CLEVELAND STATE UNIVERSITY

WASHKEWICZ

COLLEGE OF ENGINEERING

2020 - 2021 ISSUE

MAKING IT WORK

DISCOVER HOW THE COLLEGE OF ENGINEERING ADAPTED TO A NEW NORM

INSIDE: STUDENTS | ALUMNI | COLLEGE NEWS | FACULTY | PROGRAMS

Message
FROM the DEAN

GREETINGS!

What a year this has been in the Washkewicz College of Engineering!

The year 2020 started off with a bang, as we worked to further our mission to prepare ready-to-go engineers. To enable the transformation of ideas into reality, all of our students — from freshmen to graduate-level — had greater opportunities to learn to use a variety of metal-forming and woodworking equipment in the Dan T. Moore MakerSpace. We expanded the MakerSpace hours, added new equipment and hired an additional machinist to train students. These activities continued this past fall, albeit with additional health precautions.

Despite the hit to the economy from COVID-19, we still coordinated 33 senior design projects, in which our students provided real-world help and problem solving to various groups. The senior design projects were sponsored by 18 different companies and organizations. We are always grateful for our sponsors who not only support these projects financially, but also contribute their time to mentor the students along their pathway from classroom to workplace. And for the second year in a row, one of our student teams earned the first-place award in the national competition of the National Fluid Power Vehicle Challenge!

Our faculty and staff went to great lengths to maintain our high standards of engaged learning within the restrictions of our current environment. Nearly 45% of CSU classes were held in-person in fall semester 2020, including most of the engineering lab courses. Technology was added to all of our classrooms and labs so that students who could not be on campus could still learn and participate remotely. For sanitation purposes, we provided each student in our freshman-level Introduction to Engineering Design course with their own equipment, so students actually had more hands-on experiences in the course this year — at least one silver lining from COVID-19.

The co-op program continues to be an essential part of the classroom-to-workplace transition. The Engineering and Computer Science Connections Fair was held virtually this past fall, with similar plans being made for spring. Our administrative, advising, lab, secretarial and technology staff have adapted seamlessly to working remotely and/or safely on campus to ensure that our College can continue to progress in its mission.

While research labs were essentially shut down for several months last spring, our research activities have been in full force since then. Our research success story has continued with multiple grants from federal and state agencies as well as from industry. Dr. Wei Zhang, associate professor of Mechanical Engineering, received the prestigious NSF CAREER award for her research in wind-hazard mitigation using biomimicry, the third awarded to CSU engineering faculty in the past three years. In 2020, we welcomed 11 new faculty with expertise in the Internet of Things, intelligent transportation systems, biomaterials, manufacturing, robotics and machine learning.

We look forward to 2021 with excitement for an eventual full return to campus to continue to teach, design, discover and innovate.

Sincerely,

JOANNE M. BELOVICH, PH.D.
Professor and Interim Dean

WASHKEWICZ
2020-2021 ISSUE

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FACULTY

Impact of Big Data

Dr. Sunnie Chung leads the Big Data Lab at CSU and its future is looking very bright

THE BIG DATA LAB at CSU is no place for old textbooks. It's a place where the targets for research and teaching are always moving, at the speed of the internet.

"In our history of technology, either in science or engineering, there is no such technology evolving this fast," says Dr. Sunnie S. Chung, the lab's director.

"Big data" refers to the collection of data sets so large and complex that it's difficult to process with traditional systems and methods. Massive data are constantly generated by systems or a variety of Internet of Things (IoT) devices capturing transactions, interactions and observations of a general population or environments. All of us both generate and consume data in our daily activities.

The volume of data is increasing explosively. There are 44 zettabytes of data in the digital universe as of 2020, Dr. Chung says, and the rate of expansion is accelerating. Get used to the word zettabyte — that's a trillion gigabytes. Imagine the challenge of designing and constantly redesigning a curriculum for a field that is changing that rapidly.

"In computer science, especially in big data-related areas, every six months you see the changes — like new methods developed in research becoming new industry standards or some methods becoming obsolete," Dr. Chung says.

And, now universities are playing catch-up. "Big data and its related areas have evolved so fast, mostly from industry research at the beginning," she says. "There's not enough workforce educated and trained in these new areas. Industry is waiting with these amazing jobs and opportunities."

So, establishing curricula to generate data scientists for big data has become one of the most important priorities to every university, according to Dr. Chung.

Big data and big data analytics form an integrated new field, which has evolved from multiple computer science areas, such as artificial intelligence (AI), machine learning, information retrieval, advanced database systems, statistics and computer vision. Nowadays, big data technologies are integrated into IoT, robotics and smart connected systems with cloud computing. In the IoT, data flow both from industries to consumers and from consumers (and their devices) to industries.

Dr. Chung joined CSU in 2015 as an assistant college lecturer in the Department of Electrical Engineering and Computer Science (EECS) and her work has focused on both establishing her research and developing a new curriculum in big data and data science. She arrived with significant experience in industrial research labs in Silicon Valley, specifically Teradata Corp. (formerly a division of AT&T) and NCR (currently part of IBM), performing optimization of big data analytic systems.

"I witnessed how this evolution started," she says. "In Silicon Valley, it actually started around 2007. Back then, not many in our society were exposed to this concept because industrial research is usually five to 10 years ahead."

The impact of big data can be felt everywhere in our everyday lives. Dr. Chung's big data research has focused on a variety of areas, such as AI and machine learning, big data analytics in IoT, health sciences and social media for business intelligence and decision support systems. Intrusion detection systems and cyber security and privacy of the cloud are another research focus in her big data lab.

In AI and machine learning, her emphasis is on natural language processing for text analysis with deep learning to build intelligent systems (like Alexa and Siri) or Google-like intelligent document search engines, and to build intelligent knowledge expert systems such as medical question answering systems. In the business area, her focus is on developing intelligent systems for product review sentiment analysis.

In social media, Dr. Chung has been studying systems for real-time opinion analysis. In IoT, her interest is in cybersecurity and the privacy of cloud computing systems for mobile health applications and network intrusion detection systems. Finally, in the health science area, Dr. Chung has been developing an intelligent system that identifies urban food desert defect areas and their impact to the development of diseases in Cuyahoga County.

Cyber security and privacy in the IoT area is a good example of the research challenges in the big data era. IoT devices communicate with cloud servers to send the data in encrypted forms. "There's no way to process them in a cloud without decrypting them," Dr. Chung says. "The problem is the cloud is public, so all these sensitive data are in the public and they need to be decrypted for computations by the cloud servers. That raises serious security and privacy issues."

The solution is "very special encryption methods," she says.

Dr. Chung is doing research on encryption methods called "semantic preserving encryptions." That puts the data in the specially encrypted forms that the cloud servers can process while the data is still encrypted. The challenge is to make the special encryption strong enough to protect the big data without being breakable by hackers and yet fast enough to complete the computations over the encrypted data for the big data applications.

"If the computation over the encrypted big data is too slow, then it's useless," Dr. Chung says. "It's a pretty challenging area, and it has been a focus of research in collaborations between academia and the major big data industry such as Google, Amazon, Microsoft, IBM and Oracle, which builds the cloud computing systems."

One of the most exciting initiatives in computer science is the establishment of the Internet of Things Collaborative (IOTC) between CSU and Case Western Reserve University. The IOTC is funded by the Cleveland Foundation and led by Dr. Nigamanth Sridhar, professor in the EECS department and an NSF program director. Dr. Chung contributed significantly to the establishment of this multi-million dollar (more than $7 million over six years) collaborative, and she has received seed funding to perform research in IoT.

CSU has been an important part of the local big data community. One of Dr. Chung's favorite activities has been the organization of five workshops on big data at CSU in the last five years. These workshops have provided an excellent platform to the regional big data research and development community, both in industry and in academia, as well as to students. She says the workshops have been attended by about 170-230 people each year, and CSU students have had an excellent networking opportunity to be connected to the big data industry.

"Attendees came from local big data industry and universities, and presenters came from big data industrial research groups and academia," she says. "A lot of them were invited from Silicon Valley. This has been the perfect platform for CSU students to be exposed to the big data industry."

Representatives from Google, Cloudera and IBM Watson have taken part in the workshops. Northeast Ohio industries such as the Cleveland Clinic, Progressive, Rockwell, Parker Hannifin, IBM Health Watson and

> "WE'RE SEEING REALLY STRONG, POSITIVE RESULTS IN TERMS OF STUDENT SUCCESS."
>
> DR. SUNNIE CHUNG

NASA that rely on big data have been there. So have other area universities like Case Western Reserve University and Kent State University.

Dr. Chung says she's seeing "really strong, positive results in terms of student success." That includes hires by Google, Amazon, Facebook and Yelp, but also by major Northeast Ohio employers like FirstEnergy, Hyland Software, Parker Hannifin, Rockwell, Sherwin-Williams, Progressive and the Cleveland Clinic. "Every industry needs big data technology and big data-related knowledge and skill sets," she says.

Dr. Chung has developed courses to help students prepare for those opportunities. The new curriculum has also had a positive effect on the research activities in the computer science program, with a significant increase in the number of thesis and dissertation projects, as well as in the number of graduate and undergraduate research projects in the last few years.

Dr. Chung's undergraduate students have had success in continuing for their doctoral studies with full scholarships/fellowships at iconic institutions, such as Northwestern University and the University of Southern California. Her first Master's thesis student, Danielle Aring, is now working for FirstEnergy as the first data scientist that CSU graduated. Another one of her Master's thesis students, Andrew Yu, is now teaching at Penn State Behrend. Nick White, whom Dr. Chung mentored in his independent study and senior design project and who won first place in the senior design poster competition in 2016, is now working for Facebook and attending Stanford University for his Master's. Finally, Suhua Wei, whom Dr. Chung advised in her research project, is now working at Amazon.

Dr. Chung's future plans are to enhance research on big data, AI and cyber security and establish global big data and data science programs at both the undergraduate and graduate levels. This will lead to the recruitment and retention of even more students and will help establish the computer science programs at CSU as among the best big data and data science programs.

FACULTY

Securing Technology

Dr. Sanchita Mal-Sarkar delves into the cybersecurity world

WHEN THE MACHINES are chatting among themselves, who is listening?

That's an issue Dr. Sanchita Mal-Sarkar and her students are working on. Dr. Mal-Sarkar, an associate college lecturer in the Electrical Engineering and Computer Science department, teaches a course on cybersecurity that features experiments on hardware devices that function in the Internet of Things (IoT).

IoT is the network of devices connected to the internet that exchange information with each other, without human intervention. Estimates of how many such devices are in operation around the globe vary — 50 billion is one estimate. Regardless of the exact number, it's growing rapidly and the devices involved — not just your latest cell phone — are increasingly becoming long-term parts of our lives.

The proliferation of the IoT has increased attention to hardware security, Dr. Mal-Sarkar says, because it has made hardware security a lot more complicated than just protecting your home computer. "Securing one device is insufficient, as a single compromised device can lead to many other compromised devices," she explains.

Her cybersecurity course, which was launched with the help of a $200,000 grant from the National Science Foundation for a hands-on approach to security education, began as a class for undergraduates, but is now also offered to graduate students.

The course focuses on the hands-on learning of computer system security, which integrates all aspects of security of computer systems — namely, network and information security, software security and hardware security. The course follows a distinctive hands-on teaching approach using a well-designed set of experiments as learning tools. Students will be able to "hack" a system at different levels and analyze existing countermeasures. In addition, students will come up with new threats that may happen in the future and think of potential protection mechanisms.

"What we proposed in this NSF grant is a holistic and comprehensive effort," Dr. Mal-Sarkar says. "Students will learn about all kinds of security issues — hardware security, software security and information security at the system level." The course is shifting toward hardware security because other courses at CSU cover some of the other territory, she says. "That's why more experiments will be added on hardware security and security related to IoT."

In a recent experiment, students created a hardware trojan, a malicious modification of an integrated circuit (IC), and studied its operation for changes in current or voltage. Such changes might indicate that while a device is doing what it's supposed to do, it's also doing something else — like sending data to a hacker.

Dr. Mal-Sarkar explains that the IoT operates in layers. "The first layer is the data acquisition layer," in which devices and their onboard sensors collect data. The next layer is the "gateway," where the data collected by the sensors is aggregated and relayed to the cloud. The third layer is data analytics, when data is stored and analyzed in cloud servers. This layer employs different data science and analytics techniques. In the analytics layer, the raw data is converted to useful information for decision making. The fourth is the application layer, where users interface with the data and receive application-specific services.

If one of the devices involved in these layers is compromised to behave maliciously, it can affect all of the devices. "That's why we need a comprehensive approach in order to make sure that each layer is secure," Dr. Mal-Sarkar says. "First, we need to know what our vulnerability is. Once we know the vulnerabilities of the system or devices, then we can offer some protection or mitigation techniques."

According to Dr. Mal-Sarkar, there are primarily two types of testing to identify vulnerabilities. One is logic testing, which checks to make sure the device is doing what it's supposed to do. Trojans can damage the effectiveness of a device, and so can things like dead batteries

> "ONCE WE KNOW THE VULNERABILITIES OF THE SYSTEM OR DEVICES, THEN WE CAN OFFER SOME PROTECTION OR MITIGATION TECHNIQUES."
>
> DR. SANCHITA MAL-SARKAR

in sensors. "But sometimes, an intelligent attacker will not change the level of functionality," Dr. Mal-Sarkar says. "What they will do is incorporate a circuit that will create a covert channel. This covert channel will send sensitive information. Through the logic testing, we will not find anything wrong because the device will do whatever it is supposed to do."

That brings us to side-channel testing, which is what Dr. Mal-Sarkar's students are doing when they study the current and voltage. Unexplained changes mean something suspicious is going on, possibly involving a covert channel.

"There are a couple of solutions," she says. One is comparing an IC with a "golden IC," which is known and trusted. If you have previous experience with an IC, you can compare and look for differences between the IC you're testing and the golden IC, according to Dr. Mal-Sarkar.

The other tactic is to obfuscate the design or logic of the IC to confuse the attacker. "We can hide a wire," Dr. Mal-Sarkar says. "Or we can add some dummy components randomly in our design that don't do anything. The whole purpose is to make the design obscure and prevent reverse engineering. The hackers will be confused and won't be able to figure out the actual design or the purpose." Additional logic gates can also be randomly inserted in the design to scan the outputs at different parts to check if anything suspicious is happening.

Side-channel analysis tends to work better for larger, more complicated trojans with a lot of wires and gates. "If the hardware trojan is very small, the current change and power change can be very small," Dr. Mal-Sarkar says. That small change might be caused by an intrusion or it might just be a natural fluctuation in performance called process variation. That can make logic testing more effective for smaller trojans, she says.

A couple of other causes for concern in IoT security come from the changing nature of the devices themselves. Some of the fastest growing categories of devices in the IoT are those that enhance things that a user owns for a long time — like a house. The vulnerabilities of a smart home device might be known, "but in several years we can have many new vulnerabilities," Dr. Mal-Sarkar says. "It can be very dangerous. If a component of a smart home does not work properly, it might give wrong information to a smart car."

The other issue is "hardware trust," referring to issues in the manufacturing of devices. Device production is often outsourced to off-shore facilities for economic reasons. This opens up the opportunities for insertion of malicious design alterations in the foundry, intended to cause malfunction or leak secret information. This is called "fabless" manufacturing because the company designing and selling the chips doesn't have any fabricating facilities of its own. It saves time and money, but the chips might be less secure, even intentionally made to contain trojans.

With the increasing complexity of hardware design, it is becoming a common practice to purchase hardware intellectual property (IP) blocks, saving on the design and verification effort. "These days, we do not create the system from scratch," she says. "We use different hardware IP blocks from different vendors. And those vendors can be from anywhere. There are so many instances of fake IPs and counterfeit chips in the market."

Another focus of Dr. Mal-Sarkar's research is working with uncertain data in sensor networks. The example she uses is predicting the likelihood and intensity of a forest fire based on data from a large number of unattended sensors, arranged in clusters in the harsh environment of a forest. Some of the sensors may fall into the fire zone and be destroyed, or they may have low battery power and send ambiguous data. "Because of this, sometimes data is ambiguous, and sometimes data is missing," Dr. Mal-Sarkar says. "But given this scenario, how can we best make a decision?" The method uses the "rough set theory," which generates useful patterns for making critical decisions from the recorded data even when some information is missing or is ambiguous. The sensors measure various atmospheric conditions: temperature, humidity, the moisture of the soil, lightning, the height of the canopy and the speed and direction of the wind. A data center — that third layer of the IoT function — "will collect all this raw data and convert to real information," she says. "So that means we need to do some preprocessing to get rid of all this duplicate data and ambiguity. Then we can make a decision" on whether firefighters should be dispatched.

Dr. Mal-Sarkar, who earned her Ph.D. in engineering at CSU while already a full-time faculty member, is also the chair of the Dean's Diversity Council at the Washkewicz College of Engineering. "We try to encourage more women in science," she says. The council is also focused on improving retention and graduation rates among minority students.

FACULTY

Summer 1997: After the first successful ADRC Motion Control Test (front from left: Jingqing Han and Dr. Zhiqiang Gao; back: Fanjun Jiang, a doctoral student at that time)

HISTORY AND ENGINEERING

History has a place in Dr. Zhiqiang Gao's engineering classes

WHEN DR. ZHIQIANG GAO starts to explain something in his classes, he teaches his students both history and engineering. He'll make an observation about Thomas Edison, James Watt's 18th century work on the steam engine or the work process of Elmer Sperry, a prolific inventor of the late 19th and early 20th centuries. He might even venture into philosophy and quote Aristotle.

"I try to include the history of engineering in the course material, especially early in the semester," Dr. Gao says. "The original pioneers, the innovators, they didn't just apply science. They applied human ingenuity. Humans are endlessly resourceful. It's that resourcefulness I try to capture and I try to cultivate. If I have any success, it's the success of the spirit of innovation, not simply copying somebody's formula and applying it."

To understand the foundations of Dr. Gao's work in active disturbance rejection control (ADRC), a method that revolutionizes how industrial machines are controlled, you have to go back to before he started working on it.

The story starts with Dr. Gao's arrival at Cleveland State University in 1990, with a Ph.D. from the University of Notre Dame. When he was a teaching assistant at Notre Dame, he says, his students mostly came straight from high school and relatively wealthy families. At CSU, however, he found his students mostly working to pay their own way. Many of them had engineering experience but needed a degree, in contrast to his own situation. "The teaching is in both directions," he says of CSU. "I teach them the theory, and they teach me the real world."

About five years after he came to CSU, Dr. Gao met ADRC pioneer Jingqing Han while attending a conference in Beijing. Han was working to advance the dominant proportional-integral-derivative (PID) regulation technology, which uses the deviation from the intended result of a machine's action to make an adjustment. For example, the cruise control on a car recognizes that the car has slowed down when it starts to climb a hill and returns the car to the desired speed by adjusting the gas flow. The idea of PID hadn't changed much since Watt put it to work on steam engines in the 1780s, according to Dr. Gao. "We talk about mechanical inertias in engineering," he says, "but we never talk about the inertia of human thought."

ADRC adds a second dimension to PID with an algorithm that detects and counteracts anomalies before they affect the machine's performance, leading to better quality and less energy consumption.

In the mid-1990s, the problem with ADRC was that no one had proven it would work. But Dr. Gao remembers telling himself after speaking to Han in 1996 that "I do not need any proof, I do not need any evidence. The idea is powerful enough for me."

He dropped everything he had been doing up to that point to focus on ADRC. Dr. Gao arranged for Han's colleague Professor Kekang Xu, a brilliant mathematician, to visit Cleveland State. When Han came to the lab in 1997, Dr. Gao says, "My students and I were sitting at a table with a small tabletop machine, and we were tuning ADRC parameters without much success. He looked at how the machine was turning and he made a few suggestions. 'You change this number by this much, and try again …' There were like 15 parameters in the formula but only Han knew how to change them. Within 30 minutes, we had this outstanding result, something we had never seen before."

Visiting the ADRC Team in China in 2002

"ADRC: Industrial Solutions to Process Uncertainties:" 2013 Workshop at the American Control Conference, Washington D.C.

A wheel in the machine spun and then stopped on a dime, with no vibration, no deviation. Han was "ecstatic, because he never saw his formula work so well," Dr. Gao says.

But it took a long time to break the math barrier. "We still didn't understand what he did. He would show me how he changed the parameters. I would record the stats, but I could not repeat it. We struggled for five years. In 2003, I finally figured it out."

That was one breakthrough. But before ADRC could revolutionize anything, it had to be converted into something that could be implemented outside of a laboratory. The bridge that had finally been built between Han's algorithms and Dr. Gao's experiments had to be extended to end users in an industrial plant.

"The original selling point when we marketed ADRC was one-knob tuning," Dr. Gao says. The user had one knob to control the corrections being made to the machine's process. "Turn to the right, more aggressive, turn to the left, less aggressive."

It was simple and intuitive.

ADRC's first industrial application was at a Parker Hannifin plant in Ravenna that makes hoses and tubes. Dr. Gao says he and his team got their opportunity after conversations between then-CSU President Michael Schwartz and then-Parker CEO Donald Washkewicz and between Washkewicz and the plant manager. "If not for Don Washkewicz, we wouldn't have a chance," Dr. Gao says.

The factory's production lines were run by programmable logic controllers (PLC), Dr. Gao says. Changing the process would be risky, because if it didn't work, production could be interrupted. Dr. Gao's team was allowed to install its code into a PLC, "but they were adamant about not changing their side of the code. Just add yours and put a switch in there. If we flip a switch to your code, we'll see how it works, and if we don't like it, we'll switch it back."

Dr. Gao wasn't present for the test, but he got a report from Jim Dawson, who was the president of LineStream, a company Dr. Gao founded to commercialize the technology. Dr. Gao says Dawson told him that when they switched on the ADRC code, all fluctuations disappeared and all temperature curves flattened. A *Plain Dealer* article from 2011 quoted Parker Hannifin general manager Mark Gagnon as saying power readouts "looked like they fell off a cliff, reducing power consumption by 57%."

It was the start of something big. In 2011, Texas Instruments licensed LineStream's IP to bring ADRC to control chips used in motors for a wide variety of machines.

When Dr. Gao talks about the impact of ADRC on the control of industrial machines, he puts his historian hat on again. "Any major invention, people afterward would say 'oh, of course.' But at the moment of the invention, you go from one dimension to two dimensions, that's the moment of ingenuity. You create something out of nothing. That's the human mind at work."

Dr. Gao calls his approach "engineering with a touch of humanity."

"You should be able to see that the previous method was not the only way," he says. "That accounts for almost all engineering creativity; to see the alternative. If you're not perceptive to ideas, then you will always do what you've done and you will always get what you have gotten."

While LineStream is no more, having been sold to the Danish company Danfoss, Dr. Gao is watching his students spread the fruit of his research.

"They will tell me that they interviewed with a company and out of the blue, they were asked whether or not they know ADRC," he says. "That opened the door for them. Students can go places because they learned something valuable here. In many cases, this is the best technology transfer."

FACULTY

HONORING PROFESSOR GEORGE KRAMERICH

A newly established endowment fund seeks to recognize teaching and learning

DR. ZHIQIANG GAO, associate professor in the Department of Electrical Engineering and Computer Science (EECS), recently made a generous donation of $25,000 to establish the *"George L. Kramerich Awards for Excellence in Engineering Education"* endowment fund, which will support excellence in teaching and learning. Each year, half of the fund's spendable income will be awarded to EECS faculty who teach with dedication and inspiration. The remaining spendable income will be awarded to EECS students or student teams with significant accomplishments in engaged learning.

The EECS faculty will determine the process and exact criteria for the awards, but particular emphasis will be placed on high quality, innovative teaching; activity in curriculum development; dedication to student success; and recognition of excellent teaching by students.

Dr. Gao says with passion that if anyone asked Viking engineering alumni who was the best teacher they ever had, the answer would be Dr. George Kramerich. In more than 40 years at Cleveland State University, Dr. Kramerich excelled as a professor, chair of the Department of Engineering Technology, chair of the Department of Electrical and Computer Engineering (now EECS) and assistant dean in the College of Engineering. Dr. Kramerich passed away in December 2017, but his legacy at CSU lives on.

Thanks to Dr. Kramerich's vision and leadership, CSU has become the world's leader in industrial control technology, with the cutting-edge active disturbance rejection control (ADRC) technology. He secured lab space and funding for the initial phases of this out-of-the-mainstream research, and he encouraged Dr. Gao to pursue it.

Here's how colleagues and alumni remember Dr. Kramerich:

"In a recent Industry Advisory Board meeting for the Electrical Engineering Department, we talked a lot about George and his devotion to education. Everyone agreed that he never compromised the quality of education, he set high standards and he was loved by his students." — Dr. Chansu Yu, Professor of EECS

"George was a great friend, teacher and mentor. He was universally respected by students, staff and faculty. He left a tremendous legacy at CSU. His positive impact will continue for many, many years to come." — Dr. Dan Simon, Professor of EECS

"George is the role model I've always used when thinking about what kind of teacher I want to be — students loved him for his fierce love of the subject as well as the highest level of rigor that he brought into the classroom. He helped me craft my tenure case and helped me see where my future can go." — Dr. Nigamanth Sridhar, Professor of EECS

"George Kramerich was a bit of a legend at Cleveland State University. He was an excellent teacher! He had a commanding presence that elicited both fear and respect from his students. I know many students felt that Dr. Kramerich always had their best interests at heart." — William Thesling, Doctor of Engineering in Electrical Engineering, 1995; Master of Science in Electrical Engineering, 1990; Bachelor of Electrical Engineering, 1987

"I will never forget Dr. Kramerich. He was my electronics professor at CSU in 1984-1985. He was brilliant and he had a knack for teaching like no other. He was by far the greatest teacher/professor I ever had. He had a great gift." — Dominic Vitantonio, Juris Doctor, 1990; Bachelor of Electrical Engineering, 1986

Please support the *"George L. Kramerich Awards for Excellence in Engineering Education"* fund to honor Dr. Kramerich's memory and help reward CSU students and faculty. For those wishing to make a donation, please make your check payable to the Cleveland State University Foundation, write "George L. Kramerich Awards for Excellence in Engineering Education Fund" in the memo line and mail it to:

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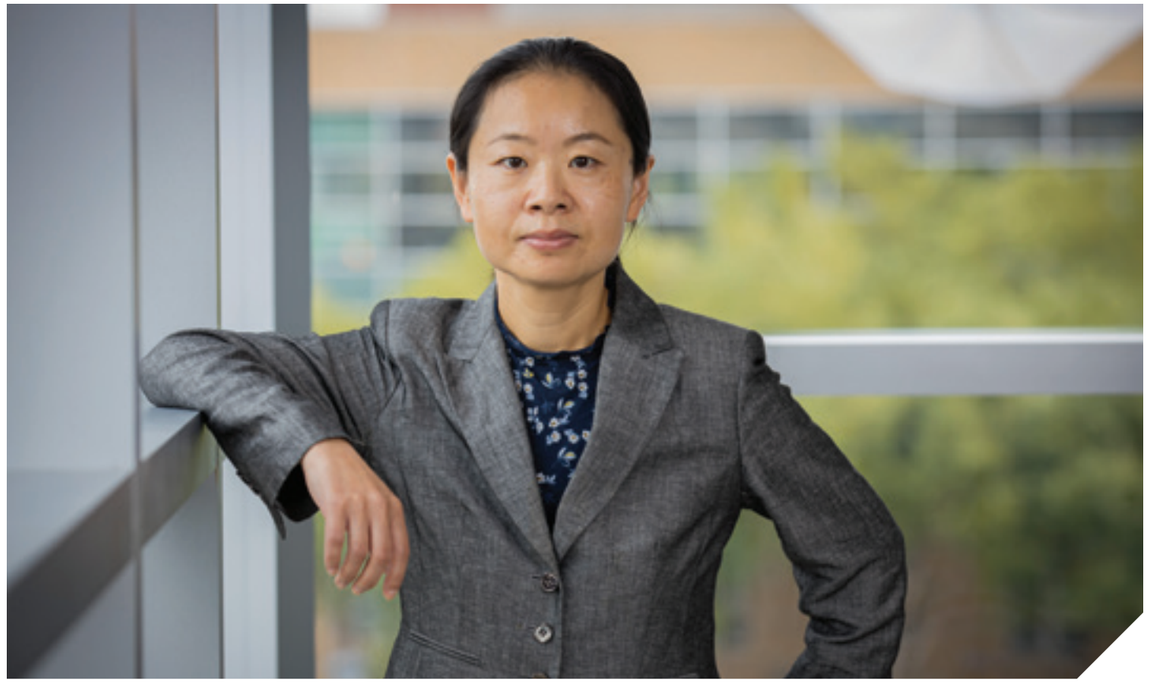


Wind Hazard REDUCTION

Dr. Wei Zhang's research earned a National Science Foundation CAREER grant

DR. WEI ZHANG speaks of the yin and yang of wind — its capacity to cause devastating damage or enable renewable energy production. Her research studies both.

Dr. Zhang, an associate professor in the Department of Mechanical Engineering at CSU's Washkewicz College of Engineering, won a five-year, $580,429 National Science Foundation CAREER grant earlier in 2020 for her work to make buildings more resilient in high winds, such as hurricanes and tornadoes. Hurricanes are among the most costly natural hazards affecting communities worldwide, especially in the coastal regions of the United States, in terms of both property damage and loss of life. On the other side of the yin-yang duality, she is researching the patterns of rotating air (wake) generated from turbines to make wind farms more efficient.

WIND HAZARD REDUCTION: KEEPING THE LID ON

The NSF CAREER project focuses on protecting the roofs of low-rise buildings in windstorms from the fundamental fluid mechanics point of view.

Damage to low-rise buildings often begins when swirling winds, or delta vortices, create a pronounced negative pressure on the edges and corners of a roof. The worst scenario happens when the wind comes in at an angle in between 30 to 60 degrees. "It's called a

cornering wind," Dr. Zhang says. The delta vortices can fan out from a corner of the roof along the edge in two directions. "It's like two arms. One series of vortices here, another series of vortices there."

The highly unsteady vortices create strong suction and thus uplift forces.

"The worst scenario would be that the roof may fly away because of this uplift force," Dr. Zhang says.

"The flow physics of these roof-top vortices are still not well understood," she continues. "The difficulty is due to rare measurements of the linkage between pressure and separated flow on roofs in hurricanes and challenges to simulate a hurricane-type wind in the lab. The first part of this project is to advance our understanding of the flow physics, which controls the vortex formation."

The second part is to invent something, for example, a flow control device, that will protect the roof by breaking down or suppressing the vortices.

But why low-rise buildings, such as warehouses and houses? A layman's intuition might suggest the biggest danger is to skyscrapers. The answer to that one isn't just scientific — it's also economic.

"High-rise buildings are so expensive that when they are being designed, a lot of calculations, or wind-tunnel tests, are done to make sure they are safe in high winds," Dr. Zhang says.

That might not be in the budget for a low-rise building, such as one- or two-story houses. Low-rise buildings turn out to be the most vulnerable civil structures in wind storms. So the solution she's looking for needs to be relatively inexpensive and can be applied to both new and existing buildings.

The hypothesis is that, what Dr. Zhang calls a "porous fractal parapet" will do the job. It's a vertical parapet structure around the edges of the roof. On a flat or nearly flat roof, "wind approaches and separates over the edges, thus forming 3D vortices," she says. "But now, these porous fractal parapets could break down the vortices, according to our preliminary research and others' work. Once these vortices disappear, there's no uplift to peel off the roof."

The porous parapets adopt the fractal pattern that widely exists in nature. One can see fractals in branching pulmonary networks, corals, river networks, cumulus clouds and the large-scale structure of the universe in astronomy. "Fractal" refers to a pattern that repeats itself at different lengths; trees are a typical example of fractals that Dr. Zhang uses.

Testing the hypothesis requires high-speed wind that isn't readily available in Cleveland. So that testing will be conducted in Miami at the Wall of Wind, a giant 12-fan driven wind tunnel at Florida International University, funded by the NSF through its Natural Hazards Engineering

Fractals in nature.

Research Infrastructure. "This wind tunnel can create wind speed up to a Category 5 hurricane; about 156 miles per hour," Dr. Zhang says. "That's the condition we want to test. We want our invention to actually work even for a Category 5 hurricane."

ENERGY PRODUCTION

The power production of wind farms is strongly affected by wind and turbulence in the boundary layer, the part of the atmosphere close enough to the ground to be impacted by friction from the surface. But it isn't just the friction that influences it. "Boundary-layer wind will be affected by many factors," Dr. Zhang says. "If there are tall and low buildings, trees, if there are large areas of water surface, wind adjusts to all obstacles and becomes very complicated. Wind is also constantly changing by the temperature variation from the heating and cooling of the earth surface on a daily basis."

As with the parapets, the issues are economic as well as scientific, because unpredictable wind is tricky for a wind farm's operation. "In order to make a profit, you have to have a good estimate of how much wind is available to drive a wind farm efficiently," she says. "How much electricity you can generate from the wind is largely affected by the wind speed. But wind is very hard to predict accurately, even with the most advanced mathematical models."

Errors of less than 1 meter per second of the mean wind speed in estimating the annual wind resources for a wind farm can translate into millions of lost dollars in annual revenues.

The turbines in operation add another, powerful source of turbulence that becomes more complex as the wind moves down a line of turbines at a wind farm.

"The wake generated by the wind turbine in front creates a very chaotic wind condition for the turbines downwind," Dr. Zhang says. "The first

Turbine wake interaction at the Horns Rev offshore wind farm. (Credited to Christian Steiness/Vattenfall)

wind turbine sees a 'clean' wind, however, the turbines downwind are immersed in the wake."

And the wakes spread vertically and horizontally, so if there's a long line of turbines, the wake from one line can merge with the wakes from the lines on either side of it, creating even more disturbance.

Research at the Horns Rev wind farm, in the North Sea off the coast of Denmark, showed that the turbulent wake has a remarkable impact on the efficiency of the downwind turbines. A turbine 500 meters behind the first turbine can generate just 70% of the first turbine's power; at 5,000 meters the output is further reduced to 55%.

One strategy for improving that situation is to not put the turbines in long, straight lines, Dr. Zhang says. Instead, wind turbines can be deployed in a staggered layout. Finding the optimized arrangement and distance between turbines is an enormous job, and might be solved by numerical methods.

"We work with researchers in Iowa and Switzerland who are developing numerical simulations to model the wind farm and its interaction with wind," she says. "You want to be able to use equations so you can tune many parameters more effectively. If you run experiments, there will be many, many combinations or configurations. It's very time-consuming. Usually we do experiments for the typical configurations and then we switch to numerical model studies after they are validated with the experimental data."

"The other related question is, when we have so many wind turbines together creating large wakes, then how about their impact on the environment? Our research published in 2013 found out if you put a wind turbine on farmland, by this rotating motion of air, one side could be dryer and warmer than another side during a clear day, so you may need to think about the irrigation plan. The impact from wind farms on our society could be more comprehensive than what we assumed and understood," she explains.

> "THAT'S THE CONDITION WE WANT TO TEST. WE WANT OUR INVENTION TO ACTUALLY WORK EVEN FOR A CATEGORY 5 HURRICANE."
>
> DR. WEI ZHANG

TEACHING THE NEXT GENERATION

Dr. Zhang teaches courses in the thermal/fluids and energy track, one of the key areas in mechanical engineering. At the undergraduate level, the courses include fluid mechanics, thermal system lab and thermodynamics. At the graduate level, she teaches applied fluid mechanics, viscous flow and computational fluid flow and heat transfer.

As an engineering educator, Dr. Zhang commits to nurture competent next-generation engineers, promote the STEM workforce of the U.S. and set student success as a priority. Dr. Zhang has advised students who have won significant research awards and competitions of design projects, and her students have gone on to work at the NASA Glenn Research Center, SpaceX, the Air Force Research Laboratory and GE Aviation.

Having benefited from her international exposure, Dr. Zhang wants her students to have a similar experience to be globally competitive. She is the principal investigator for a project in the NSF's International Research Experience for Students (IRES) program that allows U.S. students to conduct research at a top research lab in South Korea on energy efficiency and resilience of buildings in high winds. The IRES project provides future scientists and engineers with a global, cross-cultural perspective and professional growth opportunities through international research training, structured mentoring and networking opportunities.

FACULTY

Dr. Jerzy Sawicki

Dr. Dan Simon

THE POWER OF RESEARCH

Dr. Jerzy Sawicki and Dr. Dan Simon reflect on their time in the Office of Research

IF YOU'RE IN A ROOM with Dr. Jerzy Sawicki and Dr. Dan Simon — even if it's a Zoom room — it's easy to see how they've worked together to lead Cleveland State University's Office of Research for five years.

During an interview about their tenure, Dr. Sawicki led the conversation while Dr. Simon provided the interviewer with links to webpages and other information to illuminate the topics Dr. Sawicki brought up.

"You can sense the team dynamics," says Dr. Sawicki, professor in the Department of Mechanical Engineering and Bently and Muszynska Endowed Chair, who was CSU's vice president for research from 2012 until he stepped down in 2020 to return to the faculty. "Despite our differences, we made a good and synergistic team, as I was able to spend more time engaging with administration and external collaborations while Dan dedicated his time to assist faculty and ensure the Office of Research provided effective services."

"I was in the Office of Research to support Jerzy, and to be his right-hand man," says Dr. Simon. He became associate vice president for research in 2015 and also stepped away in 2020 to focus on full-time faculty work as a professor in the Department of Electrical Engineering and Computer Science. He says Dr. Sawicki was the "big-idea man" and provided the direction in the Office of Research. He was glad to help him "fine-tune some of his ideas and help him implement everything."

Together they did much to put CSU on the map as a research institution. The Carnegie Commission on Higher Education classifies CSU under "Doctoral Universities: High Research Activity," its second-highest level. CSU's research and development spending ranks in the top 20% of U.S. universities, according to the National Science Foundation (NSF). NSF data show a 45% increase in research and development expenditures at CSU between 2015 and 2017, the most recent year for which the data are reported.

Dr. Sawicki says things "took off" in 2013 after a number of new initiatives, including re-instating the CSU Research Corporation (CSURC), a 501(c)(3) nonprofit that serves as a bridge between the University and industry to commercialize work patented by CSU researchers. The appointment of a board of directors and revisions of the bylaws and regulations jumpstarted the corporation, which had been founded in 2006, but "never really was active" until 2013, Dr. Sawicki explains.

The growth of research drove the restart of the research corporation, he says. "We had faculty who created start-ups, and the licenses from CSU to the start-ups contained equity terms which proved problematic for public universities." That's where CSURC comes in. "If you want to grow innovation and entrepreneurship at the University and give faculty a range of venues to release their entrepreneurial spirit and commercialize inventions, you need to have a streamlined process to assist faculty and interact with industry," says Dr. Sawicki.

The Office of Research includes a Technology Transfer Office, directed by attorney Jack Kraszewski, who helps faculty acquire patents and further commercialize their inventions. "Our goal was not just to file patents, which can be quite costly," Dr. Sawicki says. "We would like to leverage our research value and, where justified, find corporate partners and/or launch startups. In addition, the Technology Transfer Office has been looking for state resources, which provides seed funding for commercialization. We have been very successful in this."

Another important aspect in maximizing the effectiveness of CSU's research resources, Dr. Sawicki says, is having a strong online presence "highlighting our strengths and research portfolio. That is why we created the CSU Innovation Portal (innovation.csuohio.edu). Industry can visit the website, explore our resources and assess their needs," he says. "They can connect with faculty experts, connect with the Office of Research or connect with the Technology Transfer Office for more information."

Services to help faculty develop proposals have been significantly expanded, Dr. Sawicki says, giving Dr. Simon much of the credit for that. "We greatly enhanced training for faculty on how to develop competitive submissions, and also we greatly increased seed funding for research projects across the University."

The Office of Research tried to support "a wide spectrum of our research and scholarship, across all colleges," not only in science and engineering, but also in social sciences and liberal arts, Dr. Sawicki says.

Another component driving CSU's growth as a research university, Dr. Sawicki says, was the consolidation of pre-award and post-award services to faculty. Before 2014, he says, "when a researcher received a grant, the university's grants accounting office handled all accounts and reporting to the funding agencies."

The new combined research administration unit (Sponsored Programs and Research Services) now serves as the faculty one-stop-shop for all grant and research administration functions, including proposal development assistance and submission, contract review, award setup, grant accounting, effort certification and financial close out. All services are executed in one location: the second floor of the Parker Hannifin Building on CSU's campus.

The Office of Research's relationship with faculty has been positive. In September 2020, the CSU Faculty Senate approved a resolution honoring Dr. Sawicki "for his remarkable contributions to enhance the Cleveland State University research reputation and environment, and for his unstinting service to the faculty of Cleveland State University."

That followed a November 2019 letter from 22 of CSU's most-funded researchers that praised him for "supporting and growing a culture of research and innovation at CSU," and used the analogy of a person who "knows where the potholes are and knows how to pave them over."

Now Dr. Sawicki and Dr. Simon are rejoining the faculty full-time, and the Office of Research has a new leader in Senior Vice President for Research & Innovation and Chief Health Strategy Officer Forrest Faison, M.D. The interim associate vice president for research is Dr. Benjamin Ward.

"I always looked at it as a temporary assignment," says Dr. Simon, who was associate vice president on a half-time basis while continuing to teach and research. "I want to get back to my roots as a professor. I never wanted to be a lifelong administrator."

"I often think of senior leadership as a relay race," says Dr. Sawicki, who stayed active in research but did not teach classes while serving as vice president. "You pick up the baton handed to you by your predecessor and run as far, as fast as you can. Eventually, it becomes time to hand the baton to another runner."

As that time approaches, the administrator should be sprinting to the finish line rather than slowing down, Dr. Sawicki says.

Dr. Sawicki noted that if he and Dr. Simon had different running tracks in mind, instead of returning to the faculty, they could have looked for administration positions at other universities. "I am looking at the finish line at Cleveland State," he says. "I think that makes a huge difference in how you act, what you want to accomplish and what you think in terms of your commitment to the institution."

Additions to THE TEAM

The Washkewicz College of Engineering is pleased to welcome several new faculty members. Get to know them here.

SRINIVAS ALLENA, PH.D., ASSISTANT PROFESSOR

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Dr. Srinivas Allena's main goal over the coming years is to establish a multi-disciplinary, collaborative research program in the field of sustainable and resilient infrastructure materials to address infrastructure challenges in the built environment. He received his Ph.D. in civil engineering with an emphasis in structural engineering from New Mexico State University.

Dr. Allena's main research interests are in the development of innovative structural materials, including ultra-high performance concrete and engineered cementitious composites; performance-based design of advanced concrete materials; repair and rehabilitation of transportation infrastructure; studying and understanding concrete durability and shrinkage, concrete sustainability; and the development of smart sensors for structural health monitoring.

His teaching interests are in the general area of structural engineering. He has taught engineering mechanics, structural design and construction materials.

He is an active member of several technical committees of the American Concrete Institute and the Transportation Research Board. He serves as a reviewer for several technical journals and as the proposal reviewer for National Science Foundation, Oak Ridge Associated Universities and the Qatar National Research Fund.

CHRISTOPHER HUHNKE, DR.ENG, ASSISTANT PROFESSOR OF PRACTICE

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Dr. Christopher Huhnke is a licensed professional engineer in Ohio and also has SI (formerly called surveyor-in-training) status in Ohio.

He earned his Bachelor of Science in civil engineering, Master of Science in civil engineering, Master in business administration and Doctor of Engineering in civil engineering degrees all from Cleveland State University.

Dr. Huhnke has worked in public utilities as an associate engineer for four years. Then, he spent seven years in private consulting in fiber optics, erosion control and stormwater management. At the same time, he was an adjunct instructor in a wide variety of subjects. He has six publications, and his areas of interest are in GIS/asset management, Internet of Things/physical infrastructure and construction safety/industrial hygiene.

Outside of the College, Dr. Huhnke and his wife visit Superfund sites, survey historic markers and enjoy the outdoors. Dr. Huhnke and his wife were both born and raised in Northeast Ohio. They live in the Collinwood neighborhood of Cleveland along with two hound dogs and three cats. He and his wife met while both were attending Cleveland State through the CSU Pep Band.

EMMANUEL KIDANDO, PH.D., ASSISTANT PROFESSOR

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Dr. Emmanuel Kidando holds a Ph.D. in civil engineering from Florida State University. Before joining CSU, he was an assistant professor at Mercer University in Macon, Georgia. He also worked as a research scientist at Florida State University after his Ph.D. studies, leading a research team on the evaluation of a deployed connected vehicle system in Tallahassee, Florida.

His research experience and interests cover a wide variety of transportation engineering areas, including intelligent transportation systems (ITS), autonomous and connected vehicle systems, freeway operations, highway safety, simulation modeling, software systems and data management. Dr. Kidando has authored more than 40 peer-reviewed research articles and conference proceedings in the application of advanced statistical modeling techniques in traffic operation, highway safety and intelligent transportation systems. He is currently developing a collaborative research program at CSU in the areas related to ITS, traffic simulations and highway safety, among others.

ALMABROK ESSA, PH.D., ASSISTANT COLLEGE LECTURER

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Dr. Almabrok Essa received his Ph.D. in electrical and computer engineering in 2017 from the University of Dayton. His current research areas include computer vision and machine learning for object detection, tracking and identification, wide area surveillance and scene analysis for security automation and situational awareness, face detection and recognition and remote sensing.

Dr. Essa teaches undergraduate and graduate courses and mentors capstone senior design projects. His primary goal is to help students develop the necessary computational thinking skills to succeed in the 21st century. These skills include, but are not limited to, thinking algorithmically, making use of different levels of artificial intelligence and designing machines to understand the scene and behave accordingly.

He has authored nearly 50 research articles. Additionally, he serves as a technical reviewer for several journals and international conferences as well as being a member of IEEE and SPIE.

ZICHENG CHI, PH.D., ASSISTANT PROFESSOR

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Dr. Zicheng Chi received his Ph.D. in computer engineering from the University of Maryland, Baltimore County. His research focuses on fundamental wireless communication, networking, sensing and energy-related problems for real-world applications in the areas of Internet of Things and cyber-physical systems.

In the past few years, he has published more than 10 first-author papers in venues such as SIGCOMM, NSDI and ToN. His work won SenSys's best paper runner-up award in 2018 and was selected as the best paper award candidate in 2019.

Dr. Chi, his wife and two children have just settled down in Greater Cleveland and started to enjoy the area. He likes to get close to nature with his family in his spare time, through camping, hiking and taking road trips. At home, he likes to play with a variety of electrical/mechanical devices, as small as a smart home gadget and as large as an automobile.

SATHISH KUMAR, PH.D., ASSOCIATE PROFESSOR

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Dr. Sathish Kumar holds a Ph.D. in computer science and engineering from the University of Louisville. A cybersecurity and data analytics specialist, he has 17 years of experience in various aspects of networked and distributed systems, Internet of Things (IoT) mobile computing and cloud computing.

Before joining academia, Dr. Kumar worked in industry for more than 10 years. His research and teaching interests focus on techniques for achieving security and privacy in cyber-physical social systems, IoT, blockchain, data science and analytics and machine learning/artificial intelligence systems.

His research has been supported by the National Science Foundation. Recently, he served as a summer faculty fellow at Air Force Research Laboratory. He is currently a senior member of IEEE and a member of ACM, and serves as an associate editor for the IEEE Access journal. He has published more than 60 technical research papers in journals and international conference proceedings.

Outside of work, he enjoys following sports and listening to music.

MEHDI RAHMATI, PH.D., ASSISTANT PROFESSOR

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Dr. Mehdi Rahmati received his Ph.D. in electrical and computer engineering from Rutgers University. Before joining Rutgers in 2013, he was a faculty member in Iran, where he taught more than 50 different courses in electrical engineering, computer engineering and computer science at different universities, and was recognized as an exemplary lecturer in 2010.

Dr. Rahmati is a senior member of IEEE and has published more than 30 peer-reviewed conference and journal papers. He has received multiple awards, including the first prize in the IEEE Communication Society Student Competition (2019), the best demo award at the IEEE International Conference on Sensing, Communication and Networking (SECON '19), the best paper award at the IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS '17) and the best paper runner-up award at the ACM International Conference on Underwater Networks and Systems (WUWNet '15).

His research interests lie primarily in the areas of communications and networks for distributed robotics and Internet of Things in dynamic and uncertain environments. Besides his professional duties as a faculty member, he enjoys reading non-fiction books, literature and poetry, and also visiting museums of art and historical places.

HONGKAI YU, PH.D., ASSISTANT PROFESSOR

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Dr. Hongkai Yu's research interests are in computer vision, machine learning, deep learning and artificial intelligence. He received his Ph.D. in computer science and engineering in 2018 from the University of South Carolina. The algorithms and solutions that he developed have been successfully applied in the areas of transportation, autonomous driving, materials and remote sensing. His research achievements have led to a book chapter, three patents and more than 30 published papers, including many prestigious conference proceedings and journal articles in CVPR, ICCV, AAAI, IEEE T-IP, IEEE T-MM and Neurocomputing, among others. His research has been supported by grants from the National Academy of Sciences, the Ohio Department of Higher Education, NVIDIA, Amazon AWS and more.

He received the Outstanding Graduate Researcher award from the University of South Carolina and the Outstanding Reviewer Award from the journal Pattern Recognition Letters in 2017. He is a member of IEEE.

JINGRU ZHANG, PH.D., ASSISTANT PROFESSOR

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Dr. Jingru Zhang received her Ph.D. in computer science from Utah State University in 2017. Before she joined CSU, she was an assistant professor at University of Texas Rio Grande Valley for two years and an assistant professor at Marshall University in West Virigina for one year. Her research interests include algorithms and theory, combinatorial optimization, computational geometry and machine learning. Dr. Zhang has published 18 papers in international journals and conferences, such as Algorithmica and SoCG, and she has been awarded two patents. Her research has been supported by NVIDIA and she has served as a reviewer for several conferences and journals.

MARYAM YOUNESSI SINAKI, PH.D., ASSISTANT PROFESSOR OF PRACTICE

DEPARTMENT OF MECHANICAL ENGINEERING

Dr. Maryam Younessi Sinaki joined the Department of Mechanical Engineering after a couple of years as a visiting faculty. She received her Ph.D. in mechanical engineering from the University of Waterloo in 2014.

Before joining CSU, she worked in industry as a researcher and consultant on steam power plants, reciprocating engines, combined heat and power plants, desalination plants, petro-chemical plants and hydrogen production. She also taught at the University of Akron.

At CSU, she teaches in the areas of applied combustion, thermo-dynamics, heat transfer, formula SAE vehicle design and thermal systems. Her expertise and interests are in the areas of energy conversion systems, numerical modeling, combustion, thermo-fluid systems and hydrogen production.

Dr. Sinaki has 18 publications and she is the 2018 recipient of the Most Outstanding Mechanical Engineering Faculty award. She enjoys hiking and biking with her family, and she loves to travel.

PRABAHA SIKDER, PH.D., ASSISTANT PROFESSOR

DEPARTMENT OF MECHANICAL ENGINEERING

Dr. Prabaha Sikder is the newest faculty member in the Center for Human-Machine Systems. He received his Ph.D. in mechanical engineering from the University of Toledo.

During his Master's studies, he focused on the development of high-performance materials, but his research direction took a turn when he became fascinated by the field of biomaterials during his Ph.D. studies. His research interest lies in the development of medical implants and scaffolds, which aim to treat orthopedic and musculoskeletal defects.

As a post-doctoral scientist at the University of Pittsburgh, Dr. Sikder worked to develop 3D printed electroactive materials. He was in the first cohort at the University of Toledo to win a Non-Academic Research Internships for Graduate Students (INTERN) grant from the National Science Foundation. In 2018, he was also the first to receive the highest ranked recognition in UT, the Outstanding Scholarly Achievements award and the Translational Research award.

He is the author of 21 peer-reviewed journal publications and 13 conference presentations. He is on the board of reviewers of the journal *Coatings* and an active reviewer for various journals.

When he is not writing papers or grants, he loves to go out for a swim, go hiking or biking on trails. He is a coffee connoisseur and loves to explore different cuisines. He is an avid gourmet and loves cooking different kinds of dishes.

Engineering TRAILBLAZER

Washkewicz College of Engineering's Spring 2020 valedictorian Ellen Rea shares her passion for engineering

ELLEN REA'S TOYS COULD HAVE USED STUNT DOUBLES.

"I used to throw my Barbie dolls off of the roof with little parachutes," Rea explains. "When I was a kid, I always built contraptions around the house. I'm sure it was kind of annoying to my mom, but, if it was, she never let me know."

A couple of years later, she and her friends built a zip line by attaching ropes to a swing set. "The rule was that it was fine as long as an adult came out and inspected everything before someone actually got on it. My parents definitely encouraged my creativity when I was a kid," she says.

Rea, 22, is using that creativity on a larger scale. The recent graduate of Cleveland State's Washkewicz College of Engineering (a double major in mechanical engineering and physics) was one of two valedictorians for Spring Semester 2020 and a member of the team that won the NFPA Fluid Power Vehicle Challenge for bicycles with a hydraulic power system.

She was also valedictorian at Cuyahoga Heights High School, so she went into the college application game playing a strong hand. She attended Cleveland State for a post-secondary program during her senior year of high school, but was still undecided. She remembers some advice she got from her mother, who told her CSU was "just starting to make a name for itself."

"She said, 'They're probably going to work hard for you.' And they have. I've had so many opportunities here. Looking back, I'm so happy I picked CSU," she says.

At CSU, she produced an undergraduate thesis about using drones to take wind measurements with the goal of creating a virtual weather mast.

"You could have multiple drones flying at the same time and taking measurements simultaneously," Rea says. "Then you would be able to map the profile of the wind, which is helpful for researchers in wind energy generation, and also designing tall buildings and learning how wind behaves in a cityscape. My leg of the project was to develop a drone that was really stable and position-accurate so the next phase of the project has this platform to start with, and future researchers will make the network out of these drones."

The project relies on having stable drones that don't fluctuate in flight and precisely measure their own positions. "I chose and implemented the software and put all the electronics together," Rea says.

Putting it all together is a core value for Rea. She has been accepted into GE Aviation's Edison Engineering Development Program, which will put her in three different departments on one-year rotations to learn jet-engine design. She also took a hands-on approach to a summer job at Enprotech Industrial Technologies that she pursued through CSU's Fenn Co-op Program.

"I redesigned their quoting process for their caster department to make it more efficient, user-friendly and automated," she says. "After I finished doing that, they said 'Hey, what do you want to get out of this? What do you want to learn here?' I said you know, I would love to learn how to use a CNC [computer numerical control] machine."

From there, Enprotech assigned her to a veteran machinist. "I basically got to be his apprentice for a week. He showed me all the different machines and he ended up really teaching me how to use the lathe. I ended up making one part that was actually used in our production line. It was a specialty thing they needed," she says.

"There's a lot of value in the hands-on part of production – the machinists, mechanics. Those people are absolute experts at what they do and it is important for me, when trying to think of designs, to consider: how is this going to be made, and how am I going to spec a drawing to make it easiest for the machinist. You can only get good at that by listening to those people and trying to learn a little bit about what they do. The best engineers that I know are all people who started out technical in some capacity."

Much of Rea's volunteer work is with children. She has helped teach fourth-graders at Carylwood Intermediate School in Bedford about simple machines and worked with a Girl Scout troop at a STEM day at CSU by teaching the girls how to make miniature catapults.

Rea is currently working on a master's degree in Aerospace Engineering at Georgia Tech and will start working at GE Aviation in January 2021, but she's not sure where she'll end up down the road. "I'm actually not sure if I want to be in engineering or in business. If I want to become more of a subject expert or more of a management-type person. There are parts of both of those that I love."

STUDENTS

MAKING IT WORK

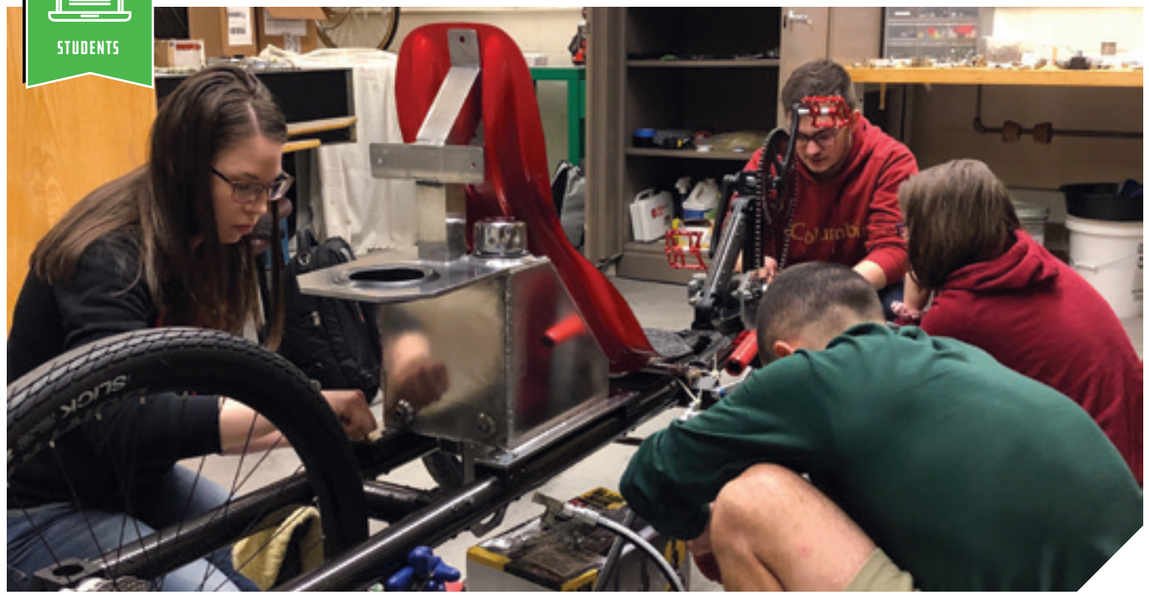
The coronavirus pandemic has impacted every aspect of our lives. Here's a look at how some classes and labs in the Washkewicz College of Engineering have adapted to the new normal.

The MakerSpace's New Machinist

The Washkewicz College of Engineering recently welcomed a new part-time machinist Evan Hubbard. He will mainly work in the Dan T. Moore MakerSpace, assisting the manager of the facility, Matthew Johnson, and the full-time machinist of the College, David Epperly. His duties in the MakerSpace include maintaining the machine shop tools and equipment, consulting on student projects that involve machining and training students to use machine shop equipment safely under supervision.

Hubbard's industrial background includes three years in die-casting and six years in machining before deciding to attend CSU full-time as an electrical engineering student. He is also an avid martial artist. He says that "the intense physical exercise and the demanding mental requirements of the sport push me to become stronger than who I was yesterday." He likes to read for entertainment, alternating between non-fiction and fiction. "Sci-fi/fantasy is my jam," he shares.

He says that his wife inspired him to attend CSU full-time as an engineering student. Being a full-time student is an exciting change from working full-time and he relishes the opportunities over the coming years to connect with other motivated students and have a positive impact on the CSU community.



ON A ROLL

For the second consecutive year, the Washkewicz College of Engineering's student team won the Fluid Power Vehicle Challenge

IT WAS A YEAR OF CHANGE in the Fluid Power Vehicle Challenge, but the result was the same. Students from CSU's Washkewicz College of Engineering won the overall championship for the second year in a row.

The students' bicycle that runs on hydraulic fluid power bested bikes from 14 other colleges. The contest was conducted in April through remote virtual testing and presentations, after the COVID-19 pandemic ruled out having the teams meet in Colorado.

The National Fluid Power Association (NFPA) "did a nice job of accounting for changes in the schedule due to the virus," says Jacob Landry, who was on the team of seniors along with Ellen Rea, Angela Rodriguez, Sarah Smith and Naik Yusufi. "We were still able to present our work in its entirety and we're really proud of that."

Ordinarily, there are three races of different types that test the vehicles' speed, endurance and efficiency, in addition to a presentation of the team's work. This year the racing was done through test data submitted to the judges.

"We didn't miss anything besides having a crowd," says the team's advisor Bogdan Kozul, assistant professor of practice in the Department of Mechanical Engineering. According to Kozul, Cleveland State, in all categories, "had the best design and implementation."

"These other teams did a great job," he says. "The CSU bike was an engineering marvel with all the project constraints."

Kozul says the CSU bicycle was the first in the challenge's 15-year history that used a carbon fiber frame built specifically for the competition, instead of aluminum, steel or carbon fiber from a stock bike.

The main advantage of that was reducing the bike's weight, "but it's also very durable, strong and stiff," so the frame stays in place, explains Yusufi.

The team: from left to right, Angela Rodriguez, Sarah Smith, Naik Yusufi, Jacob Landry and Ellen Rea.

"THE REALLY COOL THING WAS THAT WE FABRICATED A LOT OF THE PARTS OF THE BIKE OURSELVES."

NAIK YUSUFI

The frame supports a bracket behind the rider that holds the hydraulic reservoir, the accumulator that stores the energy and the hydraulic motor. "We were able to integrate many component mounts into the hydraulic reservoir, so we didn't require a bunch of separate brackets," says Rea. "Through doing that, we got rid of some weight and also made everything more streamlined."

The bike weighs 171 pounds and has a top speed of 27 mph.

The vehicle boasts several riding modes, including a direct pedal drive similar to a traditional bicycle. The rider can also charge the accumulator by pedaling and use the stored energy to power the bike without pedaling. Additionally, the accumulator can be charged with an electric drill, and it's charged by regenerative braking. "While the bike is stopping, you're using the inertia of the rear wheel, that's already turning, to force fluid into the accumulator," says Rea.

"The really cool thing was that we fabricated a lot of the parts of the bike ourselves," shares Yusufi. "There was a lot of design involved and fabrication of even minor parts."

The work involved "everything from welding to machining to computer modeling," says Landry. "It was a really good summary of a lot of the things we've learned in school as a whole."

Before winning two years in a row, CSU finished second in the Fluid Power Vehicle Challenge in 2018. Kozul — who came to Cleveland State from Mayfield Heights-based Parker Hannifin Corporation, which started the competition and ran it until the NFPA took over — has a plan to keep the success rolling. "We're bringing in a lot of underclassmen to participate or observe the team so that they can build a legacy around the skill sets needed to be ready to go when they become seniors," Kozul says.

The other schools that competed this year were the University of Akron, the University of Cincinnati, Arizona State University, California Polytechnic State University, Colorado State University, University of Denver, Iowa State University, Michigan Technological University, Milwaukee School of Engineering, Murray State University, Purdue University, Purdue University Northwest, West Virginia University Institute of Technology and Western Michigan University.

Kozul and team members say their success isn't really about weight and stored energy, but about people. Kozul stresses support from the leaders of the engineering college, including interim dean Joanne Belovich and associate dean Brian Davis, and school facilities, including the Parker Hannifin Human Motion and Control Laboratory and the Dan T. Moore MakerSpace. "You couldn't ask for better facilities," he says.

"I think it was the team," adds Rea. "We had a lot of different skill sets."

"I've worked with a lot of teams over the years, both at Parker Hannifin and at CSU, and I've never met a team that was so internally motivated," says Kozul. "They did not get this from me. They were really just genuinely curious and had a great project to explore their curiosity to the point that I've never met a team with this type of DNA before."

STUDENTS

Student Success

Recent graduate Farid Khoury received a National Science Foundation fellowship

FARID KHOURY HAS BIG PLANS FOR MICROALGAE.

Khoury recently completed a master's degree in chemical engineering at Cleveland State and won a National Science Foundation (NSF) fellowship, which will pay for all expenses to pursue a Ph.D. He is continuing his education in chemical engineering at Columbia University.

Khoury's Master's thesis was about optimizing light conditions for the production of biofuel from microalgae. He says he's excited about microalgae's potential as a source of fuel because its production is carbon-neutral and it doesn't divert resources from other needs.

"There are three generations of biofuels," he says. "The first one is that you use corn. You take the sugar out of the corn and you make ethanol and stuff like that."

But as population growth continues, making fuel out of food won't make sense, he explains. The second generation is "biomass" fuel that comes from trees, leaves and other kinds of plant material that isn't food. But chewing up trees to make fuel has a downside, too.

> "CLEVELAND STATE HAS BEEN A GREAT HOME FOR ME. I FELT LIKE I BELONGED HERE. I NEVER GOT DENIED AN OPPORTUNITY."
>
> FARID KHOURY

Algae is part of the third generation. "It just needs water," Khoury says. "It doesn't have to be fresh. You can use sea water or even sewage water."

But there isn't yet enough fuel to be had from the algae to make it an economically feasible alternative to fossil fuels, he reveals.

The problem to be solved is that while humans use the lipids (fat) stored in microalgae to make biofuel, the microalgae make it for another purpose. They make carbohydrates out of light and carbon dioxide and consume it when there is no light. "They use it to survive the night. That's why they make lipids," he says.

Khoury is diving into a two-pronged project of trying to increase production of the lipids by day and improve conservation of them by night. "During the day, how can we make the usage of light more efficient? And during the night, how can we prevent algae from eating its own lipids? Our goal is to get them as fat as possible," he says.

Khoury is studying the effect of light intensity on the growth of microalgae. "If you have too much light, it will damage those light-harvesting complexes [that the algae possess]", he says. "It will slow down the growth rather than enhance it."

Khoury, 24, came to the U.S. from Syria seven years ago, to escape from a civil war. His family's house was damaged in a missile strike. "Two missiles, but nobody was hurt," he says. "They hit the walls on the side of the house." Another missile strike across the street resulted in fatalities.

The move to the United States was facilitated because his mother was born in Arizona, where his grandfather was studying for a doctorate. "We chose Cleveland [because] we know some family here," Khoury says. "I started at Tri-C [Cuyahoga Community College] doing my English as a second language classes. It was an option between transferring to Kent State or Cleveland State."

His experiences in Syria fueled his interest in biochemical engineering. "With the war, there were always people dying because there's no drugs," he says.

At CSU, his first research project was a study of whether hydrophobic or hydrophilic drugs were best suited to treat bone issues such as osteoporosis. "One that hates water and one that loves water," he explains. "Which one will transfer into the bone better."

Khoury spent about 13 months on that project, which is ongoing. He believes he was positioned to get his bachelor's and master's degrees simultaneously and move on, but the chance to participate in the algae project drove him to stay another year. That had been his first choice all along, but the previous year there were no openings.

He says that as a student who grew up outside of the U.S., he found that "Cleveland State has been a great home for me. I felt like I belonged here. I never got denied an opportunity. When I couldn't get into the algae project, I was offered many other projects. There's constant support among all professors," he says.

Khoury's advisor at CSU's Washkewicz College of Engineering was interim dean Dr. Joanne Belovich. She raves about his drive and enthusiasm. "He really likes to dive deep into the scientific phenomena and try to figure out the 'why', and not just the 'what,'" she says. "And he's highly energetic. When given a problem to solve, he searches the literature, studies the manuals and gets in the lab to build devices — often within a few days."

That sort of commitment applies outside the lab, too. During Khoury's junior year at CSU, he helped his mother start a business called Aquamarine Spa.

"She is a skin-care expert," he says. "I was basically in charge of starting the business from overseeing construction and obtaining permits, setting up the website and all online listings, hiring qualified people, to following all state guidelines for an industry that I knew nothing about. It was a heavy load as I had to handle all my schooling as well."

The load didn't keep him from getting his bachelor's degree summa cum laude. Khoury says the business is growing, and he's still involved on a remote basis with its finances and marketing. He thinks what he learned setting up the spa will help him with a long-term goal of starting his own chemical company, after he receives his doctorate.

In his studies at Columbia University, he says, he hopes to work with a group that is researching genetic modification of proteins and the design of new proteins. "Instead of looking at the cell as a whole, they're going much deeper."

He hasn't gone to New York right away. "The first semester was online, so I stayed home, close to my mom so I can eat," he says with a laugh.

The opportunity presented by the three-year NSF fellowship excites Khoury. "I remember jumping out of bed when I got the email," he shares. He won it with a research proposal about the algae project and a personal statement. Both highlighted his concerns about climate change.

He has an optimistic take on the future of the planet. "We'll figure it out," he says. "We're not going to go extinct. Humans are too smart to go extinct."

STUDENTS

RESEARCH AND INNOVATION

Washkewicz College of Engineering is helping advance Ganesh Walunj's extensive research on metals

GANESH WALUNJ spent a total of nine years in the corporate world, before and after earning a master's degree in industrial engineering from the University of Texas at Arlington. He was a manufacturing engineer, working to build machines for steel plants. He also worked as a supply-chain analyst, partly in the pharmaceutical industry.

"I was always attracted by the world of research," Walunj says. "I needed to do something innovative."

A return to research was what he had in mind, and Walunj found the projects he was looking for at Cleveland State University. As a Ph.D. student in the Department of Mechanical Engineering of the Washkewicz College of Engineering, he's working with metals again. He's advancing the science of alloys with research into low-density and high-entropy alloys, which have great potential to reduce energy consumption and CO_2 emissions due to their unique nature and potential outstanding physical and mechanical properties.

The search focuses on high-temperature structural applications for the aerospace, automotive and other industries, and the effort is leading to "different alloys that are cheaper and have outstanding physical and mechanical properties," Walunj says. "The alloys are continuously improving." It's done by using aluminum, chromium, iron, manganese and titanium. "We try to create a unique combination of different elements that results in the low-density high entropy alloy," he says.

It's a juggling act because for a specific application — for example, building airplanes — the metals have different shortcomings as well as distinct advantages. "Aluminum is light, that's why you are using it in the plane," he says. "We need light materials, like aluminum, but with higher mechanical and wear properties. Nickel is a very soft material, and its superalloys can sustain high temperatures. But nickel's density is high and it is heavy, so we need to reduce its weight. Titanium carbide has half of the weight of nickel, so if you mix them together in some combination, the weight of the nickel-and-titanium carbide alloy would be far lower than that of nickel."

The search for the recipe is illustrated by a project in nickel-titanium alloys that Walunj worked on with Dr. Tushar Borkar, assistant professor in the Department of Mechanical Engineering, and fellow students Anthony Bearden and Amit Patil. Walunj submitted this work to the Society of Tribologists and Lubrication Engineers and won its Canton section scholarship for 2020. (Tribology is the study of friction, wear and lubrication when objects rub against each other.)

"We used different combinations of nickel and titanium carbide, and we tried to find out what percent of titanium inside the nickel is good to produce the best possible results," Walunj says. An alloy that has high specific modulus, fatigue strength, thermal stability and wear resistance has applications in the automobile, aerospace and other industries, he explains. The challenge of high temperature is that it can loosen the bond between the components of the alloy.

Nickel and nickel-base superalloys are widely used in aircraft jet engines, land-based turbines and chemical-petrochemical plants because of their excellent properties. Titanium carbide has high hardness, high melting point, low density and high mechanical strength, but it cannot be used as a monolithic ceramic. That is why titanium carbide-reinforced nickel matrix composites are considered for high-temperature refractory, abrasive and structural applications. Walunj processed these composites using mechanical alloying, followed by spark plasma sintering. The experiments were conducted with powder metallurgy, another focus of Walunj's research. "We can make the alloy without reaching a melting point," he says. "We just compress it at high pressure and temperature, a unique technique for processing dense and near net shape bulk alloys with homogenous microstructure."

> "I WAS ALWAYS ATTRACTED BY THE WORLD OF RESEARCH."
>
> GANESH WALUNJ

Walunj and the team varied the titanium carbide reinforcement in the nickel matrix from 5% to 50% weight to investigate the effect on the microstructure and mechanical behavior of the resulting composites. He found that increasing the reinforcement caused a corresponding increase in microhardness and tribological behavior. "The grain size of nickel became smaller and smaller with increasing the weight percentage of the titanium carbide. The smaller the grains, the greater the hardness," he says.

Another finding was that if there's more than 25% titanium carbide, the temperature of 900 degrees Celsius they'd been using in the sintering machine was insufficient. It wasn't close enough to the melting point of TiC, which is much higher than the melting point of nickel. "It's not good enough to sinter the particles," Walunj says. "So we had to increase the temperature from 900 to 1,200 degrees."

"There's more testing left. We are also working on the installation of new equipment, which will enable us to run more tests," he says, noting that they are also installing a new tribology testing machine for that.

Walunj was born near Pune, in Western India, and earned a bachelor's degree in automobile engineering before moving to the United States and getting his master's in Texas.

He says that when he decided to pursue a doctorate, he wasn't looking for a university as much as for specific research that fit his interest and expertise. He finds the atmosphere at CSU inspiring.

"This is a new building in which I'm sitting right now," he says with a smile. "The expansion of the research facilities of the College of Engineering has had a significant impact on the quality of research. The wide variety of research topics, from robotics to human motion and control, will encourage several students toward research."

STUDENTS

Taylor Scardelletti (former WIE CSU student chapter president), Dr. Hannah Arnson, Dr. Lili Dong and Mark Travis (former IEEE CSU student chapter president) at the WIE seminar on April 12, 2019

WIE seminar on April 12, 2019

STRENGTH IN NUMBERS

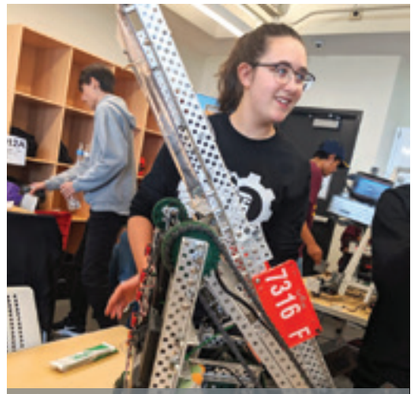
CSU's Women in Engineering chapter is focused on promoting women within the engineering community at CSU and beyond

TWO PIONEERING ELECTRICAL ENGINEERING STUDENTS, Taylor Scardelletti (B.EE '19) and Brighid Rancour (B.EE and B.CPE '19) eagerly joined Dr. Lili Dong, associate professor in the Department of Electrical Engineering and Computer Science, in her efforts to support and inspire future women engineers. While women constitute more than 40% of the undergraduate chemical engineering students at CSU, only 13% of the electrical engineering majors are women. This low percentage inspired Dr. Dong, together with Scardelletti and Rancour, to establish the CSU student chapter of Women in Engineering (WIE) in 2018.

Scardelletti became the first president and Dr. Dong remains the chapter advisor. The group, which currently has 20 members, joins a global organization of over 20,000 members in more than 100 countries. WIE's motto is "Designing the Future with Excellence," and is an affinity group of the Institute of Electrical and Electronics Engineers (IEEE). The goal of the student chapter is to promote academic excellence and career development, while ensuring personal and social growth. In addition, it advocates for women in leadership roles and mentoring of younger students.

In its short lifespan on the CSU campus, WIE has organized two professional seminars, one hands-on workshop and multiple member recruitment events and officer training meetings. The group enjoyed hosting an engaging, three-hour soldering workshop in November 2019, led by WIE officers Anusree Mandali, Grace Quaintance and Diana Valle, electrical engineering student Dereck Woods and electrical technician Karen Jackson. Thirty-two young women enthusiastically donned protective eyewear and learned the delicate skill of soldering while building an LED lighting circuit.

In spite of COVID-19, WIE has continued to recruit new members and train new officers via online meetings. The active chapter co-organized a virtual seminar with the HKN honor society via Zoom on November 20, 2020. The seminar featured a presentation titled *Reflections of an Engineer on the Past, Present and Future* given by Steven Galecki, chair of IEEE, Cleveland Section. More than 40 engineering students and faculty participated in the virtual event. WIE will keep moving forward to help raise the profile of female engineers and spread awareness of the importance of promoting women within the engineering community at CSU and beyond.



Gabi Lathrop from Firestone High School with her team's VEX robot. Her team finished in first place overall, thus becoming eligible for the state tournament.

Students from multiple schools in Northeast Ohio competed at the VEX Robotics *Tower Takeover* event. Shown here are students from Firestone High School being recognized for their award-winning performance.

Anything is POSSIBLE

The IEEE Student Chapter Fall 2019 Conference provided attendees with an inspiring presentation and engaging VEX Robotics competition

JONATHAN CHEW, a Walt Disney imagineer, was the keynote speaker for CSU's Institute of Electrical and Electronics Engineers (IEEE) Student Chapter's two-day conference in Fall 2019. Organized to inspire young engineers, the conference was planned in conjunction with the Student Professional Awareness Activities branch of the national IEEE organization. Held on November 1, 2019, in Washkewicz Hall, Chew's presentation was entitled, *Seeing the World Differently: Noitanigami::imagination*. His message to students: "It's kinda fun to do the impossible and to know that anything is possible!"

The second guest speaker was Jim Watson, who after a 36-year electrical engineering and management career at Ohio Edison Company, established Watson Associates to provide programs to incorporate non-technical skill development within existing university engineering technical classes. He co-authored the book *Engineering Skills for Career Success* with the former CSU Dean of Engineering Dr. Charles Alexander. More than 100,000 students around the world have learned the soft skills necessary for career advancement, and CSU's very own aspiring engineers thoroughly enjoyed learning Watson's keys to professional success.

On the second day of the conference, CSU's IEEE Student Chapter hosted a regional VEX Robotics Competition. The highly interactive, hands-on contest provided the opportunity to teach and test teamwork and perseverance in the face of hardship. VEX Robotics provides a uniquely engaging approach for developing problem-solving strategies that resemble the same mindset used by rocket scientists, brain surgeons, inventors around the world and, most of all, strategies used by CSU engineering students every day.

New Additions

The Washkewicz College of Engineering recently welcomed a new assistant dean as well as two academic advisors

Dr. Susan Carver

SUSAN D. CARVER, PH.D., is the Washkewicz College of Engineering's new assistant dean of Student Affairs and Advising. She has transitioned into her new role with ease — it feels like she has been with the College for years, not since April 2020.

Prior to coming to the Washkewicz College of Engineering, Dr. Carver worked for seven years in CSU's College of Sciences and Health Professions, specifically the math department, where she was the director of two student success programs: Operation STEM and the Louis Stokes Alliances for Minority Participation. These highly regarded programs provide comprehensive year-long academic programming in the precalculus-calculus sequence, student support services and a summer bridge program designed primarily to support first-generation and underrepresented students in STEM.

Dr. Carver's master's degree in curriculum and instruction from CSU, along with her doctorate in educational administration from Kent State University, have served her well in the curricular development and leadership roles that lie at the heart of her work at the University.

Among her passions, Dr. Carver is dedicated to working with CSU's faculty and staff to ensure engineering students graduate with their hard-earned degree. Another life-long passion for her is designing and implementing diversity and inclusion programs, workshops and graduate courses for educational and religious institutions, city governments, NASA and large and small businesses. Dr. Carver has been recognized for her unique capacity to discern her own worldviews, which informs her capacity to help others increase their cultural self-awareness. She has received national recognition for her creative leadership, winning the Rutgers University Women in Government Award, and she was honored by the United States Conference of Mayors for excellence in the development and implementation of anti-racist programming.

These two passions are naturally fueled by her enriching interactions with CSU's community members. "There is absolutely no place I'd rather be than at Cleveland State University," Dr. Carver says.

New Academic Advisors

IN ADDITION to Dr. Susan D. Carver, two new academic advisors, Alita Cauley and Pamela Kromer, joined the College. They each play a significant role in helping students take the right paths, leading to timely graduation and successful careers.

Cauley's educational background consists of a bachelor's degree in criminal justice and a master's degree also in criminal justice with a concentration in justice administration. Through her educational career, which spans over 15 years, she has worked with different groups of diverse students and colleagues. Through the years in her role as a facilitator of instruction, she worked hard to become more than just "the professor."

After learning the needs of students, her responsibilities shifted to becoming a role model and mentor and the voice of students. As an academic advisor, she is engaged with nearly every student within the Washkewicz College of Engineering. She has taken it upon herself to become involved in several committees to improve her ability to understand and help individuals from a standpoint that promotes cultural awareness, student success and diversity. When she is not working, she enjoys karaoke, plays and being with her family.

Kromer earned her bachelor's degree in writing from Bowling Green State University and her master's in English literature from the University of Texas Rio Grande Valley while studying ethology and primatology. She has advised at both two- and four-year institutions, and has spent time as an advisor to both first-year and transfer students. She also teaches the Engineering New Student Orientation course at CSU and serves as an Engineering Student Success (ESS) Scholars Program coach.

While issues related to college transfer students are a special interest, Kromer works to support special populations such as veterans, non-traditional students and first-generation and underrepresented students. Mostly employing a developmental and appreciative approach to advising, she makes strong efforts to meet students where they are as individuals in their university experience.

Alita Cauley

Pamela Kromer

TECH BREAKTHROUGHS

High school students learn about captivating research from CSU engineering professors

ON NOVEMBER 26, 2019, CSU hosted *Believe in Ohio,* an event that brought 240 high school students from across Northeast Ohio to campus. The event sought to introduce students to the breadth of opportunities at CSU and highlight the role of STEM in future technological breakthroughs that could impact Ohio's economy.

Throughout the day, students listened to faculty describe how their research relates to future breakthroughs in engineering. Dr. Josiah Owusu-Danquah, assistant professor in the Department of Civil and Environmental Engineering, described and demonstrated metal alloys that change shape if they are heated and how this may apply to future metal implants that are used to treat orthopedic fractures.

Dr. Geyou Ao, assistant professor in the Department of Chemical and Biomedical Engineering, described multifunctional nanomaterials and their exceptional optical, electronic, mechanical, thermal, chemical and therapeutic properties. Dr. Brian Davis, associate dean and professor in Mechanical Engineering, provided numerous examples involving fluid flow from airflow in patients with respiratory problems to blood flow in cardiac patients. He also showed how data can be displayed as a "flow" and how animation sequences can help visualize large data sets.

Dr. Geyou Ao, assistant professor in the Department of Chemical and Biomedical Engineering, (top photo) and Dr. Josiah Owusu-Danquah, assistant professor in the Department of Civil and Environmental Engineering, (bottom photo) speak to the high school students about their research.

New Manager of Student Programs and Assistant Director of Fenn Academy

We're pleased to welcome W.C. Vance, the new manager of Student Programs and assistant director of Fenn Academy. He brings more than 25 years of university admissions experience, specializing in engineering student recruitment.

Before joining the Washkewicz College of Engineering, Vance served as a director in recruitment and admissions at Ashland University, University of Missouri - Kansas City and Slippery Rock University, and as associate director at the University of Toledo. While at Toledo, Vance was part of a team that increased new student enrollment nearly 100% over five years. Most recently at Ashland University, Vance led the efforts to bring in the four largest freshmen classes in the university's history.

Vance received his Bachelor of Business Administration and his Master of Public Administration degrees from the University of Toledo. In his free time, Vance leads an F3 men's fitness group as well as repairs and sells Hobart brand commercial food mixers, slicers and meat grinders, and fabricates obsolete parts for the equipment.

Growing Our Experiential Learning Opportunities

The CEEL office welcomes two new staff members

Angela Benton-Smith

Nicole Tischler

RECENTLY, two new staff members joined the Center for Engineering Experiential Learning (CEEL) office: Angela Benton-Smith, CEEL coordinator for special programs, and Nicole Tischler, coordinator for special academic programs. Together with Sandra English, senior manager of CEEL, and a number of graduate and undergraduate student assistants, they provide unparalleled help and services to students.

Benton-Smith shares her expertise as a primary resource person, advisor and advocate for multicultural engineering experiential learning initiatives. She's earned several degrees: a Bachelor of Science in physics from Spelman College; a Bachelor of Science in electrical engineering from Georgia Institute of Technology; and a master's degree in business administration from Clark Atlanta University. Her noteworthy career and rich professional experiences include working as a project engineer for LTV Steel, interim director for community services for Spelman College and coordinator for the Washington Bridge to Spelman Program. Most recently, she served as the facility coordinator for the Center for Experiential and Service Learning at Hawken School in Gates Mills. Benton-Smith's professional background as well as her personal experience uniquely qualify her for her vital role in CEEL.

Tischler works in both the co-op and industry-sponsored senior design programs of the College. She received her Bachelor of Science in psychology and theatre from Baldwin Wallace University and her Master of Arts in counseling from the University of Cincinnati. Tischler first gained experience working in engineering co-op programs as a graduate assistant at University of Cincinnati's Division of Professional Practice and Experiential Learning (ProPEL), one of the first cooperative education programs in the country. At ProPEL, she was able to work with mechanical engineering students to both prepare them professionally for co-ops and help them process what they learned through their professional experiences. Tischler is excited to be working in co-op again and looks forward to continuing to help CSU engineering students develop professionally.

FENN CAREER FAIR GOES VIRTUAL

Most of the CEEL office's co-op-related activities have gone virtual this past fall. The Fall Engineering and Computer Science Connections Fair was held virtually on October 1 and 2, with 52 employers and nearly 400 students participating. The number of employers is down significantly from pre-pandemic levels, but, even in the midst of a pandemic, many companies have continued to hire co-op students.

Plans for the Spring Connections Fair are being finalized, with both hybrid (on-campus and virtual) and completely virtual models being considered.

HELPING STUDENTS SUCCEED

The third cohort of the Engineering Student Success Scholars has started

The Washkewicz College of Engineering is excited to welcome the third cohort of 26 Engineering Student Success (ESS) Scholars, for a total of 63 scholars, both on campus and virtually this year. ESS offers academic and financial support to underrepresented minorities studying engineering and computer science at CSU. The program provides students with academic enrichment and professional development programming, scholarships and comprehensive advising and academic plans tailored to the needs of each student.

This past year, the ESS program offered workshops in technical writing, dress-for-success, time management, financial literacy and engineering careers, as well as review sessions in core engineering subjects such as differential equations and statics. One of the year's highlights was the Guaranteed 4.0 workshop, presented by Donna O. Johnson Mackey, Ph.D., last January.

Dr. Mackey is a motivational speaker and the founder of the Guaranteed 4.0 method, which teaches successful brain-based learning strategies. In the workshop, she presented a learning method that uses an easy-to-follow, three-step systematic framework using repetition and effective information input, which empowers students to learn concepts and enhance their critical thinking skills. The ESS Scholars were given notebooks and assignments in order to practice the techniques in their coursework and their coaches helped them implement these techniques throughout the semester.

FOR MORE INFORMATION, PLEASE CONTACT

Sandra English, ESS Scholars project director and senior manager of CEEL, at 216-687-6968 or s.l.english@csuohio.edu or

Angela Benton-Smith, CEEL coordinator for special programs, at 216-687-2517 or a.bentonsmith@csuohio.edu.

ENGAGING THE FUTURE

Lawrence J. Cawley's humble beginnings led to a successful career and generous gifts to CSU

THE CAWLEY FAMILY considered many charitable donation options in memory of Lawrence Cawley. They decided that the Freshman Design Laboratory in Washkewicz Hall captured the essence of what Larry held most important about educating young people to be great engineers — engaged learning.

Most engineering students don't begin hands-on learning in a lab until their sophomore year, so this lab is a game-changer. The teaching lab is geared to help first-year students learn about what engineers do. Each class is set up to drive students' interest and imagination through hands-on projects while they learn fundamental engineering concepts with a professor to guide them. Working in teams of four, students complete a wide variety of experiments designed to introduce theories that will be central to future engineering coursework and cooperative education.

Larry believed in teamwork and "rolling up your sleeves" to gain the experience and skills necessary to be a successful engineer. It is in this spirit that the Cawley family named this lab The Lawrence J. Cawley Innovation Laboratory.

To further remember Larry, his family — his wife, Lillian, and sons, Terence and Patrick — have provided their thoughts and memories for this article.

Lawrence Joseph Cawley was born on April 9, 1934, in Cleveland. His parents were Mary Keane Cawley and William Cawley, both born in County Mayo, Ireland. They emigrated to the United States separately, met in the Cleveland area and were married in 1923.

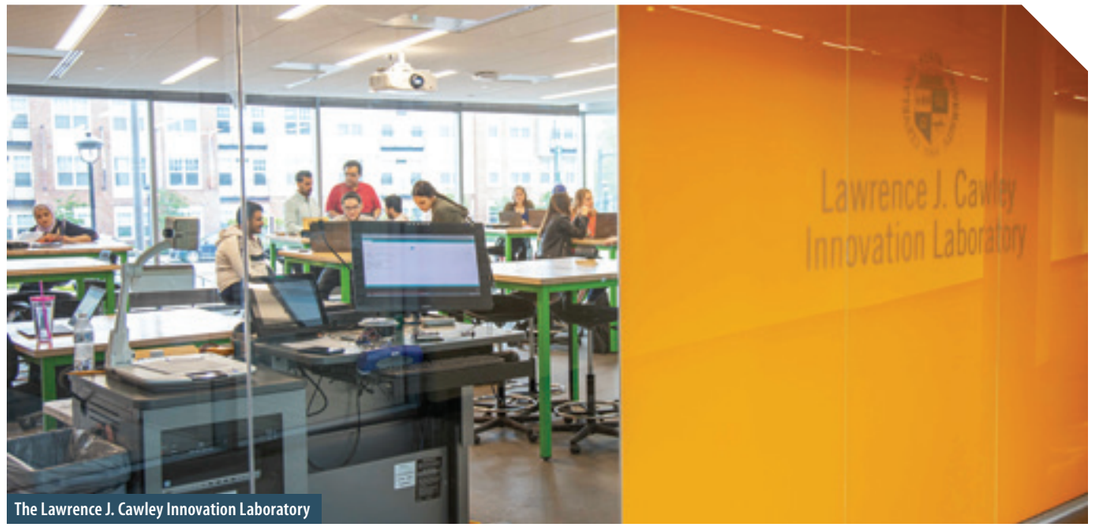
Larry, the fourth child of six, was raised in the Cleveland area and attended Holy Name High School in Cleveland. He earned a bachelor's degree in mechanical engineering at Fenn College, which later became a part of Cleveland State University.

At Fenn, Larry took advantage of the co-op program. One of his co-op assignments was with a company called Otto Konigslow, and Larry benefited from the mentorship of a manager there who encouraged him with his career and ambitions.

The co-op program gave students an opportunity to make money for books and tuition. During those days, Larry carried a full load of classes and worked long hours on the co-op jobs. His days sometimes started in class at 8:30 a.m. and ended when he finished studying near midnight.

He later worked at Republic Steel as a shoveler on a crew on a Hulett unloader, taking iron ore from ships on Lake Erie.

Larry held Fenn College's School of Engineering in very high regard. He praised the quality of his professors, classes and programs. Some of the fondness that he held for the school came from the challenges he overcame, including early struggles in classes such as calculus. His son Terence remembers hearing about a certain professor who would "walk into the classroom, set down his book on the table, pick up a piece of chalk and start to lecture as he wrote formulas on the board." The joke was told that "as he wrote with his right hand he was erasing with his left." In his third year, after Larry ran a gauntlet of classes such as calculus, differential equations, thermo dynamics, fluid mechanics and others, a professor on the first day read his name, asked him to stand and told the class, "I never thought you'd make it." Larry's grades improved, and he made the Dean's list in one quarter.



The Lawrence J. Cawley Innovation Laboratory

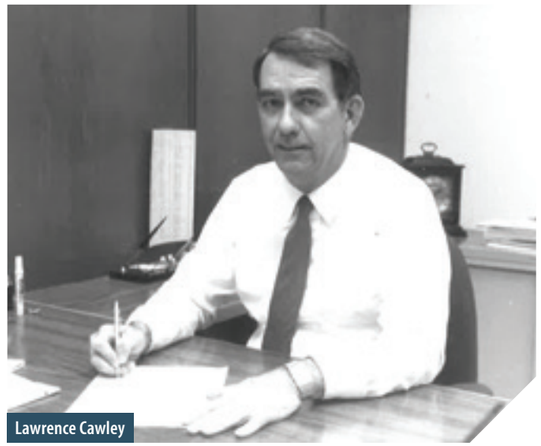
On June 8, 1959, he landed an offer to become a mechanical engineer at Cleveland Graphite Bronze, also known as Clevite. Larry held a variety of positions there until 1985. He rose through the engineering ranks, including several positions that involved the development of new products and innovative technology.

Eventually, Larry moved into management roles. Clevite morphed into an acquisition of Gould, and then a leveraged buyout led to the company being reorganized as Imperial Clevite. He was promoted to director of product development, vice president of operations and, finally, president and general manager. As the president of Clevite, he traveled to Australia, South Korea, Taiwan, Japan, Singapore, Brazil, Argentina, Bolivia, Mexico, France, Italy, Switzerland, Russia and more.

He made a career change in the 1980s, landing a position with Kaydon Corporation, which made bearings. He started as president of the bearings division. He was promoted to president and COO of the company in 1986, and also began to serve that year on the board of directors. He was promoted to president and CEO in 1987. In 1988, he was appointed to be CEO and chairman of the board of directors. He served in those roles through 1996.

In addition to growing the base business, he was instrumental in the company's many acquisitions of other companies. He took pride in the performance of the company and was proud of the compensation and bonus programs that he enhanced, including bonuses paid to all full-time employees, whether union or non-union.

In 1994, he transitioned to a different role, continuing to serve as chairman of the board. In 1998, he again resumed his role as chairman and CEO. In his final phase of involvement with Kaydon,


Lawrence Cawley

he served in 1999 as a member of the board of directors and ceased to serve on the board in 2000.

In May 2003, Larry was named the first winner of the Engineering Dean's Alumni Award. This recognizes engineering alumni of Fenn College and CSU who have achieved the highest levels of success, personally and professionally, and have supported the school with their time and talent.

Lawrence Cawley passed away unexpectedly on Nov. 18, 2004. He is remembered fondly and with love by his wife of 44 years, Lillian J. Cawley of Brecksville, their two sons, Terence Cawley, of Rocky River, and Patrick Cawley, of Brecksville, and five grandchildren.

ALUMNI

Paying It FORWARD

After a successful and fulfilling career, Ron Pasadyn is creating opportunities for today's CSU engineering students

WHEN RON PASADYN grew up in Elyria, college wasn't what he expected. "I was one of the first of my 54 cousins who went to college," he says. Of his 16 uncles, one had a college degree and went on to a career in the Air Force. A few of his aunts were nurses.

In high school, he says, "I did the first year of industrial arts. My advisor said, 'You need to be in college prep.' The head of industrial arts said, 'You're too smart to be taking this. You need to go to college.'"

The opportunities that followed led Pasadyn to a successful engineering career that started at NASA and continued in the natural gas industry.

Now, the 1970 Cleveland State graduate is creating opportunities for today's CSU engineering students. Pasadyn has made a gift for an endowed scholarship fund to help students achieve their educational goals while lessening their financial burden. He has also made an additional gift to engineering honor society Tau Beta Pi, which helped him in the job market.

"I did well. I've done a lot of mentoring and still have a large network of friends. I wanted to give back," says Pasadyn, who noted that even with the much smaller costs of higher education in the 1960s, he had three part-time jobs when he was a freshman.

When he was a co-op student at CSU, Pasadyn worked on space suits and Lunar Module rocket engines for the NASA Apollo program in Houston. "Growing up, I had a passion for space," he says. "I read everything I could on space."

So, when working for NASA was one of his co-op options, it was an easy decision. He started that co-op assignment in a materials testing lab in 1967, two months after three astronauts died in a cabin fire during preparations for the Apollo I mission. "Our objective was to test the materials and come up with something that would not be flammable in the pure oxygen environment inside the Apollo spacecraft," Pasadyn explains.

After earning his bachelor's degree in chemical engineering, Pasadyn returned to NASA and worked on conceptual designs for Space Shuttle engines, including the engines for orbital maneuvering.

However, that post-graduate hiring by NASA was a cliffhanger. Pasadyn says he was told there might not be money in the budget to hire him. NASA was in a budget crunch and did not know how many of the 100 graduating seniors could be hired. They finally decided to hire 50. Pasadyn was one of those selected.

Later, he entered the U.S. Navy Officer Candidate School and went on to be an instructor at the Navy's Nuclear Power School in Maryland. His wife, Judy, taught high school German and English while they were in Maryland.

Judy and Ron Pasadyn

> "THE FIRST THING I DECIDED I WANTED TO DO WAS CREATE THE SCHOLARSHIP IN HER NAME AND MY NAME."

In 1975, the Pasadyns had their first child, Alex, and Pasadyn returned to NASA, including more work on the shuttle engines.

In 1977, he left NASA to become a process design engineer at Chapman Engineering. In five years at Chapman, Pasadyn rose to the position of chief process engineer as the company designed, fabricated, installed and started up over 25 natural gas processing plants. During that period, the Pasadyns welcomed their second child Alicia.

Pasadyn then left Chapman in 1981 to form his own company, Pasadyn Inc., that for 25 years performed troubleshooting, optimization and de-bottlenecking studies of natural gas processing facilities around the world. In 2005, he closed Pasadyn Inc. and joined EDG Inc. as process engineering manager. There he helped to execute world-class project designs for major oil company projects in the Gulf of Mexico, Southeast Asia and West Africa.

In 2012, he joined Chart Industries in the Woodlands, Texas, and, as program manager, developed feed design packages for natural gas liquefaction plants. In 2016, he joined Freeport LNG to construct a world-class liquefied natural gas plant and export facility in Freeport, Texas, as senior technical advisor to the project vice president.

Judy passed away in April 2018, just before their 47th anniversary. As the facility in Freeport began operations in July 2019, Pasadyn retired to their home in the Houston area to pursue charitable volunteer work.

"I finished the job that I was on. I retired, I was 72," he says. "The first thing I decided I wanted to do was create the scholarship in her name and my name."

Pasadyn says his work ethic was a factor in his success, an observation he's passed along to the people he has mentored. "I was always one of the first people at work in the morning. If there was something that needed to be done, I volunteered. I was usually one of the last people to leave in the evening," he reveals.

And he has no intention of being an idle retiree. One of his first retirement projects was to take a Master Gardener's course. In that class, he met Rev. Mary Wilson, a retired Episcopal priest whom he married in July 2020. Gardening, traveling, enjoying grandkids and, yes, some consulting is in the future.

ALUMNI

Leading the Charge
IN MEDICAL INNOVATION

Accomplished alumna Dr. Ediuska Laurens is using the powers of science and engineering and her know-how of industry to improve the health of vulnerable populations

DR. EDIUSKA LAURENS, who earned a doctoral degree in Applied Biomedical Engineering in 2009 from a joint doctoral program of the College of Engineering of Cleveland State University and the Cleveland Clinic, invented a device to help infants who are born with jaws too small to function properly.

"In plain English, we were making implants that are used to repair babies' heads," she says.

It's called a pediatric mandibular distractor. At the time, she was leading a global research and development team at Stryker Corporation, a giant medical technology company, "and pretty much taking products from concept to global commercialization," she says.

That means navigating the approval process of the U.S. Food and Drug Administration, which might sound like a chore. For Dr. Laurens, it was an adventure.

"During product development, we had an explosion in one of our plants in Germany," she says. "When we were trying to do FDA approval, the U.S. government shut down. When we finally got clearance, we had to accelerate product launch, because there was already a surgery booked, so we needed to expedite everything. There's a baby that needs this."

She emerged with a keen understanding of what the approval process does to ensure the quality of a new product, and also of the advantages she had because she was learning the process at a Fortune 500 company. That led her to form Genius Shield, which helps smaller companies navigate the system.

"Unless you spend many years in the industry connecting the dots, like I had the opportunity to do, it's not going to make sense right away," Dr. Laurens says.

"What is happening is you get this flow of amazing new ideas to solve medical issues," she says, that could be coming from entrepreneurs who could be students or experienced surgeons. "But they have absolutely no clue what it really takes to develop and get this through this regulatory process, which includes product development and quality. There's tremendous risk of not knowing that. Not only you failing as a company, but most importantly, harming patients."

"I always say that I was the entrepreneur at Stryker, with all the cash, the expertise and a process already in place," she says. "And then you get the early-stage medical device companies, they have none of that. Sometimes they don't even realize that they need to take a step back. They're brilliant people, brilliant engineers and scientists. It's just that, where would you learn this?"

Enter Genius Shield. The company website, geniusshield.io, identifies Dr. Laurens as the "Head Fanatic" and explains the mission as "We geek-out on safer products and successful launches."

Dr. Laurens says a friend told her, "I've never met anybody as passionate about regulation as you."

"I'm actually passionate about protecting patients," she shares. "I truly believe that we live in a time where, if we do this correctly, if we're mindful of this, we have an opportunity to raise the quality standards in the market. So we can reduce, if possible completely eliminate, any type of recalls that are affecting your mother, your father."

Dr. Laurens' own parents were the target of her first big sales pitch. When she was an 8-year-old girl in Venezuela, she told them she wanted to move to the United States to build satellites.

She came to the U.S. at age 16, shortly after graduating from high school. "That was the deal that I made with my parents. I was valedictorian at my school, so I was showing my parents that I meant business."

Years later, she was finishing a master's in mechanical engineering at SUNY Buffalo. Her mentor there, Dr. Robert Baier, suggested she consider a biomedical engineering doctoral program run in partnership by CSU and the Cleveland Clinic.

"I looked it up, and there was a lab at the Cleveland Clinic working with hydrogel biomaterials, which is exactly what I wanted to do since I studied them during my master's," she reveals. "They're like jelly, they're like 90% water and they can be synthetic or natural, and can easily change their mechanical properties. It was love at first sight when I learned about this lab."

Using tickets to a Maroon 5 concert as bait, she persuaded a friend to drive her to Cleveland to check it out.

"The program is set up in a way where you spend the first year between Cleveland State University and Cleveland Clinic," Dr. Laurens says. "You take the courses at the University and you do the research at the Cleveland Clinic. I think this partnership is so brilliant, and it offers such a robust ecosystem that I was very fortunate to be part of it and have the best of both worlds. I had so many incredible opportunities, including being elected as the student representative of the International Society of Biomechanics."

That put her in a position to found a gait analysis laboratory in Venezuela, only the second one in the country. "I could have only had this opportunity by being in this ecosystem," she says. "Definitely some of my best years. After succeeding in shipping equipment to a developing country like Venezuela, I felt like I could do anything."

After she finished her post-doctorate at the Cleveland Clinic, Dr. Laurens started at a Stryker office in Mahwah, New Jersey. She is now based in Jersey City.

"I learned the know-how in one of the best environments to learn the know-how," she says. "There is an advantage to being in the kind of environment where you are just absorbing and learning, and there's opportunity for mentorship. When you are in a startup, it's chaotic. You're trying to create some sort of stability. I have a clear language for the science and engineering, I can speak that language very well. I also speak the product development and regulatory language very well and know exactly how to translate the science into a medical product. And now I can take all of that and really help these early-stage med device companies to put it together, and set them up for success from the very beginning."

In March 2020, Dr. Laurens came back to Cleveland to accept a Women in STEM award at a CSU Women's History Month event. "A couple of weeks after, I received an invitation to attend the Women and Girls in Science assembly of the United Nations, which was another amazing surprise. I was just on cloud nine."

While in Cleveland, she made a presentation about pediatric mandibular distractors. The award, she says, "felt like a confirmation from the universe that I am in the right path with what I consider to be my mission. I truly believe that we live in a very exciting era for women, where women, and especially women in science and engineering, will play a crucial role in democratizing health care globally, because it is a human right."

"I believe that inspiration is one of the most powerful feelings. It's contagious, and this is how we get to make positive change for the good of all and really serve humanity."

CSU student Hanieh Mohammadi, Dr. Ediuska Laurens, Jarrett Pratt (CSU's Director of Student Success, The Pratt Center), CSU alumna Cassidy Reaser and Dr. Jeanne Porter King (keynote speaker at the event)

ALUMNI

ENGINEERING ROOTS

An alumnus' unique career trajectory marries his engineering and law background

JOSEPH MASTERS followed two paths as a student, then merged them into a successful career as a lawyer who was trained as an engineer.

"Even though I principally enjoyed a legal career, my entire professional life was dedicated to the engineering and construction industry," says Masters, a 1979 graduate of Fenn College of Engineering and a 2019 winner of CSU's Distinguished Alumni Award. "While I was in private law practice, all of my clients were either design professionals or contractors. When I was general counsel for a large corporation, it was an engineering company, and being an engineer meant you were sort of a member of the club. While I was always introduced as the company's general counsel, it was quickly followed by 'But he's also an engineer.'"

After he received a bachelor's degree in civil engineering at Fenn College of Engineering, Masters earned his law degree at Case Western Reserve University. "When I finished at Case, I really wanted to do something where I could combine both engineering and law, and so I managed to get a job in the legal department of a local engineering company," he says.

After a transfer to California when the company was sold, he came back to Cleveland and went into private law practice representing architects, engineers and contractors.

"I then went in house with URS Corporation, went back to California, became general counsel. At that time, the company was relatively small — about 1,500 employees. Then we aggressively grew through acquisitions and organic growth," he explains.

When the company was sold in 2014, Masters says, it had about 50,000 employees.

"It was a terrific career, thanks in no small part to the four years I spent at Cleveland State," he shares.

Masters gives the CSU faculty of his undergraduate years credit for helping him launch that career. "All of the professors were terrific. Every one of them cared deeply about the students, tried hard to make sure that the students were as prepared as they could be for their careers," he says. "There was a Professor (Frank) Gallo who, in a sense, was the heart of the civil engineering department in that he encouraged us all to get involved in the student chapters of the professional organizations, to get involved with the Cleveland Engineering Society, things like that. That was the foundation of my career."

"I believe in Cleveland State University. I believe in the power of Cleveland State University," he states. "The fact of the matter is, for a reasonable amount of money, a little bit of brains, a lot of hard work and four years of your time you really have something. Something tangible. It can be a degree in teaching, accounting, nursing or engineering. But that will be the foundation of a career, of a lifestyle. A degree from Cleveland State will pay dividends for the rest of your life."

Looking Back

In the past year, several colleagues from the Washkewicz College of Engineering retired. We thank them for their services, hard work and collegiality, and we whole-heartedly wish them best of luck in their future endeavors.

Ali Kaddah

ALI KADDAH, shown in the photo with his grandson, was the College of Engineering's laboratory maintenance specialist. He joined CSU in August 1985. His role was to support the College's research and educational laboratories by maintaining and upgrading the lab equipment, activities that are essential for the delivery of hands-on educational experiences. He also trained undergraduate and graduate students in the research labs on the safe use and transport of gas cylinders and other equipment.

Given his nearly 35 years at CSU, he knew the campus and its community well. He was very resourceful and he could be counted on to help with any task, whether it was moving furniture or dismantling major pieces of equipment. He states that "being a member of the CSU employees' community was a privilege to me," and that CSU is "a great institution to be part of, which offered me the opportunity to seek knowledge and advancements in my field of expertise and also provided me with the opportunity to enable my family to seek top-quality education."

He has been enjoying his retirement, spending time with his family and entertaining his grandson. "Retirement is a wonderful gift that we all deserve, and it is not free," Kaddah says. "It is something we have worked hard for to earn."

Walter Kocher, Ph.D.

DR. WALTER KOCHER earned a Bachelor's of Science in civil engineering and a Master's and doctorate in environmental engineering, all from Drexel University, and a certificate in hazardous materials management from University of California - Davis. He joined the Department of Civil and Environmental Engineering at CSU in 1989, staying on the faculty until his retirement in 2019, with professor emeritus status.

As a self-described "civilized environmental engineer," he taught mostly environmental engineering courses and served as the academic advisor for the Pollution Prevention Program of the Cleveland Advanced Manufacturing Center during the 1990s. He directed numerous projects about pollution prevention, life cycle assessment and sustainable development at the NASA Glenn Research Center for 10 years, serving as the academic director of sustainability for five years. He worked on several environmental projects, including radioactive waste treatment and management systems, air pollution modeling and innovative hazardous waste treatment systems.

The streamlined lifecycle assessment tool that he developed at NASA was further developed into the Environmentally Preferred Product Plus online system, where off-the-shelf products are evaluated for specific uses through the life cycle assessment process. In his retirement, he is enjoying fixing up his house in Southern Ohio and helping his brother-in-law with his 180-acre farm.

Becky Laird

AFTER 33-PLUS YEARS, befriending and championing countless students, Becky Laird retired from CSU's Chemical and Biomedical Engineering Department in December 2019. She always joked that she had been at CSU longer than the furniture in her office. Little did she know when she walked into the Chemical Engineering Department in 1986, she had found her niche where she would be able to encourage students while working with people from around the world.

Laird served as the administrative secretary in the department during her entire tenure at CSU. She was instrumental in managing the day-to-day administrative operations of the department, supporting the department chair and faculty.

"She knows all aspects of the job, from scheduling courses, processing admissions, processing graduate assistant and instructor contracts, to keeping track of budgets," says Dr. Joanne Belovich, interim dean of the Washkewicz College of Engineering. "But not only did she perform these aspects of the job well, she anticipated what needed to be done and often handled issues before they became problems."

Anticipating and preventing problems "was one of the goals I always had," Laird says. "You don't want to look stupid in front of all these brainiacs."

If someone did tell her about something she didn't know, she would tell them, 'Gee, I will look into that.' "Because honesty is the best policy," she shares.

She played a big role in student recruitment and advising, while also scheduling classes and preparing graduate assistant contracts. She managed the department budget and external grants and served as the liaison with alumni and the departmental industrial advisory board. Faculty, staff and students have characterized her as the soul of the department. She was always available to help anyone who needed her assistance.

"Anybody who walked in, I would stop what I was doing and give them my attention," she says. "They wouldn't come in if they didn't need something."

That goes for students, faculty and administrators. "If I needed a budget balance, a purchase requisition, paperwork on a student who hadn't even joined the program yet or a memo written years ago, I knew that she'd be able to locate and produce that information quickly," says Dr. Belovich.

Before coming to CSU, Laird served at Tri-C as the secretary of the Ohio Department of Development Small Business Resource Center; at Greyhound Lines Inc. as senior stenographer; and at Graybar Electric Company Inc. as an assistant.

During her tenure at CSU, she assisted in the organization of the 2005 International Society of Biomechanics Conference, which took place at CSU, and of the 2003-2004 Fundamentals of Adsorption Conference, which took place in Sedona, Arizona. She also was the American Institute of Chemical Engineers - Cleveland local office liaison with CSU from 1986 until 2019, and served on several University committees.

Laird received several awards during her time at CSU, including the 2002 and 2012 Distinguished Staff Service Awards and the 2006 Kaizen Achievement Award. She was also a member of the Golden Key National Honor Society. Additionally, she is the author of *The Mysterious Murder,* published in 1999.

Laird now serves as program assistant for the American Society of Thermal and Fluid Engineers. In that role, she helps the president and the board of directors. Additionally, she serves as the assistant to the program director for the NSF grant for the Center of Leadership Development in Built Environment Sustainability in recruitment initiatives, interacting with students in the Leadership program and serving as editor of the newsletter.

Gregg Schoof

GREGG SCHOOF was hired at CSU in 1995 and served as the manager of Engineering Student Programs in the Washkewicz College of Engineering until his retirement in November 2019. He earned his B.A. in sociology/social work from Kent State University in 1979 and a Master of Science in social administration from Case Western Reserve University in 1992.

Before joining CSU, his career started as a special projects coordinator with the City of Cleveland's department of health and human resources. There, he managed a caseload of 120 clients and provided job training and job placement assistance for underrepresented residents. Later, he also helped to coordinate the city's Summer Youth Employment Program and worked in the city's health education office. For his efforts to lead the city's annual *Have a Heart* food drive campaign, Schoof won a U.S. Mayor's End Hunger Award.

As a member of the engineering dean's office administrative staff at CSU, Schoof's responsibilities included community outreach and recruitment, as well as overseeing the College's 18 engineering student chapter organizations. He also managed the engineering tutoring program, in collaboration with the University's Tutoring and Academic Success Center (TASC), leading up to 10 part-time engineering students to provide help to undergraduate engineering students in key courses.

The majority of Schoof's time was spent leading Fenn Academy, a partnership among 82 local schools in several Northeast Ohio counties, industry and the Washkewicz College of Engineering. Schoof supervised a team of up to 15 part-time engineering student recruiting assistants and a full-time coordinator to conduct fun, interactive activities both on- and off-campus, with the goal of encouraging middle and high school students to pursue engineering careers.

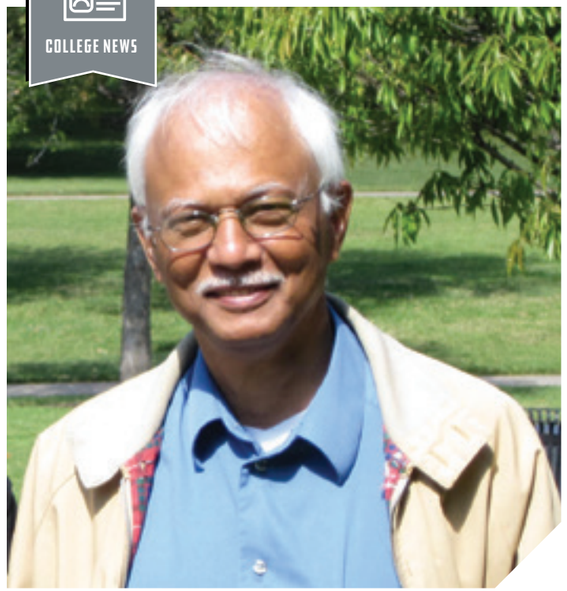
Fenn Academy also offered after-school activities, special events, summer camps and field trips, and allowed students to ride a Segway, a transportation device that Schoof also used to move quickly around campus. All these initiatives contributed to the significant increase in the overall enrollment at the Washkewicz College of Engineering.

Of all the special events in which Schoof was involved, he is most proud of the Engineer-for-a-Day job shadowing program, an effort he coordinated since 1999. The program matched high school students with local engineers during the annual National Engineers Week. As a result, more than 1,300 students benefited from their visits to local companies. Many current engineers often cite the program as the reason that they pursued an engineering degree.

Leading the annual engineering picnic, being the emcee at the annual Order of the Engineer Steel Ring and Awards ceremony and coordinating activities for the annual Northeast Ohio Science and Engineering Fair were other highlights of Schoof's career. He also cites the partnership with the Six District Educational Compact, as well as Cleveland's New Tech East High School, as other meaningful accomplishments, including new scholarships for the former. Schoof also served as a chair and member of the Engineering Dean's Diversity Council.

In his retirement, aside from taking time to relax, Schoof plans to continue his efforts to help underrepresented students go to college, whether that occurs through the Fenn Academy, the ACE Program or simply by supporting engineering and other scholarships for students at the colleges he has attended. In addition, he wants to continue volunteering at local hunger centers and help those who have been negatively affected by COVID-19. More travel is also in his plans, especially to his favorite vacation spot on the Outer Banks of North Carolina and other parts of the U.S. not yet explored.

COLLEGE NEWS



Surendra Tewari, Ph.D.

DR. SURENDRA TEWARI received a Bachelor of Science in metallurgical engineering from the Indian Institute of Technology in Kanpur, India, in 1968, and a Master's and Ph.D. in materials engineering from Purdue University in 1970 and 1974, respectively. From 1974 until 1976, he was a National Research Council research associate at NASA Lewis Research Center (now known as NASA Glenn Research Center at Lewis Field) in Cleveland. He then spent eight years in the Defense Metallurgical Research Laboratory in Hyderabad, India, first as a scientist (1976-1981) and then as assistant director (1981-1984).

He returned to NASA Lewis Research Center, where he spent two years as a senior research associate, before joining CSU and the Department of Chemical Engineering in 1986, where he has been until his recent retirement. At CSU, he was first an associate professor (1986-1991) and then a professor in the renamed Department of Chemical and Biomedical Engineering (1991-2019). He has since been a professor emeritus of CSU.

During his tenure at CSU, Dr. Tewari was awarded nearly $16 million of sponsored research via 56 grants from federal, state and industry sources as principal investigator. These grants helped establish a well-equipped, state-of-the-art materials processing laboratory at CSU and were sponsored for the education and training of all of his 47 master's and doctoral students and his 13 post-doctoral fellows. Many undergraduate students also participated in his research projects, mostly during summers. The work of his research group resulted in 123 refereed articles in leading materials journals, 38 papers in peer-reviewed international conference proceedings and 89 conference presentations. His papers have been heavily cited by U.S. and international researchers — more than 1,600 citations so far. Dr. Tewari organized and chaired several conference sessions in the area of solidification processing and microgravity-materials research in the American Society of Materials and the Metallurgical Society meetings.

He developed and taught courses related to materials science, materials selection and processing, computer programming and other graduate-level courses in the Department of Chemical and Biomedical Engineering.

As the Co-PI of a joint NASA-European Space Agency research program (MICAST), Dr. Tewari's research group performed the first U.S. materials science experiments on the International Space Station using the NASA Materials Science Research Rack (2011-2014). Three aluminum-silicon alloy single crystal samples, prepared at CSU, were flown to the Space Station using Space Shuttle Discovery for their microgravity processing. They were then brought back to his materials processing lab at CSU, where they were characterized and studied (2012-2018).

His awards and recognitions include: National Metallurgist - India Government and the Indian Institute of Metals (1984); Distinguished Research Faculty at Cleveland State University (1994); NASA - Certificate of Recognition (1996); Outstanding Teacher at CSU Center for Teaching and learning (1999); Finalist - Northern Ohio Live Award of Achievement (2000); The Metallurgical Society Champion H. Mathewson Award for the paper considered the most notable contribution to metallurgical science during 2003 (2004); awarded Fellow of the American Society of Materials-International (FASM) for Outstanding scientific and technical contributions in solidification processing of materials (2004); Fenn College Outstanding Research (2011); and ASM International Technical Educator Award (2014).

After retiring from CSU, Dr. Tewari continues to conduct his NASA-funded research through the project *Spurious Grain Formation in Alloys Directionally Solidified on the Space Station Due to Marangoni Convection*, and to teach part-time at CSU.

"I would love to try out research ideas that I could not explore earlier due to time constraint," he says.

COLLEGE NEWS ROUNDUP

Dr. Zhang Receives NSF CAREER Grant

Dr. Wei Zhang, associate professor in the Department of Mechanical Engineering, has received the prestigious Faculty Early Career Development (CAREER) Award from the National Science Foundation for the project entitled *Flow Physics of Transient Rooftop Vortices at High Reynolds Numbers and Bio-Inspired Flow Control Strategies to Mitigate Wind Hazards*. The five-year grant of $580,249 advances innovative research to reduce damage to infrastructure from high winds, and provides training to the next-generation of STEM workforce.

Dramatic damage repeatedly occurs on low-rise building roofs during windstorms, as observed in recent hurricanes Matthew (2016), Maria (2017) and Michael (2018). Roof failure often starts at the windward roof edges and corners, where extreme peak suctions are induced by flow separation and unsteady delta vortices. Improved understanding of the flow physics of rooftop vortex dynamics governing the worst roof suction will contribute toward more accurate wind load prediction. Smart flow control strategies can be learned from studying nature, which can be used to design cost-effective strategies for reducing hurricane-type, wind-induced damage to low-rise buildings. This research will use the Natural Hazards Engineering Research Infrastructure (NHERI) Wall of Wind test facility at Florida International University. A series of wind-tunnel experiments will be conducted to reveal unsteady flow and pressure correlation over a scaled low-rise building model.

To strengthen the persistence of engineering students, first-year undergraduate students will be engaged in a new learning community to gain early research experiences and attend workshops and seminars. The learning community program will improve the STEM infrastructure, broaden underrepresented groups' participation in engineering and build a solid pipeline for the engineering workforce.

Internet of Things Collaborative Receives Third Round of Funding

The Internet of Things Collaborative (IOTC), created in 2017, is a partnership between Case Western Reserve University and Cleveland State University to drive transdisciplinary research, education and innovation in Internet of Things (IoT). The project goal is to spur economic transformation in the region, leading to improved quality of life for residents of Greater Cleveland. The Cleveland Foundation has awarded a $3.1 million, two-year grant to the collaborative for 2020-2022, totaling support to more than $7 million over six years.

The funding has enabled recruitment of a new cadre of top faculty experts in IoT, crafting an extensive memorandum of understanding between CWRU and CSU that makes possible robust collaboration in labs and in classrooms, forging dynamic partnerships with industry, city governments and nonprofits and securing $13 million in federal funding.

The new infusion of grant funds further develops and activates two hubs: an Industry+Technology hub, emphasizing high-growth areas of smart manufacturing and connected health; and a Community+Technology hub, building research, education and engagement in public interest technology.

The Industry+Technology hub will drive research and education at both universities and will also serve as a catalyst for regional economic development; help faculty seek and secure federal research funding in IoT-related technology development; expand technical curriculum to meet talent needs of regional companies in our driver industries of manufacturing and health care; build professional services offerings to support industry adoption of advanced technologies; and provide student experiential learning opportunities to gain practical experience and deepen engagement with local industry to fuel company growth and retain students in the area.

The Community+Technology hub will develop public interest technology curriculum to prepare future leaders of the public and nonprofit sectors to lead in a technology-infused world; secure federal funding for projects to drive planning and implementation of digital innovation to make communities and neighborhoods stronger and residents' lives better; and deploy smart and sensible technologies in communities in ways that are community-led and help meet neighborhood aspirations.

Central to the development of the two hubs is the concept of a multi-disciplinary approach to IoT related research and projects. Through the support of the grant, a new university-wide center (the CSU T.E.C.H. Hub) has been created at CSU and led by faculty from multiple disciplines (Dr. Patricia Stoddard-Dare, College of Liberal Arts and Social Sciences; Dr. Sathish Kumar, Washkewicz College of Engineering; and Dr. Nicholas Zingale, Maxine Goodman Levin College of Urban Affairs). The faculty leaders work in close collaboration with Shilpa Kedar, co-executive director for the IoT Collaborative at CSU.

Investment Grant Fuels Efforts to Digitize Manufacturing

CSU's proposal to establish the Entrepreneurial Manufacturer Digitization Support (EMDiS) Center of Excellence is one of the awarded projects of the 2020 Build to Scale (B2S) Venture Challenge Program from the U.S. Economic Development Administration — in fact, it is the only B2S Venture Challenge award in the State of Ohio.

Dr. Jerzy Sawicki, Bently and Muszynska Endowed Chair and professor in the Department of Mechanical Engineering, is the principal investigator for the grant and will lead the program. A project coordinator will be hired to manage client relationships, ensure service delivery and collect data for metrics.

This $600,000 EDA investment will fund the establishment of the EMDiS Center of Excellence to bring state-of-the-art digital manufacturing tools to small manufacturers, specifically tier 2 and tier 3 suppliers, in the Greater Cleveland metropolitan region. The EMDiS Center will address the gap small manufacturing companies face when considering, acquiring and implementing cost-effective digital manufacturing technologies, helping them to become more productive, agile and resilient even in the face of economic challenges and supply chain disruption.

EMDiS will consist of faculty and labs from CSU's engineering and business colleges, supported by manufacturing experts at MAGNET, an Ohio Manufacturing Extension Partnership affiliate. The Ohio Aerospace Institute will provide access to smaller aerospace manufacturers, OEMs and integrators and the larger Ohio aerospace ecosystem. In addition, the AeroControlex Group will provide guidance on aerospace supplier requirements and digital tools/processes. CSU faculty participants will provide digital, business and learning expertise from the fields of mechanical engineering, electrical engineering, engineering technology, supply chain management, information systems and education.

Dr. Lee Receives NIH Research Grants

Dr. Moo-Yeal Lee, associate professor in the Department of Chemical and Biomedical Engineering, has received $1.6 million for three years from the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health through the Cincinnati Children's Hospital Medical Center for the project entitled *Modeling Diabetes Using an Integrated Plate System*. The total funding of this project is $5.35 million. The major goal of it is to develop a tractable, high-throughput, integrated plate system containing human pluripotent stem cell (PSC)-derived liver, pancreas and intestine organoids to simulate normal and diseased mechanisms involved in inter-organ crosstalk and investigate how hormones, nutrients and drugs might mediate the reversal of Type 2 diabetes.

Dr. Lee has also received $830,000 from the National Center for Advancing Translational Sciences of the National Institutes of Health through his start-up company Bioprinting Laboratories Inc. (PI: Dr. Pranav Joshi) for the project entitled *Pillar and Perfusion Well Plate Platforms for Reproducible Organoid Culture from iPSC*. The main goal of this project is to commercialize patent-pending, pillar/perfusion well platforms (including a 384PillarPlate as well as a 36PillarPlate and a 36PerfusionPlate) and demonstrate reproducible brain organoid culture from induced pluripotent stem cells (iPSCs) using his unique miniature 3D bioprinting technology.

The Cleveland Foundation Awards Grant to the College for Engineering Co-op

The Cleveland Foundation, through its Fenn Educational Fund, has awarded $149,413 to the Washkewicz College of Engineering for a two-year period for the project *Reimaging Co-Operative Learning and Working*. The project is led by Sandra English, senior manager of the Center for Engineering Experiential Learning of the College, which includes the Fenn Cooperative Education (Fenn Co-op) program.

In the last several months, nationwide, college students have had their co-ops canceled or delayed and many have been unable to secure placement due to the COVID-19 pandemic. Despite these challenges, some students have been able to complete co-ops remotely, obtain co-op assignments that provide remote work, obtain traditional placement with appropriate safety measures or a hybrid placement of remote work and in-office assignments.

Through this funding from the Cleveland Foundation, the Fenn Co-op program will develop a student-centered approach that will build on the success of the program and maximize student access and flexibility as a working learner in a virtual environment. Emphasis will be on increasing the placement of chemical engineering students in the fields of manufacturing, drug discovery and delivery and chemical processing. The continued placement of engineering students in co-ops by using alternative modes will contribute to an adaptable and resilient workforce that is prepared to navigate the uncertainty and complexity of the near future.

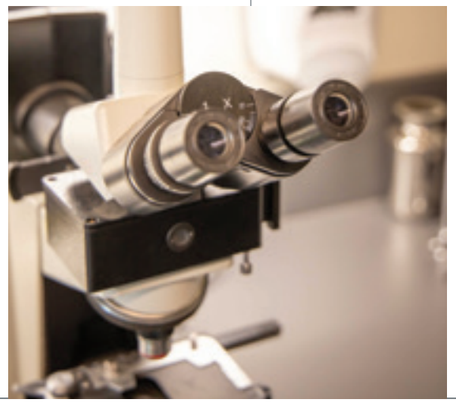
The Washkewicz College of Engineering partners with 500 corporations in providing cooperative education. Over the past six years, the Fenn Co-op program has engaged more than 700 students completing over 1,400 co-op assignments. Previous support from the Fenn Educational Fund significantly helped the college to grow placement of underrepresented minorities and first-generation students in engineering by over 90%.

Dr. Kothapalli Awarded NSF Research Grant

Dr. Chandra Kothapalli, associate professor in the Department of Chemical and Biomedical Engineering, has been awarded $299,872 from the National Science Foundation for the project *Collaborative Research: Design and Development of a Multifunctional Nanoplatform for Augmented Elastic Matrix Repair.* The motivation for this project has been that elastic fibers, which allow tissues to stretch and recoil, acting like rubber bands, are not naturally repaired or regenerated in adults following injury or loss in a spectrum of degenerative disorders. Developing methods to stimulate the repair or regeneration of these fibers is a critical but unmet need towards restoring tissue structure and function.

Dr. Kothapalli will collaborate with Dr. Anand Ramamurthi (currently at Lehigh University) to identify molecular regulator proteins within diseased cells isolated from rupture-prone expansions of the human aorta (i.e., abdominal aortic aneurysms). They will then test novel drugs that can inhibit the enzymatic breakdown of elastic fibers, as well as stimulate new fiber assembly and maturation. Further, the studies will help us understand how to deliver these drugs in a predictable and sustained manner from biodegradable polymer nanoparticles, which are themselves chemically modified to be able to stimulate new elastic fiber formation and prevent its breakdown.

The investigators will then test the effectiveness of these nanoparticles in structurally disrupted blood vessels, using bioreactor systems to maintain viability of the blood vessels. The feasibility of these techniques in the treatment of aortic aneurysms and other soft tissues (e.g., in lung) in need of structural repair will be assessed. The significance of this work is linked to the potential of nanoparticle technology to enable robust on-site elastic tissue repair, specifically for cardiovascular disorders which afflict millions worldwide. In addition, many opportunities will be available for the scientific education and research training of high school, undergraduate and graduate students, as well as summer internship and outreach programs.



Dr. Schearer Receives Grant from the Ohio Department of Higher Education

Dr. Eric Schearer, associate professor in the Department of Mechanical Engineering and director of the CSU Center for Human-Machine Systems, has received $249,569 from the Ohio Department of Higher Education for the two-year project *Controlling Functional Reaching with Eye and Head Movements of People with High Cervical Spinal Cord Injuries*. Dr. Schearer will collaborate with Dr. Hongkai Yu from the Department of Electrical Engineering and Computer Science and Dr. Andrew Slifkin from the Department of Psychology at CSU, as well as with Dr. Kevin Kilgore, Dr. Kimberly Anderson and Dr. Anne Bryden of the MetroHealth Medical Center and Ian Burkhart, a consumer advocate.

The need for the restoration of arm and hand function exists for people with high cervical spinal cord injuries. There are several technologies that have potential to restore reaching and grasping function, but they require brain surgery or significant effort from the user to produce simple movements. Eye and head movements tracked by wearing eyeglasses instrumented with small infrared cameras can potentially provide continuous and natural control of reaching and grasping without brain surgery.

The objective of this pilot project is to develop methods that would allow individuals with high tetraplegia to control the movements of a helper robot using an existing eye and head tracking system. The long-term goal is to develop and commercialize technology that allows people with high cervical spinal cord injuries to independently feed and groom themselves by controlling a wearable robot on their own arms via functional electrical stimulation.

Dr. Tewari Awarded NASA Grant

Dr. Surendra Tewari, professor emeritus in the Department of Chemical and Biomedical Engineering, has been awarded $199,998 from the National Aeronautics and Space Administration (NASA) for the project *Spurious Grain Formation in Alloys Directionally Solidified on the Space Station due to Marangoni Convection*. The project is a collaboration with Dr. Mohsen Eshraghi from California State University at Los Angeles.

In a recent NASA European Space Agency research project (MICAST), misoriented (spurious) grains were observed in Al-7% Si single crystal dendritic samples that were directionally solidified on the International Space Station. The presence of spurious grains is highly detrimental to the operating life of single crystal turbine blades, the most critical component in any modern aerospace or power generating gas-turbine engine. Although spurious grains were not expected to develop in a microgravity environment, a closer examination of these MICAST samples showed occasional presence of surface voids on their surface, where the melt appears to have become detached from the ampoule walls during solidification. On earth, such a detachment is not possible because the weight of the liquid maintains a pressure which keeps the liquid in contact with the solidifying solid and the ampoule walls. The investigators believe that the formation of these spurious grains in the MICAST samples may be due to surface-void driven Marangoni convection.

The purpose of this project is to develop a 3D solidification model incorporating Marangoni convection and thermosolutal convection, which can predict the formation of spurious grains during directional solidification. The investigators will extract data from a previous NASA Space Shuttle Project, where transparent organic alloys were directionally solidified in microgravity and video recorded. Data will be extracted and compared with the simulations in order to quantitatively validate the numerical model. This data will then be used to predict the formation of spurious grains in Al-7Si (MICAST) samples under varying processing conditions, such as during re-melting of seed-rod prior to solidification or after a step increase or decrease in growth speed.

Dr. Zhang Receives NSF IRES Grant

Dr. Wei Zhang, associate professor in the Department of Mechanical Engineering, in collaboration with Dr. Debbie Jackson of the College of Education and Human Services, Dr. Yongxin Tao, the Betty L. Gordon Endowed Chair and professor of the Department of Mechanical Engineering, and a team from the University of Akron, has been awarded a three-year, $299,998 grant form the National Science Foundation for *Collaborative Research IRES Track I: US-Korea Collaboration on Biomimicry and Bio-inspired Fluid Flows (BIOFLOW IRES)*.

The world faces a wide range of grand challenges, such as the rapid growth in energy demand and more frequent extreme weather events. Learning from nature, biomimicry or bio-inspired engineering innovation has great potential to address such human challenges. To produce talented scientists and engineers equipped with knowledge of biomimicry and cross-cultural experience, the BIOFLOW IRES Track-1 site provides international research experience to U.S. students through a partnership with Pohang University of Science and Technology in South Korea.

Research on bio-fluid flows and biomimicry focuses on two complementary research themes: energy efficiency and wind resilience of the built environment. The IRES students will perform wind-tunnel tests to evaluate the effectiveness of a seal-whisker-inspired turbine blade for vertical axis wind turbines, explore how the shapes of plant leaves affect energy exchange and create tree-like flow-control devices to reduce rooftop vortices in high winds.

The BIOFLOW IRES project leverages the world-class resources of bio-flow and biomimicry expertise, research facilities and equipment for a diverse group of 18 U.S. students to conduct bio-inspired research, gain solid research and communication skills and build a professional network.

Dr. Zhao Receives Research Grant from U.S. Department of Energy

Dr. Wenbing Zhao, professor in the Department of Electrical Engineering and Computer Science, has been awarded $180,000 from the U.S. Department of Energy for the project Secure *Data Logging and Processing with Blockchain and Machine Learning*.

The goal of the project is to develop a framework for secure sensor data logging and processing with blockchain and machine learning for power plants. Dr. Zhao will conduct a comprehensive threat analysis of the attack vectors on sensor systems; perform a secure authentication and identity verification of sensor nodes, actuators and other equipment within a network; and securely log the sensor data using blockchain technology. Dr. Zhao has proposed a two-level logging mechanism to overcome the issue of limited throughput offered by current public blockchain. He has designed and implemented a framework for secure data logging with the IOTA distributed ledger using Python. To properly inform administrators and other decision makers, he has developed a prototype mobile app using React Native that can fetch sensor data directly from the IOTA framework and visually display the data using charts.

CSU Receives RAPIDS Award

Cleveland State University has been awarded $213,888 by the Ohio Department of Higher Education's Regionally Aligned Priorities in Delivering Skills (RAPIDS) program to purchase an immersive virtual reality (VR) system for use in engineering design and prototyping. After installation in the Dan T. Moore MakerSpace of the Washkewicz College of Engineering, the VR system will provide students with new ways to visualize and interact with course curricula, develop familiarity with current state-of-the-art digital design tools and expand skill sets that can translate directly to Ohio's smart manufacturing and health care ecosystems.

CSU will acquire equipment to create an augmented/virtual/mixed reality (AR/VR/MR) Manufacturing Visualization, Virtual Prototyping and Digital Twin Lab, also known as MVP Lab. This is a VR room that allows student and faculty programmers to create computer-generated 3D environments that are projected on the room's walls. Users will wear goggles with head-tracking technology that allows them to move through and interact with the 3D environment and objects within it. The highly specialized equipment in the MVP Lab will help to develop skills for employment in many occupations in the Northeast and Northwest Ohio region, including electrical and electronic equipment assemblers, engineers, graphic designers, industrial machinery mechanics, instructional designers and technologists, medical equipment repairers, software developers, applications, welders and more.

This award is part of CSU's partnership with Cuyahoga Community College, Baldwin Wallace University and Lorain County Community College to address regional workforce needs through the addition of equipment required for education and training of future and incumbent workers to fill in-demand jobs. The project is led by Dr. Benjamin Ward, interim associate vice president for research and director of research development, Dr. Chansu Yu, professor in the Department of Electrical Engineering & Computer Science, and Dr. Tushar Borkar, assistant professor in the Department of Mechanical Engineering.

DONATIONS

Thank You

A HEARTFELT THANK YOU to the 471 donors who gave $1,889,047 in gifts and pledges to the Washkewicz College of Engineering during the Fiscal Year 2020 (July 1, 2019-June 30, 2020).

Your generous support allows the College to continue providing a high-quality, affordable engineering education, along with innovative programming that helps our students succeed.

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