investment in students who will become the innovators and creators of tomorrow," Brad Smith, Microsoft General Counsel and Executive Vice President said. "We hope this first corporate commitment to a new UW CSE building inspires others — individual donors, companies and those in state government — to support a project vital to the future of our state."

Microsoft's gift represents the first corporate commitment to a public-private partnership to assemble \$110 million in funding to construct a new 130,000-square-foot CSE building. The new facility will provide the space to enable the UW to double the number of computer science degrees it awards annually, from 300 to 600 — an important step in closing a large "workforce gap" in computer science in the state.



Nominate an Exceptional Engineer for a Diamond Award

The Diamond Awards honor outstanding alumni and friends who have made significant contributions to the field of engineering. If you know an engineer who deserves recognition, we want to hear from you! Take time to nominate an engineer to join the distinguished ranks of Diamond Award honorees. Deadline for nominations is Friday, October 16. www.engr.uw.edu/da

Benefits and Risks of

Technology publications are calling 2015 "the year of the car hack." This summer at DEF CON — one of the world's largest computer-hacker conferences — attendees tested the vulnerability of car computer systems at the first "Car Hacking Village." Members of Congress recently introduced the SPY Car Act, aimed at strengthening security in modern cars.

In other words, the rest of the world is catching up to the University of Washington's Security and Privacy Research Lab.

Four years ago, the lab in the UW's Department of Computer Science & Engineering co-led an effort that first exposed weaknesses in car computer systems and demonstrated that hackers could remotely control a vehicle's brakes, door locks and other functions.

"We like to look in the places that no one else is looking yet," said computer science & engineering professor Yoshi Kohno, who founded the security lab. "You open that area up, and once people start to show up, you move on to the next thing."

That trailblazing strategy has put the lab, which Kohno jointly runs with assistant professor Franziska Roesner, at the forefront of computer security and privacy. The UW engineers are international leaders in unmasking problems others haven't considered and helping guide the direction of the entire field. Their findings have driven security improvements in cars, medical devices, electronic voting machines and online browsing.

The lab's work is increasingly influential as computers are installed in countless everyday devices, making our lives better and easier, but also putting us at risk for identity theft and even physical harm. This year alone, more than 530 security breaches have compromised more than 140 million records kept by credit card and insurance companies, hospitals, government agencies and others.

To combat these and other cyber threats, Kohno and Roesner investigate ways that people can co-opt a computerized product or use online information, warping it into something never intended.

Take the car example. The UW researchers, in partnership with alumni Alexei Czeskis and Karl Koscher and computer scientists from the University of California at San Diego, were curious about the security of modern vehicles and their computerized systems. So the teams at each university bought a car and plugged their computers into the vehicle's computer to see if they could decode, and ultimately hijack, the car's software. They did it by listening as the computer systems talked to each other.

"If I go to a foreign country and try to learn the language, one of the best ways to do this is to eavesdrop," Kohno said. Then you "try to repeat things, and see if you get the same reaction."

Once the engineers figured out how to talk to the computer and manipulate its functions while plugged into it, they moved to the next phase: controlling the car remotely.

The researchers identified a number of digital entry points including Bluetooth cell-phone devices, satellite radio signals and a cellular network that allows a dealership, for example, to communicate with the car. Through the cell network, they demonstrated that they could remotely take control of the car and drive it. "We were surprised by how easy some things were" when it came to commandeering the vehicles, Roesner said. But up to that point, the carmakers hadn't thought to install systems that would make it difficult.

That's no longer the case. The car hacking experiments caught the attention of the National Highway Traffic Safety Administration, and the Society of Automotive Engineers created a cybersecurity taskforce. The federal car-safety legislation can likewise be traced to the work by the UW lab.

While the car hacking work garnered the most public attention, the lab has identified other important security weaknesses.

Kohno was an author on the first publications demonstrating the security risks of wirelessly reprogrammable pacemakers and defibrillators. Former Vice President Dick Cheney even had doctors disable the wireless mechanism in his defibrillator due to hacking concerns. Kohno stresses that the benefits of these devices outweigh the security risks and that patients should have no qualms using them. However, he believes that it is important for device manufacturers to improve the security of current and future devices. almost instantly and has a waiting list of a dozen or more.

The course essentially turns traditional software development on its head by taking a finished product that works one way and asking how it could be twisted, potentially for nefarious purposes. "It's kind of a surprising mind switch," Roesner said, but an important one for students to grasp if the industry is going to get a handle on security threats.

"In order to build secure systems," she said, "you have to understand how to break them."





the Internet of Things

Roesner has led groundbreaking work in the area of online data collection, trying to identify who is gathering information and what's being done with it. She led the development of a tool called ShareMeNot. Roesner partnered with the Electronic Frontier Foundation to incorporate ShareMeNot functionality in Privacy Badger, a tool that detects and blocks online advertising and other embedded content that tracks people without their permission.

The lab, which presently has over a dozen affiliated faculty and nine doctoral students, aims to stay one step ahead of the next cybersecurity challenge. Their current interests include the field of "augmented reality," which includes technologies like Google Glass or Microsoft's HoloLens that takes computer-generated information including graphics, sound or videos and projects it into a real-world setting.

With Kohno's and Roesner's help, many of the UW's Computer Science & Engineering students will graduate with a better understanding of risks posed by hackers. The professors teach an undergraduate course in security and privacy that fills up

CYBER SECURITY RESOURCES

Tips for safeguarding your information and devices:

- Set locks on your phone and computer screens and encryption for your wireless networks.
- Enable two-factor authentication for sensitive accounts so even if someone learns your password, they would also need to have your phone or other personal device to log into the account.
- Limit the ability of third parties to track you while using Firefox or Chrome browsers by installing Privacy Badger: www.eff.org/privacybadger.

Learn more at the fall lecture series:

Learn more about Professor Kohno and Roesner's work at the 2015 Engineering Lecture Series: Robots to Web Trackers: Privacy in the Age of Smart Technology.

See page 8 for more details and visit uwalum.com/engineering to register.

UW LEADs nation in female engineering faculty

Among the nation's top 50 engineering schools, the UW has the highest percentage of women in tenure-track engineering faculty positions: 22.4 percent. Nationally, the figure is 14.5 percent, and that gap didn't grow by accident. Over the past 14 years, the UW has worked on everything from highlighting how unconscious bias can affect hiring practices, to ensuring junior faculty feel comfortable extending tenure clocks to have children, to providing leadership support.

The UW chose early on to focus on one thing that can have an outsized influence on faculty members' well-being — especially for women and other underrepresented groups in STEM disciplines. They created Leadership Excellence for Academic Diversity (LEAD) workshops to help department chairs acquire skills to create equitable and inclusive environments that work well for all faculty members.

Now, the UW is developing an online toolkit — called LEAD-it-Yourself! — that other universities can use to design and host their own department-focused workshops. The UW's original campus workshops grew out of a 2001 NSF ADVANCE Institutional Transformation Grant awarded to advance female STEM faculty and help create a diverse and supportive climate for all STEM faculty. These workshops continue today on the UW campus. Since the first grant, the UW has seen a 78 percent increase in the number of tenured or tenure-track women faculty in all ADVANCE departments, including an 100 percent increase in engineering departments and a 59 percent increase in science and math departments.

New Career Center @ Engineering to Connect Students and Employers

Opening to students this September, the new Career Center @ Engineering (CC@E) is designed to help students develop lifelong career strategy skills. The center will function as a single entry point for employers seeking to hire engineering professionals. The center aims to improve visibility and responsiveness to students and companies and will coordinate on-campus recruiting, including interviews, information sessions, and job postings. The CC@E provides leadership, resources and networks to link employers with highly qualified candidates across the broad range of the University's engineering disciplines. The CC@E will also partner with companies to help develop an individualized campus recruiting strategy.

Center staff will coach and prepare students in areas of career strategy and successful job search techniques, including writing and tailoring a resume, how to build and sustain a professional network, and how to conduct an excellent job interview. Staff

will also work with students to help them concisely communicate about talents, strengths, values, transferrable skills, and experiences in ways that align with various industries and

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engineering career options. The CC@E will house the Engineering Internship Program (formerly known as "co-op"). This program will provide students an opportunity to enhance their engineering curriculum through practical application, make professional networking connections and potentially gain academic credit.

"The Career Center @ Engineering is an important initiative for the college — one that promises to enrich our students' educational experience and deepen our industry partnerships. Our students develop strong technical skills in the classroom. This center will expand opportunities for experience based learning. This will allow our students to enter the workforce with confidence and, at the same time, meet the needs of industry," said Mike Bragg, Frank & Julie Jungers Dean, College of Engineering

The center was formed as a branch of the UW Career Center and will be housed in the College of Engineering in Loew Hall.

IN THE LAB

Researchers scaling up fusion hopes with DOE grant

Producing reliable fusion energy — the same process that powers the sun — has long been a holy grail of scientists. It releases no greenhouse gases, can be fueled by elements found in seawater and produces no long-lived nuclear waste.

The basic mechanism — getting two nuclei that want nothing to do with each other to fuse — is also difficult enough that there's no danger of a runaway chain reaction. In fact, scientists so far have struggled to create self-sustained controlled fusion reactions that produce more energy than they consume.

UW researchers have spent two decades developing a novel way to provide plasma stability that's critical to achieving fusion. With a \$5.3 million U.S. Department of Energy grant announced in May, they will partner with Lawrence Livermore National Laboratory to scale up their "Sheared Flow Stabilized Z-Pinch" device in the hopes of achieving a sustainable fusion reaction that might one day power homes or propel spaceships far beyond current limitations.

"Fusion energy is the ultimate energy source. It has the potential to be a very robust source without the reliability problems of wind and solar," said UW professor of aeronautics and astronautics Uri Shumlak, who collaborated with UW electrical engineering professor Brian Nelson to develop the device. "Our project will be a proof-of-principle experiment, and just showing that the sheared flow stabilized Z-pinch approach scales to higher powers is going to be really exciting."

They will need to increase the amount of energy that has been injected into the Z-pinches they've built to date by more than tenfold. The team plans to build a new Z-pinch device at the UW by summer of 2016 and run its first fusion tests in 2017.

Creating accessible makerspaces for people with disabilities

Inside the UW's CoMotion MakerSpace, students, faculty and staff use sewing machines to create anime convention costumes, 3-D print models for aeronautics research or make circuits for a custom-built amplifier.

Inspired by the DIY movement, these communal spaces enable a broader array of people to tinker, create, or prototype whatever invention they can dream up.

To ensure those spaces are truly inclusive, a team of UW researchers has released new guidelines aimed at ensuring makerspaces are accessible to people with disabilities.

The effort is part of a broader NSF funded AccessEngineering initiative, which supports students with disabilities in pursuing engineering careers and promotes accessible design in engineering departments and courses.

"A lot of universities are creating more casual prototyping spaces as an alternative to a traditional machine shop," said AccessEngineering co-principal investigator Kat Steele, a UW assistant professor of mechanical engineering whose Human Ability & Engineering Lab focuses on developing tools for people with movement disorders. "This is a big growth area for engineering schools. We wanted to help develop best practices so as these new spaces are being created they can be accessible to the widest group possible."

The idea for makerspace guidelines arose, in part, because so many new computer-aided design tools are making it easier for people with disabilities to explore their creativity, prototype ideas and invent.

"It's really important to make sure these spaces are accessible precisely because these technologies are so enabling," Steele said. "Engineers are problem solvers, and the more diversity we have in the field the more problems we'll be able to solve, because everyone comes to that process with different life experiences and priorities."



COLLEGE OF ENGINEERING

UNIVERSITY of WASHINGTON

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2015 Engineering Lecture Series Robots to Web Trackers: Privacy in the Age of Smart Technology

The Invisible Trail: Pervasive Tracking in a Connected Age Franziska Roesner, Assistant Professor, Computer Science & Engineering Wednesday, October 7

As our world becomes more computerized and interconnected, we find ourselves increasingly at risk of security breaches and invasions of digital privacy. Recent UW studies explored how advertisers, social media sites, and others invisibly track your browsing, and how smartphone applications are able to access your camera, location, and other sensitive information in ways you may not expect. Learn about improved systems, currently being developed at the UW.

Our Robotic Future: Building Smart Robots that See in 3-D

Dieter Fox, Professor, Computer Science & Engineering Director of the UW Robotics and State Estimation Lab Wednesday, October 21

Robots have long been a science fiction staple, but with recent technology advances robots will soon integrate into our lives. Much of this progress came about through the introduction of video cameras commonly used in gaming applications. These cameras provide information that enable robots to see and interact with the world in 3D. Learn more about how robots are learning to perform 3D mapping, recognize and manipulate objects, and track human movement and poses.

Responsible Innovation: A Cross Disciplinary Lens on Privacy and Security Challenges

Tadayoshi Kohno, Short-Dooley Professor, Computer Science & Engineering and Co-Director, UW Tech Policy Lab Batya Friedman, Professor, Information School Co-Director, UW Tech Policy Lab

Ryan Calo, Assistant Professor, School of Law Co-Director, UW Tech Policy Lab

Tuesday, November 3

Engineering innovations drive changes in how people interact, conduct business, raise their children, and care for elders. New technologies emerge and enter the marketplace at an incredibly rapid rate, and bring with them benefits and risks. Policy, society's regulator, hastens afterward. What does it mean to innovate responsibly, particularly with respect to privacy and security? Join us for a panel discussion with the UW Tech Policy Lab, an interdisciplinary center uniquely positioned to address these issues.

All lectures are at 7:30pm, Kane Hall, UW Campus – FREE! Registration required, online at UWalum.com/engineering or call (206) 543-0540.

Presented by the College of Engineering in partnership with UW Alumni Association