

AUTUMN 2019

MESSENGER

MECHANICAL ENGINEERING | UNIVERSITY of WASHINGTON

Autonomous systems follow
the flock, *Pages 6-7*



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CHAIR'S MESSAGE

A DIVERSE DISCIPLINE

Mechanical engineering deals with every imaginable system, from the tiniest microparticles to the largest spacecraft, and even the human body. It's the most diverse of all engineering disciplines, and that makes it exciting. Our faculty and students are working in clean rooms and research labs, prototype shops and health clinics, on assembly floors and research vessels, with start-ups and industry in Seattle's thriving high-tech economy, and in middle school classrooms, where they're introducing young people to the excitement of solving the most pressing societal problems through engineering.

This issue features stories of ME at work across several of these diverse areas. To learn more about the impactful research under way across the department, visit us online at me.washington.edu.



Per Reinhall

Mechanical Engineering Chair

New faculty, recent promotions and retirements



Xu Chen

(Ph.D., University of California, Berkeley), assistant professor, joins us from the University of Connecticut, where he was an assistant professor of mechanical engineering. His research interests include

dynamic systems and controls, advanced manufacturing and smart machines. Chen is a recipient of a NSF CAREER Award and the Young Investigator Award from ISCI / ASME International Symposium on Flexible Automation.



Juan Carlos del Alamo

(Ph.D., Escuela Técnica Superior de Ingenieros Aeronauticos, Madrid), professor, joins us from the University of California, San Diego, where he was a professor of mechanical and aerospace engineering. His research focuses on biological fluid mechanics and

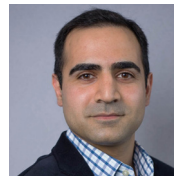
cardiovascular biomechanics, with emphasis on cell mechanics and intracardiac flows. His research awards include the U.S. Geological Survey Director's Award, a NSF CAREER Award and the William Parmley Award from American College of Cardiology.



Michelle DiBenedetto

(Ph.D., Stanford University), assistant professor, will join us in 2021. Currently a postdoctoral scholar at Woods Hole Oceanographic Institute, she investigates fundamental fluid mechanics phenomena relevant to the

environment. Her work aims to address how properties at the particle scale can impact large scale physical processes. She is motivated by problems such as microplastic pollution in the ocean and how active plankton respond to flow cues.



Mohammad Malakooti

(Ph.D., University of Florida), assistant professor, researches at the intersection of solid mechanics, nanotechnology, materials science and manufacturing. His

contributions have led to 60 publications, including 29 peer-reviewed articles in high impact journals. Prior to joining us, he was a research scientist at Carnegie Mellon University, where he explored stretchable electronics for wearable computing.



Krithika Manohar

(Ph.D., University of Washington), assistant professor, will join us in 2021. She specializes in optimization of data-driven learning, dimensionality reduction and control

of large-scale dynamical systems, with applications to sensor and actuator placement, fluid dynamics and manufacturing. Manohar is currently a postdoctoral fellow in Computing & Mathematical Sciences at the California Institute of Technology.

We are also pleased to announce **Nathan Sniadecki** and **Junlan Wang's** promotions to full professors, and **Igor Novoselov's** promotion to research associate professor.

Finally, join us in congratulating professor **Minoru Taya** on his retirement this year. He will continue to pursue research in ME.

Transforming titanium with 3D printing

ME's newest 3D printing lab explores additive manufacturing of complex structures with titanium.

By Chelsea Yates

3D printers can print objects from a variety of materials: plastics, ceramics, glass, nylon, resins, even chocolate. Thanks to recent advancements in additive manufacturing technology, engineers can add titanium to this list. An earth abundant metal, titanium is valued for its unique mechanical properties and high strength-to-weight ratio.

However, due to its strength and high melting point, titanium is difficult to convert from its raw form to a finished part. This makes manufacturing processes challenging and uneconomical, and it limits the applications of the metal. But engineers hope that advancements in 3D printing will change that.

“UW engineers with this experience will be in high demand worldwide as 3D printing continues to change how manufacturing occurs.”

- ME professor Ramulu Mamidala

“Titanium 3D printing has the potential to open new pathways in additive manufacturing for industries ranging from health to aerospace,” says ME professor Ramulu Mamidala, who leads the Metal 3D Printing Lab as part of the Washington state-funded JCDREAM (Joint Center for Deployment and Research in Earth Abundant Materials) initiative. In 2017, the lab acquired a 3D printer capable of printing titanium. It's the only one of its kind at the UW and one of just a few at universities across the country.

There are several benefits to printing titanium. In addition to being abundant and strong, it is corrosion resistant and melts at a much higher temperature than most common metals. It's also lightweight and biocompatible, making it a very good material for surgical implants and medical devices.

The lab's researchers say this printing method is more versatile than traditional manufacturing methods, and because of how easily parts can be designed and printed,



complex geometric forms can be easily created, allowing for more efficient prototyping and part testing. Plus it's less wasteful; according to Mamidala, unlike conventional machining processes, where over 80% of the raw material is wasted, this process wastes less than 5%.

From energy to transportation, many major industries currently depend on rare earth materials as well as materials mined using unsustainable practices. Mamidala sees 3D titanium printing technology development as a way to reduce dependence on these materials. He says that it's especially important for universities like the UW to be involved in this work.

“Titanium 3D printing is going to revolutionize industries where lightweight, complex geometries are essential to a design's performance,” he explains. “Additive manufacturing places us on the cusp of enabling the next major changes in aircraft and spacecraft capability; therefore, UW engineers with this experience will be in high demand worldwide as 3D printing continues to change how manufacturing occurs.”

Learn more about the Metal 3D Printing Lab at depts.washington.edu/mstlab/research/metal-3d-printing/

Above: A 3D-printed wheel hub mount. Notice the intricate details. Titanium 3D printers are capable of creating complex geometric forms more so than traditional manufacturing methods. Photo by University of Washington

ON TRACK TO STEM

By Chelsea Yates
Photos courtesy of Washington Hyperloop

Since 2016 Washington Hyperloop has been one of the top three U.S. teams competing in SpaceX's summer challenge. Now they're setting a new goal: get more kids excited about engineering.

Not long after John Buffalo began ESS307, a diversity outreach class offered through the UW's Earth and Space Sciences (ESS) department, he told his Washington Hyperloop teammate Ethan Simcock to sign up.

"Originally I enrolled to fill some requirements, but wow did it open my eyes," Buffalo, a ME senior, remembers.

Taught by Isabel Carrera Zamanillo, the ESS course exposes students to the barriers that underserved and underrepresented young people in the Northwest may face in pursuing careers in science, technology, engineering and math (STEM). It also helps UW students understand how to design culturally appropriate outreach activities. Along with attending lectures, students are required to log 40 service hours in Washington schools, working with K-12 students and teachers through science education outreach.

"They may have been 'required,' but honestly those volunteer hours flew by," Buffalo says. "Encouraging younger kids in STEM turned out to be as much fun as it is important."

Simcock, a civil and environmental engineering senior, agrees.

"My first thought was, why aren't all engineering students doing this?" he recalls.

Then the two had an idea: Why not get Washington Hyperloop more involved in outreach?

A student team that designs, builds and competes small-scale pods in SpaceX's college Hyperloop challenge each summer, Washington Hyperloop consists of about 30 UW students. Simcock is one of the directors, and Buffalo leads the Structures subteam.

"Many of us had access to advanced science and math classes and resources before coming to the UW, but that's not the case for a lot of high school students, and the degree to which access varies school-to-school is shocking," Simcock says.

So they pitched their idea: in addition to preparing for summer competition, would their teammates be open to participating in a few outreach events?

They received a resounding answer: Of course!

A need for STEM outreach

Middle school is an especially critical time for STEM engagement, according to ME professor and College of Engineering Associate Dean of Academic Affairs Brian Fabien.

"Kids begin to identify with specific disciplines and question their confidence in others

This page: Middle schoolers construct spaghetti and marshmallow structures. The goal is discover how tall they can be and how much weight they can support.

Opposite page: Washington Hyperloop teammates use soda bottles to demonstrate the effect of buoyant forces on a Cartesian diver.



around the fifth grade, so this is the time to capture their imaginations and help them see possibilities," he says.

Unequal access to high-quality STEM education complicates matters further. Because these inequalities tend to run parallel with socioeconomic and racial lines, outreach efforts are especially important for low-income and minority students.

"It's great if a middle or high school has 3D printers, a robotics club and coding classes, but many don't," says Buffalo. "That means students start college — if they have access to college — at different levels of familiarity. Those who've already been doing engineering-type work have a head start."

Fabien adds that it's beneficial for college students and teams like Washington Hyperloop to be involved with outreach activities, since younger students are more likely to identify with college students than with faculty. And exposing college students to gaps in educational access helps shape their perspectives and understanding. It also gives them an opportunity to sharpen their communications skills.

"We need to be able to explain what we do as engineers and how it benefits society," Fabien says. "Talking to middle schoolers is very different than talking to peers. In many ways it's more challenging, and that's a good thing."

Encouraging engineering excitement

With their ESS instructor's help, Buffalo and Simcock connected Washington Hyperloop with the Northwest Earth and Space Sciences Pipeline, which was coordinating educational events in conjunction with the Apollo 11 mission's 50th anniversary last spring. Team members participated in two events for middle school students in Tacoma and Everett. Each event drew more than 100 parents and students.

"Kids can see what college looks like and, hopefully, see themselves at a place like the UW one day."

- ME senior John Buffalo

Hyperloop team members led activities that demonstrated physics and science principles. For one, they used stretchy Lycra fabric and marbles to emulate how gravity works on planets. For another, they demonstrated the effect of buoyant forces on a Cartesian diver with a soda bottle.



"While the demos were fun, we got a lot of questions — from kids and parents — about what exactly engineers do and what it's like to be an engineering student," Simcock says. "So we started building time into our outreach events to discuss this."

They also realized the value in hosting classes on campus.

"This way, kids can see what college looks like and, hopefully, see themselves at a place like the UW one day," Buffalo explains.

Last spring the team tested on-site demonstrations and discussion by inviting an Everett Gateway Middle School class into their UW CoMotion workspace. Buffalo says they focused the presentation on foundational engineering activities.

"As much as we love talking to people about our pod, it doesn't resonate with middle schoolers the same way that, say, challenging them to build structures from spaghetti and marshmallows to determine how much weight they can support does," he says.

The team is eager to advance their outreach efforts this year by hosting more classes on campus.

"If Washington Hyperloop can encourage kids to get excited about engineering, hopefully we can also help them see that college is an option and imagine themselves in a fun engineering workspace like ours one day soon," says Simcock.

**Interested in learning more
or requesting a class visit?**

Email washingtonhyperloop@gmail.com

THE MURMURATION WHISPERER

Santosh Devasia is investigating how the flocking behavior of birds could inform autonomous robotics research.

By Sarah DeWeerd

Many of us have found ourselves transfixed by a flock of birds swooping and shifting direction in such perfect synchrony that the whole flock seems to shimmer in the air, a phenomenon sometimes known as a murmuration.

Engineers are fascinated by murmurations and flocking behavior too, albeit not so much for their beauty as for their practical import. A flock is an example of a distributed system — one in which individual members work together without central control.

“As soon as something happens in one end, everyone knows what to do,” says ME professor Santosh Devasia.

The development of autonomous robots — driverless cars, drones and so on — has touched off increasing interest in distributed systems. Distributed systems have a lot of advantages — security, resilience, practicality. The question is how to make sure everyone knows what to do as seamlessly as happens in a flock of birds.

“How information propagates is very important,” Devasia says.

Devasia recently proposed a new mathematical model that captures this information propagation within flocks much more accurately than past models have been able to do. Now, he’s working to refine his model even further, and test whether it actually works when applied to robots in the real world.

Birds do it

Devasia got interested in murmurations about four years ago, when he heard a talk at a conference about research using data from real bird flocks to cast doubt on a standard mathematical model of flocking behavior that had prevailed for several decades.

The conventional model assumes that each bird looks to a set of neighbors to see what they are doing and adjusts

its own flight path accordingly. The model’s equation is essentially the same as that used to explain heat transfer, such as how an incandescent light bulb warms the surrounding air.

In fact, that approach works pretty decently to describe the behavior of small flocks or ones moving slowly. But when the model is run with larger numbers or higher speeds, the flock splits apart — in contrast to the seamless unity of flocks in the real world.

“The model is very simple, the equation is really incredibly simple,” Devasia says. “And yet the birds have found a way to beat it.”

He wanted to find out the birds’ secret.

It turns out the problem is that in the conventional model, information transfer about rapid turn maneuvers dampens as it moves through the flock.

(Similarly, if a light bulb is turned on for a little while and then switched off, the transferred heat diminishes with distance: The air an inch from a light bulb is warmer than the air a foot away.)



Devasia’s model improves on the status quo by adding an additional mathematical term to the model equation. His version assumes that each bird adjusts what it’s doing based on its own past actions in addition to its observations of neighbors.

“So it’s an extra kick to what you’re trying to do,” Devasia says. He calls this concept ‘delayed self-reinforcement.’ In computer simulations using this new model, even large flocks moving and shifting directions rapidly remain perfectly synchronized, he reported in a paper published earlier this year.

Robot, take the wheel

But Devasia wasn’t content to just improve things. “As an engineer, the next question is, what’s the best I can



do?" he laughs. In a forthcoming paper, he dives deeper into the rationale behind the new model and adds a few more mathematical refinements to further improve its performance.

These new refinements account for the fact that, unlike dots in a computer simulation, birds and robots can't shift speed and direction instantly. "So the new theory allows us to then apply it to real-world problems," Devasia says.

He's beginning to do just that. In his lab, downstairs from his spare, tidy office in the Mechanical Engineering Building, Devasia's team has built a fleet of 3D-printed robots that look like deconstructed toy cars. They want to see whether applying the new algorithm enables the cars to form tighter, more reliable groups, or 'platoons,' which saves both fuel and road space.

Another floor down, in the Boeing Advanced Research Center, which Devasia directs, he's working on coordinating groups of robots to move larger structures. This could be useful in manufacturing processes, such as attaching a wing to an airplane.

If the approach pans out, it could have a host of other applications, such as coordinating robots in warehouses, fleets of drones delivering packages or arrays of satellites used in remote sensing.

Devasia even hopes that his model might aid in understanding the human brain. He's been thinking

"The model is very simple, the equation is really incredibly simple. And yet the birds have found a way to beat it."

- ME professor Santosh Devasia

about how neurons fire in a distributed manner, yet their activity adds up to organized patterns that underpin complex thought. Could the idea of delayed self-reinforcement yield insights into how this occurs?

And then there's birdwatching. Devasia says he didn't have any particular interest in birds before starting this line of research, but now he regularly finds himself captivated by the synchronicity of their movements.

"Unfortunately, that's dangerous when you're driving a car," he says.

One more reason to get those autonomous vehicles operating smoothly.

Above: A flock of birds is an example of a distributed system – one in which individual members work together without central control. Photo by TeeFarm from Pixabay

Opposite page: Santosh Devasia

Engineering and the human body



Biomechanics, ME's newest undergraduate degree option, combines mechanical engineering with biology and physiology to enhance understandings of health and inspire innovation.

*By Chelsea Yates
Photos by Mark Stone*

According to Hector Iturribarria Bazaldua, the most exciting aspect of biomechanics is the “unknowingness.”

“In biomechanics we look at the human body as a complex system, a machine. But every human body is different and they’re always changing,” he explains. “This unknowingness makes biomechanics a challenging but fascinating area to study.”

Bazaldua, who received his ME bachelor’s degree last spring, was part of the department’s first cohort of students to graduate with a concentration in biomechanics. Along with mechatronics and nanoscience and molecular engineering, it’s one of three degree options in which ME undergrads may choose to focus while at the UW.

“Using mechanical engineering approaches to understand biological systems — and vice versa — has long been a strong interest area for ME researchers,” says ME associate professor Kat Steele, who coordinates the biomechanics option with ME professor Nate Sniadecki. “Our goal is to formalize an academic framework for it and legitimize it as a professional pathway for students.”

“ME has a rich history of advancements in biomechanics and health technologies, thanks to the work of pioneers such as emeritus faculty Albert Kobayashi and Colin Daly and alumni Wayne Quinton and Savio Woo,” Sniadecki adds. “Plus, the department has partnered for nearly 20 years with the Seattle VA’s Center for Limb Loss and MoBility, a collaboration that has helped propel biomechanics research in new directions.”

Even as a sub-field of mechanical engineering, biomechanics is quite diverse. Researchers work in areas ranging from ergonomics, human factors design, cell mechanics, cardiovascular fluid dynamics and human-machine interaction to the development of medical devices, electronic wearables and sports equipment.

Last spring 10 students completed the program. Moving forward, Steele and Sniadecki hope to see 20-30 ME students graduating from it each year.

Pursuing biomechanics

To graduate with a biomechanics concentration, ME undergraduates must complete 19 biomechanics credits. ME 411, Biomechanics Frameworks for Engineers, and ME 419, the Biomechanics Seminar, are required. Beyond those, students select electives tailored to their interests.

“ME 411 was so engaging,” remembers Toni Erwin, who graduated from ME last spring. “We learned how to apply fundamental principles of engineering to systems within our own bodies and analyzed the science behind those systems to make predictions about human bodies more broadly.”

Erwin says that the electives opened up new ways for her to explore engineering. She took courses she would have otherwise shied away from, such as classes in vibrations and finite element analysis.

“These classes focused on system dynamics, which had never been interesting to me until I started applying it in a biomechanical sense,” she says. “For example, in my vibrations class I tackled engineering challenges related to oscillation of movement in structures and systems — something very important in analyzing motion capture data or designing a prosthetic device to reduce impact on the residual limb.”

ME’s biomechanics does not require a pathway specific capstone project. However, many students choose to participate in Engineering Innovation in Health (EIH) — the department’s capstone program that connects local clinicians with student teams to solve pressing healthcare challenges — as program credits count toward the option. So, too, do credits from internships at places such as the Seattle VA.

“The skills I gained through biomechanics helped me become a more well-rounded engineer, something companies really value.”

- Toni Erwin, BSME '19

ME graduate Ian Johnson did both. “During my sophomore year I interned at the VA where I helped create 3D-printed foot models for researchers working to enhance mobility in people with foot and leg impairments,” he says.

Then during his senior year, he took part in EIH and was on a team called DopCuff, which created a device to get more accurate blood pressure readings.

“Having real-world experience like these projects and working alongside clinicians, professional engineers and sometimes even patients was so valuable,” he says.

Becoming a more well-rounded engineer

During the winter quarter seminar, biomechanics students have the opportunity to hear from industry leaders and professionals, connecting them to potential post-graduation career opportunities. Since it’s only offered once each year and can help students decide if the biomechanics option aligns with their interests, Sniadecki advises students interested in the biomechanics concentration to take the seminar before their senior year.

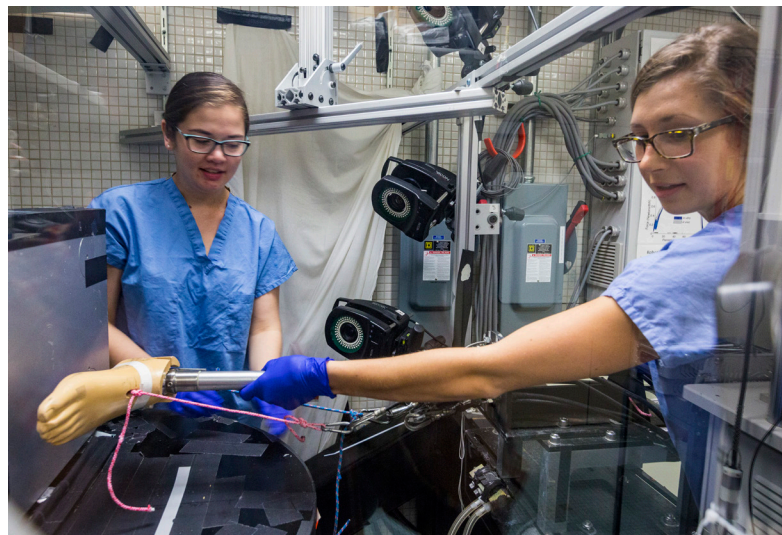
Irwin, Johnson and Bazaldua say that their biomechanics background played a key role in the jobs they now have, even if those jobs are not directly related to the field.

“The skills I gained through biomechanics helped me become a more well-rounded engineer, something companies really value” says Erwin. Now a mechanical design engineer at Katerra, she hopes to attend graduate school in the future so she can further her studies in biomechanics.

Johnson is a mechanical engineer at Pure Watercraft, a company that makes electric motors for boats. Though his current position is not directly involved in biomechanics, he says there’s opportunity to move in that direction once he has more on-the-job experience.

And Bazaldua, who now works at The Boeing Company on flight deck design and crew operations, finds that he draws from his background every day.

“My team’s work is concentrated in human-machine interaction, especially how pilots and crew interact with airplanes,” he says. “It’s very biomechanics, which makes my job complex but cool to work on.”



Learn more about ME’s biomechanics degree option: me.uw.edu/students/ug/biomechanics

Above: ME’s ongoing partnership with the Seattle VA’s Center for Limb Loss and MoBility provides hands-on research opportunities for students.

Opposite page: In campus labs, such as the AMP Lab, students work with researchers to investigate the dynamics and control of movement to design treatment strategies and assistive technologies that improve function and quality of life.



Research impact

Elizabeth Rasmussen is developing a clean, scalable approach to synthesizing advanced materials, setting the stage for innovation in batteries, targeted drug delivery and more.

By Chelsea Yates

To explain her research — which centers on thermodynamics, heat transfer and a class of materials called metal-organic frameworks (MOFs)— Elizabeth Rasmussen turns to a kitchen favorite: the chocolate chip cookie.

“MOFs consist of metal ions and organic linkers, and because they’re highly porous and have an ultrahigh surface area, they are excellent candidates for applications ranging from targeted drug delivery to alternative energy storage devices, such as batteries,” the ME doctoral student explains.

In cookie terms, Rasmussen says to think of the metal ions as chocolate chips and the organic linkers as the dough. But she’s quick to add that she’s not focused on changing the cookie recipe; what she’s developing is a new way to cook the dough.

A National Science Foundation Research Trainee in the UW eScience Institute and a Clean Energy Institute (CEI) fellow, Rasmussen is investigating how to innovate MOF materials synthesis in a scalable, cost-effective and sustainable way. To produce them on a large scale and make MOF materials more broadly available, this synthesis step is critical; it’s the key ingredient in her research, which draws from mechanical engineering, materials science and manufacturing.

And she’s off and running: The team she founded earlier this year — MOtiF Materials — took first in the 2019 Alaska Airlines Environmental Innovation Challenge (EIC) for demonstrating how their work with MOFs can make batteries degrade less quickly over time.

MOtiF Materials technology

Smartphone owners are well aware of the frequent need to charge their phones. What if a phone’s battery life could last 10 times longer than it does now? Research suggests that MOF-based batteries could make this possible.

To synthesize MOFs for battery use, Rasmussen has developed a novel flow reactor. It’s the “oven” in her baking analogy. Current battery manufacturing processes create a lot of toxic waste; Rasmussen’s reactor produces almost zero waste. It’s also able to synthesize MOFs in a matter of seconds, as opposed to traditional methods which can take days.

A specialized reactor with cleaner performance and higher yield may seem expensive. Not so, Rasmussen says.

“Starting with energy storage technology is important because if you can improve that, you impact all other clean energy technologies.”

– ME doctoral student Elizabeth Rasmussen

“Because our process is conducted at mild temperatures, it allows us to collect and recycle unused chemicals, we can create MOFs for considerably less than current options on the market,” she explains.

Above: Elizabeth Rasmussen adjusts settings as she prepares to use the novel flow reactor she’s developed for MOF materials synthesis. Photo by Dennis Wise

It's this method that sets MOtiF Materials apart from its competitors, who tend to focus more on the "recipe" for creating MOFs, not the scalable manufacturing method needed to make MOFs more widely available.

"It's all about the science"

Though there's momentum for innovation like MOtiF Materials in the startup sector, for now, Rasmussen says she's committed to the research. "This is my dissertation project," she explains. "Before exploring business opportunities, I want to make sure the research is 100%."

A commitment to research was the main reason Rasmussen decided to enroll at the UW for graduate school. A summer internship at MIT Lincoln Laboratory solidified her desire to be part of a research community. "I was in awe of the way that the researchers interacted," she remembers. "Even when they challenged each other, it wasn't to be competitive, and responses were humble. It all stemmed from their shared commitment to the mission."

Rasmussen sees much of the same collaborative spirit across the UW, especially at the CEI and Buerk Center for Entrepreneurship, which hosts the EIC every spring.

She also cites her ME faculty advisers Corie Cobb, John Kramlich and Igor Novosselov for their support. "They have years of experience with science, engineering and technology translation," she says. "I value their expertise and really take their input to heart."

Though MOtiF Materials' focus has been on MOFs related to energy storage, Rasmussen is eager to consider its broader potential.

"Starting with energy storage technology is important because if you can improve that, you impact all other clean energy technologies," she explains. "MOtiF Materials' reactor technology is a platform — it can be used to synthesize much more than just battery-related MOFs, and I can't wait to extend it in other directions, like targeted drug delivery and water vapor capture."

For now, Rasmussen intends to optimize her design, finish securing intellectual property and publish her findings to the broader scientific community. While ultimately she'd like to work in a research and development laboratory, she hasn't ruled out turning MOtiF Materials into a business.

"In the future I may decide to move forward with creating a startup," she says. "But for now, it's all about the science."

Notable awards

Join us in congratulating our faculty on these distinguished honors.



Associate professor **Steve Brunton** has received a 2019 Presidential Early Career Award for Scientists and Engineers. This award is the highest honor bestowed by the

United States Government to outstanding scientists and engineers who are beginning their independent research careers and who show exceptional promise for leadership in science and technology.



Corie Cobb, Washington Research Foundation Innovation Associate Professor in Mechanical Engineering and Clean Energy, is the recipient of a 2019 Young Faculty Award

from the U.S. Defense Advanced Research Projects Agency (DARPA). This award engages rising research stars in junior faculty positions at U.S. academic institutions, providing funding and mentoring to awardees early in their careers.



Professor and chair **Per Reinhall** has been elected to the Washington State Academy of Sciences. Members are selected for their outstanding record of scientific and technical

achievement and willingness to work on behalf of the Academy to bring the best available science to bear on issues within the state of Washington.

MECHANICAL ENGINEERING

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Warehouse ergonomics

A research team led by ME and ISE assistant professor Ashis Banerjee is using machine learning to develop a system to monitor factory and warehouse workers for ergonomic issues. The algorithm divides up a series of activities — such as lifting a box off a high shelf, carrying it to a table and setting it down — into individual actions and then calculates a risk score associated with each action. The team is working on a smartphone app so that workers can receive feedback on how risky their behaviors are in real time.



Advanced composites and clean energy

Researchers in the UW's Boeing Advanced Research Center (BARC) have received \$1.2 million in clean energy funding from the Washington State Department of Commerce to improve composites manufacturing. The project aims to predictably design and produce complex thermoplastic composite parts using automated robotic systems. This award, along with funding from the UW and Boeing, lays the groundwork for a new UW Advanced Composites Center, which will bring together composites manufacturing research and education.

Chemical and toxic waste elimination

ME associate professor Igor Novosselov's research team is developing a system that breaks down chemical warfare agents and toxic waste through a new Cooperative Research and Development Agreement from the U.S. Army Research Office. The group is testing a reactor that uses supercritical water oxidation technology to break down complex chemicals yielding mostly carbon dioxide and water. The mobile apparatus could be delivered for on-site processing, eliminating the transportation of harmful chemicals.

Opposite column: To train and test their algorithm, Banerjee's team created a dataset containing 20 three-minute videos of people doing 17 activities that are common in warehouses or factories. Photo by University of Washington