

The Ohio State University | Department of Electrical and Computer Engineering

BITS & SPARKS

ALUMNI MAGAZINE | FALL 2019

OHIO STATE ECE

A CULTURE OF

CARING

IMPACT:

CYBER SECURITY

BIOMEDICAL ENGINEERING

HUMANITARIANISM

ENERGY EFFICIENCY



WELCOME

FROM OHIO STATE ECE DEPARTMENT
CHAIR, **HESHAM EL GAMAL**

A culture of caring: As I was reflecting on my first year of service as a chair, I could not think of a better description of The Ohio State University Electrical and Computer Engineering (ECE) program.

We deeply care about our scholarship, the impact of our research on the state of Ohio and the world, our community composed of outstanding staff and faculty, and above all, our students. This care is exhibited in our commitment to offer our students a world class educational experience extending beyond the classroom, the high standards we hold ourselves to when conducting cutting-edge research, and the collegial, supportive and inclusive culture we are very proud of.

Our department has had a remarkable year. Our faculty and research scientists have been busy pushing the frontiers of our discipline on multiple fronts, from securing the next generation of chips to the development of bio-sensors, machine learning tools, and new devices empowering applications to benefit society, it is hard to find a branch of ECE in which our scholarly contributions are not impactful. Among other recognitions, our research at Ohio State is recognized by NSF-CAREER awards, MURI Awards, several multi-million dollar awards from the Department of Energy, and a Center of Excellence on Hardware Security from AFOSR/AFRL.

For me, the most amazing part of our research endeavor is the transformative impact on the minds of our graduate and undergraduate students. Nothing is more satisfying

than seeing the spark in their eyes as they proudly discuss their research results. We collectively decided to put more focus on engaging our undergraduate students in our faculty research activities. Toward this end, the department is offering more summer undergraduate research scholarships and developing a strategy to strengthen the engagement of our faculty with student advising and activities outside the classroom.

Last year, we held two department retreats to discuss our strategic plan for taking the Ohio State ECE department to the next level. With overwhelming support, we agreed on the following five pillars of “Diversity,” “Inclusion,” “Quality,” “Mentorship,” and “Positioning.” I am very grateful for the passionate discussions and engagement by our faculty and staff that led to this vision for our future. Now, we turn our attention toward developing and implementing policies and metrics guided by these principles, allowing us to be laser focused on our student-centric mission. Among other things, we are holding focus groups among our students to gain more insights on how to further develop our diverse and inclusive culture.

We recognize the importance of feedback while defining our path forward. Last year, we engaged different stakeholders in discussions over the



DIVERSITY

INCLUSION

QUALITY

MENTORSHIP

POSITIONING

role we should play on campus, statewide, and the world. We continue to be inspired by the insights of our accomplished alumni base and plan to put additional efforts in reaching out to celebrate their remarkable successes. The department is also very active in support of the College of Engineering and the campus research priorities in Cybersecurity, Mobility, Manufacturing, Medicine and Materials. Our quality is recognized by university leadership and the support we receive from the college and the Office of Research is highly appreciated.

I am very grateful for being part of Ohio State ECE, as we embark on our next academic year. I am a firm believer our exceptional “culture of caring” will continue to inspire our faculty, staff and students to new heights. ■

Keep up to date on Ohio State ECE news and accomplishments by subscribing to our ECE Weekly newsletter at:
ece.osu.edu/ece-weekly-newsletter

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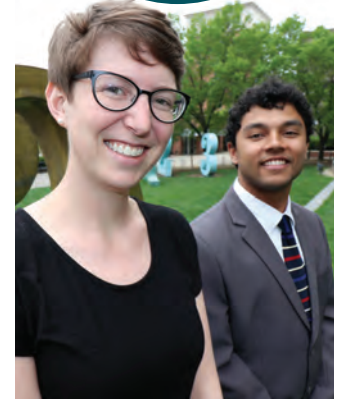
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ALUMNI

**“IF YOU’RE AN
ELECTRICAL ENGINEER,
THINK ABOUT THE AUTO
INDUSTRY. IT’S A PLACE
THAT NEEDS YOU AND IT’S
A REALLY EXCITING PLACE
TO BE RIGHT NOW.”**

ECE ALUMNUS **MATTHEW WOLFE**





OHIO STATE ECE LEADING IN VETERAN SUPPORT

Veteran.

Student.

Mother.

Engineer.

Buckeye.

After serving in the Coast Guard for six years, **Brandi Downs** found herself switching from military life to that of an atypical student at Ohio State.

A veteran, student, mother and wife, she began a new phase of her life as a Ph.D. scholar in the electrical and computer engineering (ECE) program. She is part of Professor **Joel Johnson**'s remote sensing team at Ohio State's ElectroScience Laboratory.

While her trajectory in academia is blossoming, the transition outside of military life is not always easy for some veterans. With wars in Iraq and Afghanistan winding down and enhancements to the GI Bill, colleges

and universities are expecting a surge in veteran enrollment unseen since World War II. Creating a welcome environment for those service men and women is essential.

According to the U.S. government, veterans often experience enhanced feelings of isolation, or extended recovery from physical and emotional issues from serving in wartime. Many fail to graduate or succumb to depression or suicide.

Ohio State's reputation for veteran support is growing. College Factual currently ranks the university No. 4 nationwide for veteran student support and friendliness. The electrical engineering program is specifically ranked the best

in Ohio and No. 8 nationwide.

ECE Chair, **Hesham El Gamal**, said support for veterans is crucial as they enter academia.

"Many returning vets face serious emotional challenges," he said.

Read on as Ohio State ECE alumni and current students explain why they became Buckeyes and how their time here helped to deal with the transition from carrying a weapon to carrying a book bag.

What they describe is an environment of respect for their service, diverse resources, affordability and most important, a community of supportive people.

BRANDI DOWNS

While in the Coast Guard, Downs spent time training in Alaska, Florida and Wisconsin as a machinery technician working inside battleship engine rooms.

However, it was her time spent operating navigation systems for a search and rescue station where she truly discovered a future in engineering.

Downs chose Ohio State because of its strong engineering reputation and in-state tuition assistance through the GI Bill program.

By focusing on remote sensing, Downs later learned what a great decision she made. The Ohio State Electro-Science Lab is one of the most respected of its kind in the world.

Downs is researching remote sensing signals to make measurements of the environment, such as hurricanes or ocean wind speeds. This summer, her role as an Ohio State graduate student takes her to the Arctic, as she joins the international Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAIC) expedition to study sea ice in unprecedented detail for the first time in history.

There is often a stigma surrounding veteran students, Downs said, but she found Ohio State supportive of her new role.

"A lot of the professors are very accepting of military people," Downs said. "Some I've had really kind of value the background you have and what you bring to the classroom."

Dealing with a difficult childhood, Downs said she was lucky to have supportive grandparents on both sides of her family. They instilled in her a love of learning and a strong work ethic.

"As a child, I turned to reading as a means of escape. Then, as I grew older, I realized a love of learning was truly a vehicle that could take me wherever I wanted to go in life," she said. "I could meet any challenge in my life if I learned enough about it and made the internal decision to persevere through the difficulties."

TYLER GROWDEN

Growing up in Ohio, Growden knew he wanted to go to Ohio State.

"Unfortunately, I was a bit of a troublemaker in high school," he admitted.

The chances of heading to college were not looking good for him.

"My family didn't have the money to pay for college either, so the military was a good road to take," he said. "The Army gave me the discipline, motivation, and funding I needed to take on college."

Although he shaped up his behavior and refocused years later, Growden said, his high school grades remained an issue. He enrolled at Columbus State Community College (CSCC) because of its partnership with Ohio State for transfer students.

"I attended classes there for over two years and worked hard to maintain a 4.0 GPA so I could easily transfer to the ECE program at Ohio State," he said.

The help of former ECE academic advisor **Susan Noble** and Veterans Affairs helped facilitate his transfer. By 2010 he earned his undergraduate degree, but he didn't stop there. He went on to earn his MS degree in 2015 and Ph.D. in 2016 at Ohio State ECE. Then, he stuck around and did a two-year postdoc with Prof. **Paul Berger**.

"During the second year of my postdoc, I applied for a National Academy of Sciences – National Research Council fellowship, which I was awarded," Growden said.

Today, he is working in Washington DC conducting research in conjunction with the U.S. Naval




Research Laboratory.

What helped his career trajectory so much at Ohio State, he said, was that any connections he lacked personally, ECE made up for because of its ties to NASA and the Wright-Patterson Air Force Base.

"Without the military, I never would have made it to college. Without CSCC, I never would have made it to Ohio State. Without Ohio State, I never would have developed my passion for curiosity," Growden said. "They help with your transition from a different world, back into society. It can be difficult for soldiers to assimilate, because we are used to having an easily defined purpose in life. We are used to a very regimented way of life. The college experience is on the complete opposite end of the spectrum. I think Ohio State understands this fact, and they try to reinsert you into society." ■

MAKING STRIDES AT FORD

*By Isabel Hall, ECE Student
Public Relations Writer*



Wolfe credits Ohio State for helping him smoothly transition into industry, saying Buckeye resources and connections are like those at a large company, such as Ford.

His experience with the Institute of Electrical and Electronic Engineers (IEEE), a technical professional society with a chapter at Ohio State, also helped him prepare for a real-world setting. He said the work he did analyzing data in IEEE mirrors what he currently does at Ford.

Wolfe also credits Ohio State professors who mentored him on knowledge outside of the classroom setting, which he now applies to his current work. Professors **Paul Berger** and **Steven Bibyk**, he said, are among those who served as major inspirations to him.

"[Berger] was just a great guy, easy person to talk to. Always kind of encouraged us to not let walls thrown in front of us be obstacles. There's always a way through," Wolfe said. "... [Bibyk] was a fantastic professor because he was one of those folks who encouraged us to go out and learn and explore more."

"I CAME INTO THE AUTO INDUSTRY BECAUSE OF THE IMMENSE AMOUNT OF CHANGE THAT'S HAPPENING HERE."

The rise of autonomous and electrical vehicles created a lot of change in the auto industry, Wolfe said. He wanted in on that.

"The whole reason I came into the auto industry is because of the immense amount of change that's happening here," Wolfe said. "This is a space where I see so many different things happening."

Wolfe, who also helps with Ford's recruiting efforts at Ohio State, said these changes created a high demand for electrical engineers in the auto industry, contrasting the traditional need for mechanical engineers.

"If you're an electrical engineer, think about the auto industry because it's a place that needs you and it's a really exciting place to be right now," Wolfe said. ■

Matthew Wolfe, an alumnus who graduated in 2016 from Ohio State, is using his electrical engineering degree to excel at Ford amid a rapidly changing auto industry.

Wolfe entered Ford's College Graduate Program after receiving his diploma, where he rotated positions for two years. Recently, he joined the company's tech strategy and planning team, scoping out new or upcoming technology needs for future Ford models.

"It's a really neat job because our whole purpose is to make sure we are up to date on everything that's happening," Wolfe said. "We are talking to universities, we are looking at different industries and speaking with our suppliers and seeing what is the latest and greatest that's coming out and what is going to come out down the line."

DOTTING THE 'I' IN DESTINY:

ECE STUDENT THOMAS UNGER

By Ryan Horns

When Ohio State beat that team up north in November, ECE student **Thomas Unger** was there to put the proverbial cherry on top.

After years of dedication to The Best Damn Band in the Land, Unger strutted his sousaphone to dot the "i" in Script Ohio, for two minutes of glory before 104,944 screaming fans in the Ohio Stadium.

For those unfamiliar with the sousaphone, or walking tuba, it's not the most convenient instrument. Playing something the size of a dorm fridge lends itself to jokes:

Q: Why did the chicken cross the road?
A: To get away from the tuba recital.

Q: What does a tuba and a lawsuit have in common? A: Everyone is relieved when the case is closed.

In an interview with the Cincinnati Enquirer, Unger described the sousaphone as "a tuba you can wear. People have back problems. You get sore with it hanging on your shoulder all day."

Unger's dedication to music is one thing, but juggling that as an ECE student at Ohio State is another beast entirely. Regarded as one of the more challenging majors at the university,

Unger said the drive to succeed equally in music as well as the classroom turned out beneficial.

As the semester winds down to its final week, Unger offered some advice to other students about his time at Ohio State.

"Having such a big-time commitment like marching band actually forced me to be more organized with my time," he said. "I tried to keep check lists of everything I had to get done on any given day, including homework, projects, exam studying, music checks for marching band, job interview prep, and other day-to-day tasks. This semester was pretty difficult from a workload standpoint, but I was able to succeed by staying organized and trying to get ahead on assignments when I had time."

A graduate of LaSalle High School in Cincinnati, Unger knew he wanted to go into engineering. With another goal set on joining the marching band, he knew he couldn't go wrong in Columbus.

"I originally came to Ohio State as an undeclared engineering major and decided on ECE," he said. "I was interested in computers and wanted to understand how they worked, and to eventually get a job in the tech industry."

With graduation on the horizon,

Unger said seeing what he accomplished gives him more confidence in where he is headed next.

"I'm in my final semester. When I look forward in my career and think about how much I still have to learn, it can be daunting, for sure. When I look back to where I was as an incoming freshman, however, I can appreciate how much I have learned," Unger said. "Since I took some of my initial classes in digital logic and computer programming, I knew that software engineering was the career I wanted to pursue. After landing some engineering internships, I now feel prepared to take on the responsibilities of a software engineer."

With the challenges that come with undertaking an ECE major at the top engineering school in the state, and the high rate of jobs available after graduation, university advisors and wellness representatives encourage students to find hobbies to take their minds off their studies from time to time. For Unger, his dream to dot the "i" offered a stabilizing focus.

"Dotting the 'i' is an honor reserved for fourth- and fifth-year members of the sousaphone section of the marching band," he said.

It's also highly competitive.

"Every member has to try out for the band each season, so returning members are not guaranteed spots," Unger said. "We use a ranking system based on how many games each person marched as a regular member on the field, versus as an alternate on the sideline. Alternates can challenge regulars for their spots each week, so the rankings can change considerably over the course of a season."

Fulfilling his dream in the stadium was a lasting memory from Unger's time at Ohio State. The noise from the crowd as the band steps onto the field for Script Ohio was a rush. It takes two minutes to dot the "i," but a lifetime of planning. ■

CDME

Join the next MeetUp event: meetup.com/OSUECE-Alumni/



THE COLLEGE OF ENGINEERING STRIVES TO BRIDGE THE NEEDS OF INDUSTRY WITH EDUCATION, RESEARCH, LABORATORIES, EQUIPMENT AND STUDENT RESOURCES. THE ESTABLISHMENT OF THE CENTER OF DESIGN AND MANUFACTURING EXCELLENCE (CDME) FITS THIS GOAL.

Industry and academia both benefit from its focus: continuously developing new technologies into business prototypes ready for manufacturing. On Nov. 1, approximately 20 faculty, alumni and students from Ohio State's Department of Electrical and Computer Engineering (ECE) gathered for an after-hours tour of CDME during the ongoing ECE Alumni Society MeetUp social/tech event series. ■



“I THINK CDME IS GOING TO SET THE MODEL FOR MAKER SPACES,
in terms of helping students launch entrepreneurial ideas. I’m anxious to see that.”

—ECE Professor **Steve Bibyk**



EE/ECE Alumni Society

NOTE FROM THE EE/ECE ALUMNI SOCIETY PRESIDENT, **ZIA MOHAMMED**

EDUCATION FOR CITIZENSHIP. Ohio State instilled in us one of the core beliefs behind our motto: The work we do and the efforts we put in encompass a larger vision. A vision knowing we are part of a global stage.

As Buckeye engineers, it is our prerogative to pay it forward – to ourselves and our communities. From networking nights and MeetUps to reunions and Saturday morning tailgates, our global community comes together to celebrate our common values and Buckeye pride.

This year we continue upon the legacy of our ECE Alumni Society and shift into the digital era. As our society grows, we are embracing new ways of communicating and have started to live stream our meetings for alumni around the globe to participate. Our committees are always looking for fresh faces to get involved, help lead and plan new events. Each graduate is automatically a member of the society and we are always open to hearing from alumni on their needs!

I remember post-graduation in 2017, I wanted to stay in touch and get involved with the

ECE department. I fondly remember flipping through the alumni magazine and wanting to get involved so I could give back to the community that provided me the opportunities I have today. Discovering the Alumni Society allowed for me to stay in touch with our department post graduation and join one of the greatest networks possible.

I graduated from Ohio State with degrees in electrical engineering and computational neuroscience. Veering down the untraditional career path post-graduation, I shifted into the field of product management at IBM Watson. One thing I came to realize after graduation is that your engineering degree opens you up to roles outside of the traditional engineer job as industry values your problem-solving abilities independent of the field.



INTERESTED IN GETTING INVOLVED AND MAKING A DIFFERENCE?

Reach out to us at
eeecesociety@osu.edu
and check out our website
ece.alumni.osu.edu



RESEARCH

**OHIO STATE ECE:
COMMUNITY OF PURPOSE**

WORLD RECORDS IN ENERGY EFFICIENCY

ADVANCING CLIMATE SCIENCE

LEADING AUTONOMOUS VEHICLE RESEARCH

DEFINING NEXT-GEN CYBERSECURITY

MACHINE LEARNING EXPLORATION



PICTURED: ECE GRADUATE STUDENT, **LUYAO XU**

UNDER THE RADAR

ÇAĞLAR

YARDIM WINS

ONR YOUNG

INVESTIGATOR

AWARD FOR

MARINE

ATMOSPHERIC

RESEARCH

By Ryan Horns

“They won’t spot us,” the hero jet pilot says calmly. “We’re going under the radar.”

The aircraft noses dives toward the ocean below. The co-pilot grabs the dashboard in fright.

Meanwhile, back at enemy headquarters, the blip of light tracking their aircraft disappears from the radar screen.

“We lost him, sir!” the enemy dispatcher shouts, banging the table with his fist.

It’s a scene right out of a Hollywood action film – although, it turns out, not that scientifically sound in most coastal and marine environments.

Çağlar Yardim is an assistant research professor at Ohio State, specializing in low atmospheric conditions through remote sensing and applied signal processing. Based out of the ElectroScience Lab on Kinnear Road, he also directs the Atmospheric & Ocean-

ographic Electromagnetics and Marine Systems Laboratory (ATOM).

In other words, Yardim helps ensure “flying under the radar” remains a trick of the past. He recently earned a \$510,000 Office of Naval Research Young Investigator Award for his research proposal, “Multiple Grazing Angle Electromagnetic Propagation and Scattering in Non-Standard Atmosphere Marine Meteorology and Space Program,” under the Marine Meteorology and Space Program.

The research has taken his team to many interesting locations over the years, with the goal of improving communication systems, weather prediction models and earth science technologies through electromagnetics.

For Ohio State Ph.D. student **Luyao Xu**, the lure of doing research and living on a ship in the middle of the ocean for months at a time was too strong to pass up. She is a graduate research associate at ESL and part of Yardim’s research team at ATOM Lab.

Xu said, “When I first

came to Çağlar, he told me there was a chance we could all go outside and stay on the sea for months or so, and we could stay on a ship forever and never get back to the land. I said, "That's awesome. I want to do that."

Yardim said her focus as a team member is solid.

"She carries things, builds hardware and loves going to experimentation," he said.

Together with Professor **Robert Burkholder**, Yardim is on a multi-university research initiative (MURI) project called "CASPER," or Coupled Air-Sea Processes and Electromagnetic Ducting Research. The \$7.5 million project studies lower atmospheric temperature, humidity, sea surface conditions, and how they affect marine radar and communication systems.

Their data helps improve battlefield awareness, electromagnetic propagation models, understanding of lower atmospheric processes and air-sea interactions, as well as weather prediction codes for not only military use, but the local weatherperson as well.

Understanding how the lower atmosphere affects radio waves, Yardim explains, will help advance long-distance communications to benefit society as a whole.

"When we were doing our experimentation off the coast of California in 2018, the first day we had a very

strong atmospheric duct from the Santa Ana winds and I could Facetime with my parents at 45 kilometers away from the shore," Yardim said. "The next day, the atmospheric conditions completely flipped and we lost our entire cellphone coverage within 5 kilometers of the shore."

He said finding a sense of stability between radio wave reception and atmospheric conditions is key. The ATOM team measures the variations of refractivity in the atmosphere. Right above the sea surface, these variations cause the propagating radar communication signal to bend toward the Earth's surface, effectively trapping the signal in what is called an atmospheric duct.

That's why the concept of jet pilots flying close to the ocean without knowing the ducting conditions to avoid radar detection is a source of amusement for Yardim.

"Flying inside the duct, where most enemy radar signals are trapped, is the last place you want to be, because the radar's detection range could easily have extended fivefold," he said. "You want to fly right above the duct, not inside the duct. That's why battlefield awareness is indispensable for the Navy."

According to ONR, the Young Investigator Award recognizes research in the broad thrust areas of atmospheric prediction, atmospheric effects, air-sea interaction, marine boundary layer processes and space environment. Emphasis is placed on research aimed at improving data, analysis and prediction systems for describing and forecasting

environmental parameters critical to Navy and Marine Corps operations.

With prior ONR funding, Yardim and his team developed the Lower Atmospheric Propagation System, or LATPROP, to measure electromagnetic signals under non-standard atmospheric conditions and remote sensing of atmospheric refractivity.

LATPROP has three components. The first, LATPROP-UWB, is a 2-40 GHz ultrawideband propagation loss measurement system deployed from research vessels off the east and west coast. The second is a heavily modified commercial marine radar system that basically turns a fisherman's radar into a coherent-on-receive software defined 25 kW real-time research radar, with a high-gain 10-foot diameter dish antenna. The third is a drone developed to carry electromagnetic and meteorological payloads to measure the lower atmosphere, ocean surface conditions and electromagnetic signals simultaneously.

Yardim and his team were based off the coast of Malibu on a research platform designed to flip from horizontal to vertical, with its stern 300 feet below the surface, providing a stable vessel for testing between

shore and their location 50 kilometers out at sea. Other research boats, autonomous underwater vehicles, shore-based systems and aircraft traveled in between to gather simultaneous atmospheric/oceanographic and electromagnetic data.

"Essentially, so we could measure the entire column, all the way from the bottom of the water to the upper atmosphere," he said.

This is a big task, he said, requiring collaboration between meteorologists, oceanographers, experts from various engineering fields to fully understand the science behind it all.

Working in this realm of science, he said, makes him appreciate teamwork.

"One of the big advantages of working at the ElectroScience Lab is you can just go knock on the door of somebody. You can talk to them and learn," he said. "That was one of the big incentives for me coming to Ohio State. The really incredible working environment and the know-how that has been accumulated at ESL over the decades."

In the ECE department at Ohio State, he said, students can take electromagnetic theory, antenna design, microwaves, remote sensing, atmospheric propagation and signal processing/parameter estimation classes to learn more about this field. ■



WATCH A VIDEO INTERVIEW WITH THE TEAM:
go.osu.edu/yardimvid



ATILLA ERYILMAZ

OHIO STATE PART OF \$7.5 MILLION MURI AWARD TO EXPLORE MILITARY 'DATA FRESHNESS' *By Ryan Horns*

AS IT TURNS OUT, EVEN INFORMATION HAS A "USE BY" DATE.

Wireless data hurtles around us in real time. Devices must channel it, process it, decide what we see first, even safeguard it from cyberattack. In a military setting, speed and reliability become even more imperative. Intelligence may be outdated within milliseconds.

At Ohio State, Electrical and Computer Engineering Professor **Atila Eryilmaz** is part of a multi-university team that recently won a highly competitive five-year \$7.5 million Multidisciplinary University Research Initiative (MURI) grant from the Office of Naval Research (ONR). The goal is to help explore this theoretical concept known as "data freshness," through their proposal, "Science of Tracking, Control, and Optimization of Information Latency for Dynamic Cyber-Physical Military Systems."

Collectively, the group also includes **Jeffrey H. Reed, Tom Hou, Wenjing Lou,** and **Walid Saad** of Virginia Tech; and **Lizhong Zheng** of Massachusetts Institute of Technology (MIT).

According to ONR, the MURI outlines the engineering concept called "network science," a collaborative realm of research demanding the broad-base expertise of scientists from wireless networks, information theory, signal processing and game theory to optimization, mathematics, physics, computer science and security.

Eryilmaz said their work applies to a wide net of wireless technologies related to the Internet of Things (IoT), cyberphysical systems, and next-generation communication platforms. Military IoT applications could involve smart sensors for automated security screening, security cameras or collecting data from aircraft and ground vehicles.

"This is a project where communication and control coalesce. You have this large-scale distributed system, spread over a space, aiming to achieve a collective goal. Without knowing each other's state, distributed devices have to decide to send their dynamic information through a shared channel," he said. "It's about managing information more than anything, because data keeps evolving at these distributed devices, and it needs to be communicated, but there are only so many resources for it."

This project, he said, aims to answer the following questions: Which information is most urgent? Which is the most valuable? What are the fundamental limits of achieving the freshest information and how is that accomplished? Is the information still useful when it is communicated?

"How do you, on the fly, determine what's most important in a distributed fashion?" Eryilmaz said.

The collaborative MURI project is theoretical in nature, he said, but specifically applies to autonomous devices in a military setting.

As with any IoT technology under development, Eryilmaz said, cyber security aspects must be fully investigated as well. Blocking those trying to trick the system is essential.

According to Forbes, the unprecedented security challenges of the Internet-connected devices are likely to grow as their numbers potentially balloon to over 50 billion next year.

According to ONR, the general MURI efforts involve teams of researchers investigating high priority topics and opportunities intersecting more than one traditional technical discipline.

"For many military problems this multidisciplinary approach serves to stimulate innovations, accelerate research progress and expedite transition of results into naval applications," ONR reported. ■

ECE TEAM EARNS \$2.2 MILLION GRANT FOR TRANSFORMATIONAL ENERGY PROJECT



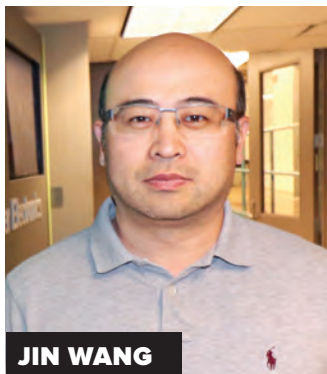
HONGPING ZHAO



STEVEN RINGEL



SIDDHARTH RAJAN



JIN WANG

Researchers at Ohio State are leading a project recently awarded \$2.2 million from the Department of Energy to develop modern gallium nitride (GaN) semiconductor materials suitable for high-voltage power control and conversion.

The proposal, “GaN MOCVD Growth on Native Substrates for High Voltage (15-20 kV) Vertical Power Devices,” is one of 12 projects receiving \$35 million in funding through the Advanced Research Projects Agency-Energy (ARPA-E) OPEN+ program.

“Today’s dominant power semiconductor devices use Silicon, which suffers at high power and high temperature operations. It is absolutely critical to find alternatives to harness medium-voltage electricity infrastructure for applications across industry, transportation, on the grid and beyond,” said **Hongping Zhao**, associate professor in Electrical and Computer Engineering (ECE) and Materials Science and Engineering (MSE). “This project aims to develop wide bandgap semiconductor GaN materials grown on native GaN substrates that enables vertical power devices with switching voltages up to 15-20 kilovolts.”

The team is led by Zhao and includes ECE and MSE professor, **Siddharth Rajan**; ECE professor **Jin Wang**; and Institute for Materials Research Executive Director, Distinguished University Professor and Neal A. Smith Professor of Electrical Engineering **Steven Ringel**. During the three year project, Ohio State will partner with SixPoint Materials, Inc., a California-based materials manufacturer, which will focus on developing GaN substrates.

Zhao joined Ohio State in August 2017 through the IMR-led Materials and Manufacturing for Sustainability Discovery Theme. Zhao’s research interests focus on the growth and physics of wide bandgap and ultra-wide bandgap semiconductor materials and devices, and the low-dimensional semiconductor nano-materials and devices for energy applications.

In this project, Zhao’s group will develop MOCVD growth of GaN films on native GaN substrates, Rajan’s group will fabricate vertical GaN power devices, Ringel’s group will study defects in GaN films, and Wang’s group will develop packaging of GaN power devices and perform reliability testing.

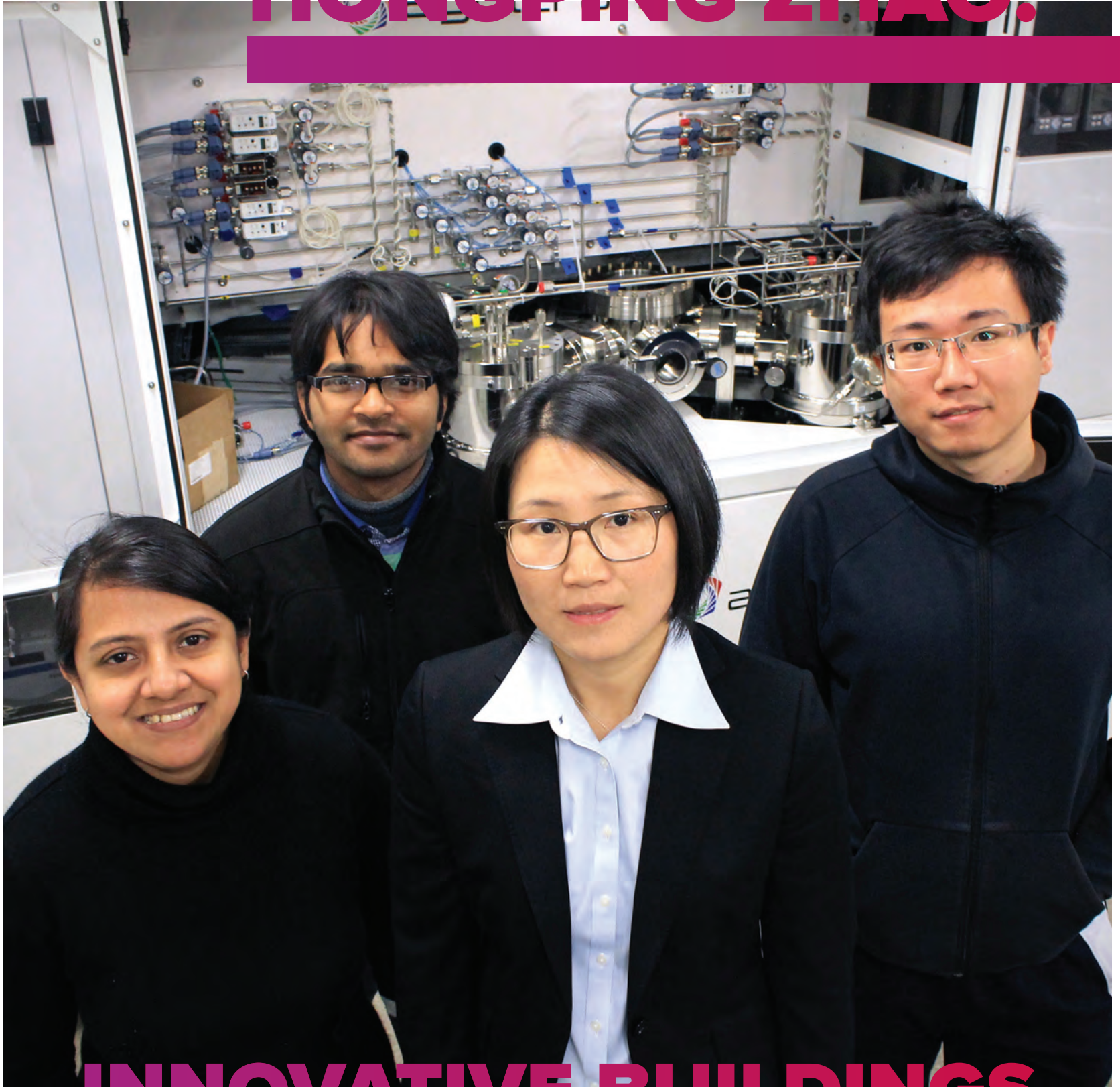
The Ohio State-led team received this funding from ARPA-E’s OPEN+ program, which issues a call to scientists and engineers every three years for transformational technology proposals benefitting its mission. The 12 selected projects are part of ARPA-E’s Building Reliable Electronics to Achieve Kilovolt Effective Ratings Safely program.

The award is the second of two high-profile collaborations with Ohio State and DOE. Zhao’s team recently joined a \$42 million government project for innovative buildings research.

“America’s energy landscape is constantly evolving, and as new ways to generate and distribute power gain popularity, it’s critical we develop the tools to maximize their utility,” U.S. Secretary of Energy **Rick Perry** said in a Department of Energy release. “These ARPA-E projects serve first and foremost to modernize how we move power around safely, reliably and efficiently, creating a new set of capabilities for tomorrow’s utilities and industry.” ■

Article by Mike Huson, IMR Public Relations Coordinator / Contact: huson.4@osu.edu

HONGPING ZHAO:



INNOVATIVE BUILDINGS RESEARCH

The Ohio State University was named among the funding recipients in a recently announced U.S. Department of Energy (DOE) \$42 million project to support innovative residential and commercial building technologies for energy efficiency.

As part of the overall program, Ohio State Associate Professor in Electrical and Computer Engineering **Hongping Zhao** is set to lead an almost \$600,000 project for the research proposal "High Efficiency InGaN Light Emitting Diodes (LED) emitting Green, Amber and Beyond."

Zhao arrived at Ohio State in 2017 as an Associate Professor with a joint appointment in the Department of Materials Science and Engineering.

According to DOE, buildings use 75 percent of the nation's electricity and account for 40 percent of its overall energy use.

"We are excited to be selected to tackle the challenges that current LED technology is facing. InGaN LEDs emitting in blue have achieved high quantum efficiencies with commercialized products available on the market. However, LEDs emitting in green, amber and longer wavelength still suffer from low efficiencies," Zhao said. "In this project, we will de-

velop novel materials and structures to address this issue."

The proposal is a collaborative project with Co-PI and Professor **Kathleen Kash** from Case Western Reserve University.

Zhao's group is addressing improved green and amber emitters based on nitride materials through an investigation of growth parameters such as temperature, pressure, and molecular ratios.

"Energy efficiency is a key driver of overall economic efficiency and part of DOE's mission to increase energy affordability and energy security," the DOE program release states. "The technology developed from these early-stage R&D projects is designed to help consumers and businesses save energy costs and drive domestic economic competitiveness."

This project for Ohio State is among 11 selected for solid-state lighting (SSL) research and development, which support key scientific advancements to help accelerate LED and organic LED lighting products to significantly improve energy affordability for American families and businesses, ensuring the U.S. remains a global leader in SSL innovation.

In total, the 11 selected projects will receive \$11 million and make a cost-share contribution for a total public-private investment of over \$15 million,

as they help to further reduce the cost and improve the quality of SSL products. This is the 13th round of DOE investments in SSL R&D.

A total of 46 research teams were selected as a result of three fiscal year 2018 funding opportunity announcements issued by the Office of Energy Efficiency and Renewable Energy's Building Technologies Office.

Major focus areas under each FOA address different issues, such as:

- Buildings Energy Efficiency Frontiers & Innovation Technologies – 19 selections for \$19.5 million
- Advanced separation technologies for dehumidification
- Innovative materials for thermal insulation
- High performance windows
- Advanced controls and automation in building energy management
- Innovative technologies using natural gas
- Solid State Lighting (SSL) – 11 selections for \$11 million
- Core technology research for LEDs and organic LEDs (OLEDs)
- Proof-of-concept and prototype development for LEDs and OLEDs
- Advanced manufacturing R&D focuses on chemistry and physics of LED/OLED panel fabrication

- Building America – 16 selections for \$11.5 million
- Development and validation of high performance residential envelope systems that provide moisture management and validation of high performance envelope specifications for performance and durability
- Heating, ventilation and air conditioning (HVAC) installation and performance
- Gap analysis of building industry standard practices

Institute for Materials Research Director and ECE Professor **Steven Ringel** made it his mission a decade ago to make Ohio State a leader in materials science.

Zhao said facilities such as Nanotech West, the Center for Electron Microscopy and Analysis (CEMAS), the Clean Room (SEAL), and the university's commitment toward establishing the metal organic chemical vapor deposition (MOCVD) capability for wide bandgap semiconductors help solidify Ohio State's influence. Additionally, her efforts are tied to Ohio State's Materials and Manufacturing for Sustainability (M&MS) Discovery Theme. ■

For more information on the selections visit the Energy Department's Building Technologies Office website. energy.gov/eere/buildings



UNDERWATER ROBOTICS TEAM MAKING A SPLASH AT ROBOSUB 2019

By Ryan Horns

Competitive water sports aren't just for athletes at Ohio State.

Outside Knowlton Hall this summer on campus, STEMbot went for a swim. Pizza was served. Onlookers stopped by to watch and chat.

STEMbot is the Ohio State Underwater Robotics Team's (UWRT) demo vehicle, a smaller submarine robot used to help draw attention to the collaborative engineering concepts explored by the student group.

"Not a lot of people know who we are, but we build autonomous submarines," **Jennifer Humanchuk** said, a third-year electrical and computer engineering

(ECE) student and member.

This year, however, all eyes are on Puddles – the team's fitting name for a larger competitive autonomous submarine officially debuting at the international AUVSI RoboSub 2019 competition in San Diego this month, July 29 to Aug. 4.

The team is determined to make a name for itself at the competition. The students came close in 2018.

"We're really hoping this year we'll be in the finals," Humanchuk said.

UWRT is an interdisciplinary student project group specializing in the design, construction, and operation of autonomous underwater vehicles (AUVs). Each vehicle is

designed to self-navigate through a series of tasks, mimicking ongoing research in Autonomous Underwater Systems.

"We design it so we can throw it in the water and it does its own thing, completely on its own," Humanchuk said.

ECE student and team member **Blaine Miller** is already reaping the benefits of joining the Ohio State group.

"I just got a job with Battelle because they saw all of my work with acoustic systems within the electronics of the robot," he said. "This team is a great experience. It's a great resume builder. People love to see that you've been gaining real-world experience."

Ohio State ECE students are involved in a broad scope of motorsport engineering teams, from EcoCAR and Buckeye Current to the Baja Buckeyes, because their technological knowledge offers a broad platform of applications.

Benji Justice, also in ECE, is the current team president.

"Joining the UWRT was probably the best decision I made during my four years at Ohio State. I discovered the team at the annual Engineering Student Involvement Fair," he said.

UWRT performs a number of STEM outreach events in the Columbus community as a way of giving back and generating

The Ohio State University
**UNDERWATER
ROBOTICS TEAM**

more interest in the field of robotics. At the Ohio State Fair, the students annually design and build an exhibit to educate the local community about marine engineering. This involves demonstrating smaller AUVs like STEMbot, which guests can engage with in a small pool. The team also presented at MakerX: The Columbus Maker Expo, an event showcasing all types of creators, and visit COSI each year to educate children about careers in engineering and give small lessons in underwater robotics – speaking on topics like buoyancy, achieving water tight housings, and basic electronics.

As proof of the team's STEM demo effectiveness, Justice said he enjoyed getting to operate an underwater robot and talk to the team members about how it worked.

"I had never seen anything like it. I was hooked. Wanting to learn more, I decided to join and the rest is history," he said.

Students from a variety of majors are responsible for building every aspect of the vehicles, including machining the housings, soldering the circuit boards, and developing the software. What Miller finds the most rewarding is collaborating with other

student engineers toward a common goal.

Justice said URT helped him develop technical, leadership, business and communication skills during his time serving different roles on the team – plus three summer trips to San Diego for the RoboSub competition.

"My experience with the team has really been an invaluable, defining piece of my experience here," Justice said. "I will never forget the memories made and lessons learned with this team."

Miller said he enjoys the collaborative engineering

environment.

"You're working with people who think the same way you do, who want to experience the same challenges that you like facing," he said.

Humanchuk currently designs the circuit boards for the robot. Starting in the fall, she will help shape the vision of the team going forward.

"I joined the team because I really like robots," she said, "and now next year I'll be the team president."

During the summer of 2018 Humanchuk interned for Northrop Grumman



FOLLOW THE TEAM

Instagram/Twitter:

@osu_uwrt

Facebook:

@osu.uwrt

working in the Signal and Conversion Technology department.

Another ECE student and team member, **Gus Workman**, said they take their job seriously - they have to.

"Safety is a big concern because it's around water," he said. "You have to prepare for the worst-case scenario. A lot of what we do is making sure to put fuses in, so if (the robot) does short out we have no issue with it electrocuting somebody. I think it's all about managing different systems, all combining different electrical signals."

Workman, a junior majoring in Computer Engineering and Chinese, joined the team in 2017. His primary responsibilities are working with the firmware for the compressor board. He recently completed an internship at Garmin, where he embedded software in aviation display units.

For those interested in joining the team in 2019, members are often recruited in the fall. The group typically meets twice a week at the Center for Automotive Research on Sundays and on campus once a week. ■

Find out more at uwrt.engineering.osu.edu and robonation.org/competition/robosub

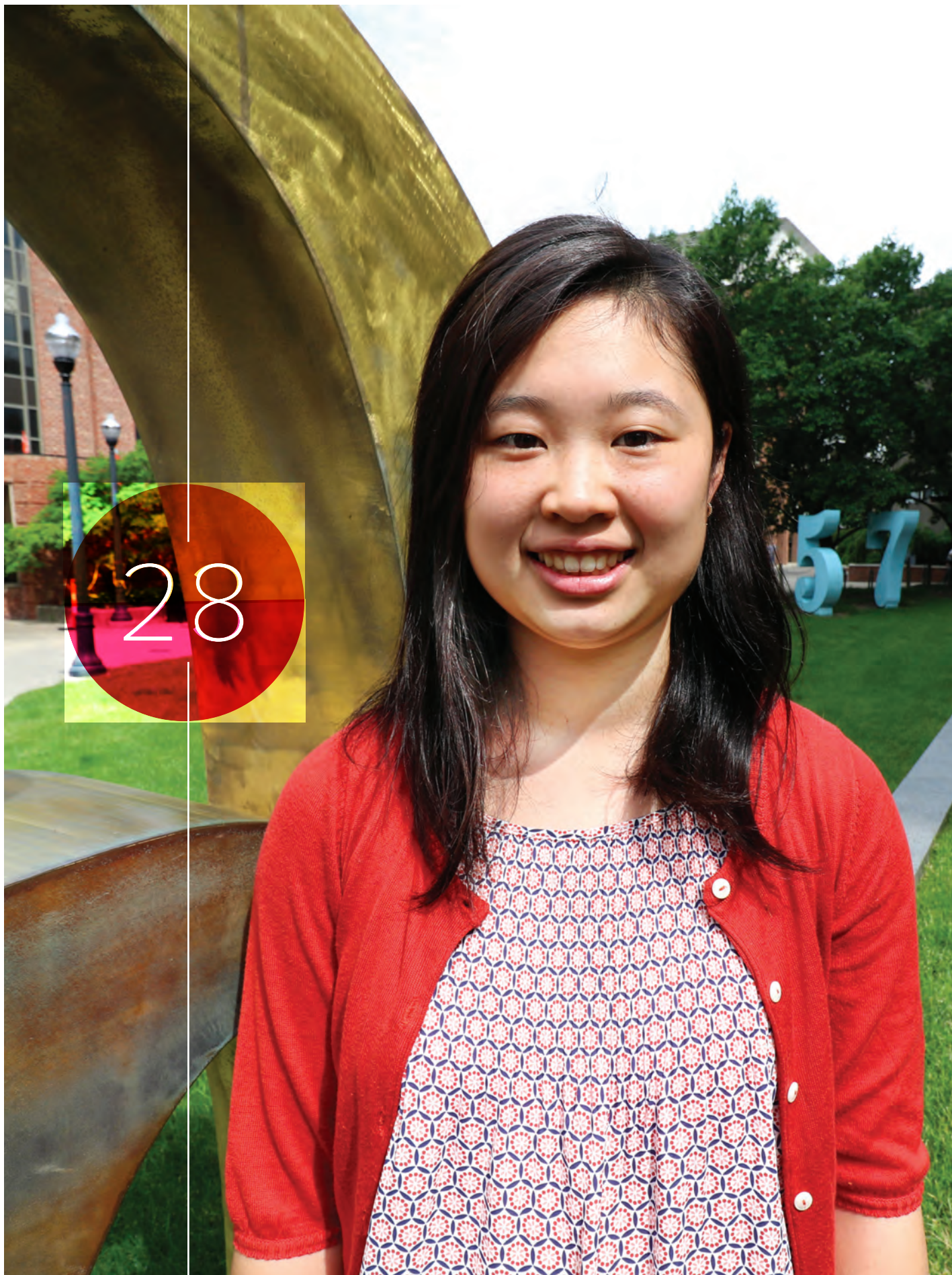
Interested in having The Underwater Robotics Team visit your classroom or STEM event? Contact osu.uwrt@gmail.com



AWARDS

**"I ALWAYS
QUESTIONED
HOW THINGS
WORKED."**

ECE UNDERGRADUATE
BARRY M. GOLDWATER SCHOLARSHIP
WINNER **MIA ZHANG**





CAREER AWARDS

**VANESSA
CHEN**

REAL-TIME MACHINE LEARNING AND CYBERSECURITY

By Ryan Horns

In a world where technology is advancing faster than security, changes are on the horizon.

At Ohio State, electrical and computer engineering assistant professor **Vanessa Chen** said smart technology is poised for another breakthrough. Her research focus is to convert data into meaningful information and protect it from cyberattack in real time.

One day, every device must auto-

matically be capable of performing its own cybersecurity and machine learning to support big data analysis. Chen said it is detrimental to protect internet-connected systems, including hardware, software and data, from cyberattacks.

The National Science Foundation just named Chen among the prestigious 2019 Faculty Early Career Development (CAREER) award winners. Her research proposal, "Bio-Inspired Sensory Interfaces Incorporating Embedded Classification and Encryption," earned \$500,000 in new funding over the next five years from its Electrical, Communications and Cyber Systems (ECCS) program.

"Ubiquitous sensing and computing, leading to rapid growth of big data analysis, will potentially transform the world," Chen said. "Now, people are trying to turn everything into smart devices."

The motivation to provide such real-time security within every smart device, she said, is because each one is under threat of malicious attacks by transmitting unencrypted data. Applications sending steady information for continuous health or weather monitoring, for example, are particularly vulnerable.

"The attacker may be able to record the confidential and private information or change the results to broadcast a fake national disaster alert. So, it's critical to protect the wireless data," Chen said.

The technological drawback for this, however, is the energy required to perform complex machine learning and encryption algorithms.

"It's hard to use the energy from the environment to power the device, because it would require a large and stable power source like

"UBIQUITOUS SENSING AND COMPUTING, LEADING TO RAPID GROWTH OF BIG DATA ANALYSIS, WILL POTENTIALLY TRANSFORM THE WORLD."

a battery," Chen said.

Instead, she is working to develop a more energy-efficient circuit architecture to embed into energy-constrained edge devices, performing classification and encryption. An edge device is any piece of hardware that controls data flow at the boundary between two networks, such as routers, routing switches, integrated access devices (IADs), multiplexers, metropolitan area networks (MAN) and wide area networks (WAN).

"We can have a sensor that can extract and encrypt critical features in situ and then only send low-volume ciphered messages to the central device, so the transmission energy can be highly decreased to enable continuous monitoring," she said.

As the director of the Energy-Efficient Circuits and Systems Lab at Ohio State, Chen mentors roughly half a dozen graduate students in the realms of low-power cognitive interfaces for world-to-information computing. Lab work spans

the design of wireless transceivers, analog neural networks as well as hardware-based cybersecurity.

One of her students, **Jack Hsueh**, is focused on low-power and secure sensory interfaces for next-generation Internet-of-Things (IoT) devices. He became the first Ohio State student to win the prestigious ISSCC Analog Devices Outstanding Student Designer Award in 2018.

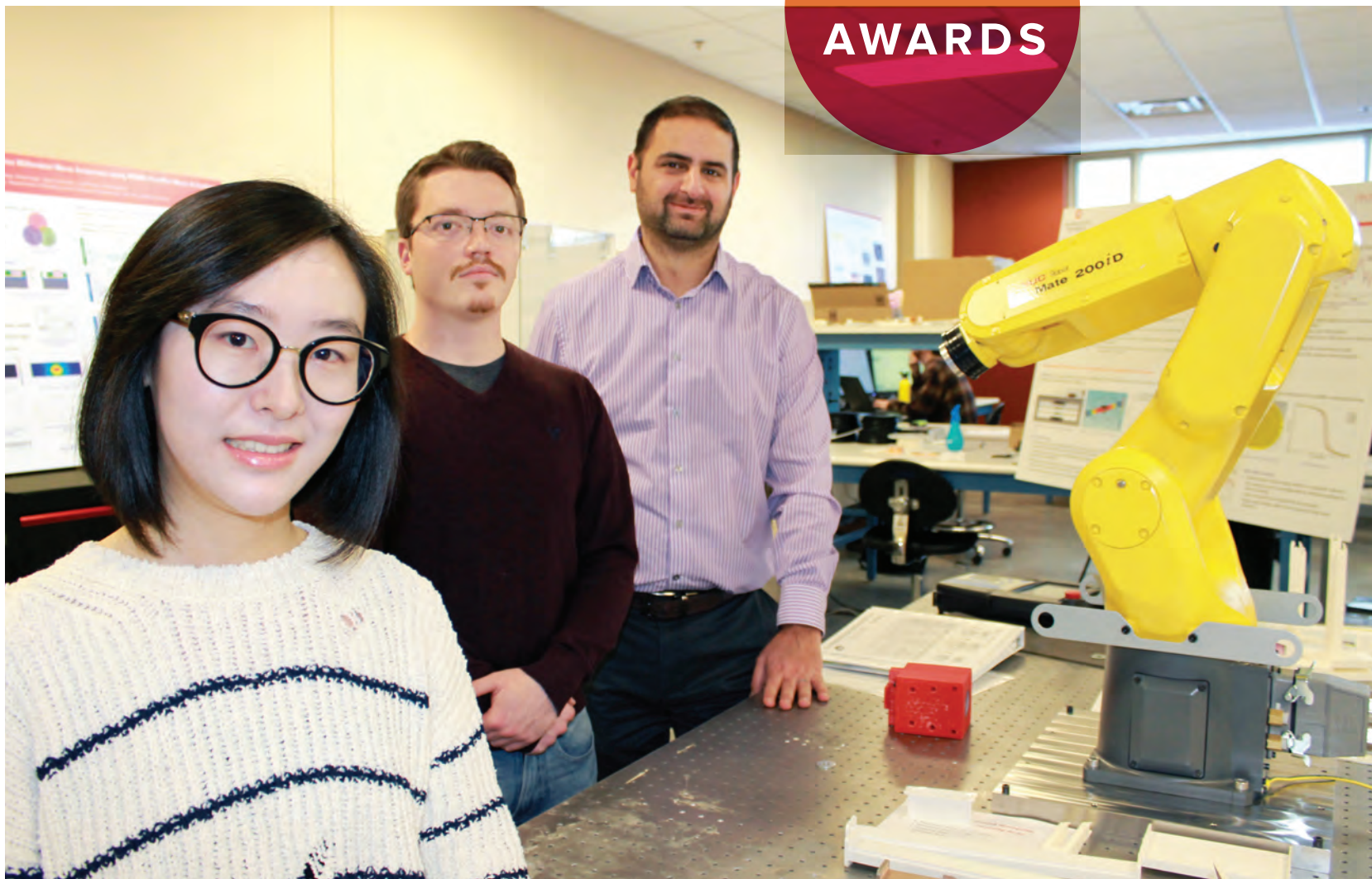
From a design standpoint, Chen's CAREER research embraces machine learning and cybersecurity through the concept of randomness.

According to the proposal abstract, data is automatically classified and encrypted within the sensors, changed unpredictably into deterministic noise for transmission.

"The pipeline chaotic system can be trained with time-varying maps to enhance the strength of the security without creating observable patterns to counter side-channel attacks," Chen said. "This ensures data integrity and basic authentication for multi-layer security schemes from the edge sensors to the cloud while classification algorithms are performed locally in sensors to achieve rapid analysis and data reduction for wireless communications."

The transmitted data from the device becomes unclonable, she said, ensuring complete security. ■

CAREER AWARDS



NEXT-GEN MILLIMETER WAVE DEVICES

By Ryan Horns

New research at Ohio State could help lead to a new generation of radio frequency devices capable of advancing space communications, smart phones and even self-driving cars.

The point is about rethinking the entire design and make-up of the materials used to make such devices, from the ground up.

For his efforts in this realm, Ohio State Electrical and Computer Engineering Assistant Professor **Nima**

Ghalichechian recently earned the prestigious National Science Foundation 2019 Faculty Early Career Development (CAREER) award. It provides \$500,000 in new funding over the next five years for his proposal, “CAREER: Understanding and Exploiting Non-linear Behavior of Phase-Change Materials for Millimeter-Wave Applications.”

Ghalichechian, who leads Ohio State’s Radio Frequency Microsystems Lab, is marrying the concepts behind materials engineering and electromagnetics. He is working alongside first-year Ohio State Ph.D. student **Mark Lust** and third-year Ph.D. student **Shangyi Chen**.

PICTURED FROM LEFT TO RIGHT: Shangyi Chen, Mark Lust, Nima Ghalichechian

“THE PROPOSED WORK IS AMBITIOUS BUT
POTENTIALLY TRANSFORMATIVE AS IT CHALLENGES
THE CONVENTIONAL WISDOM IN DESIGNING SENSORS
AND DOMINANCE OF SEMICONDUCTOR-BASED
MILLIMETER-WAVE DETECTORS.

Together, they are performing fundamental studies on phase-change materials and their applications in the millimeter-wave domain. Specifically, to create passive imaging sensors.

Passive imaging sensors gather and record naturally emitted or reflected energy from around them. For example, when the camera shutter opens on a digital camera, the array of sensors inside records the intensity of light striking them. The sensor passively collects light measurements, and the data is processed into images.

Instead of sensors detecting optical light, Ghalichechian said, their work can lead to detecting electromagnetic waves. Applications of this research could advance medical imaging, navigation, and remote sensing, to name a few.

The work is interdisciplinary and centers upon using novel material properties to address the ongoing limitations of current millimeter-wave devices, he said, such as sensors and antennas. The millimeter-wave band is defined as frequencies between 30 to 300 GHz.

Ghalichechian said phase-change materials, such as vanadium dioxide or VO₂, have been around for more than 50 years, but their uses remain elusive, especially when it comes to applications in the millimeter-wave band.

“Reconfigurability and adaptability are vital features of future agile millimeter-wave systems for sensing, imaging, and wireless communications. However, when radio-frequency systems are made reconfigurable they lose efficiency,

neutralizing any gain achieved by reconfiguration,” Ghalichechian said. “In other words, despite the added functionality, losses (low efficiencies) are the Achilles heel of any radio-frequency reconfigurable system often less discussed.”

Their work, he said, is to address these limitations. Phase-change materials are ideal for millimeter-wave reconfiguration as they provide a path to achieve low-loss microsystems.

“The proposed work is ambitious but potentially transformative as it challenges the conventional wisdom in designing sensors and dominance of semiconductor-based millimeter-wave detectors. Currently, no acceptable solution is available for millimeter-wave imaging systems operating at the room temperature,” Ghalichechian said.

As an undergraduate, Lust said he developed a “recipe” to deposit films on materials using “reactive sputtering,” which is when vanadium atoms are ejected from a target and react with oxygen to form VO₂ on the substrate. His work also improved accuracy for phase-change measurements post deposition.

“The process is very sensitive to multiple parameters, so it took quite a few iterations to get a good, repeatable result,” Lust said. “It was based on previous work in the group, but I made improvements in both the deposition and measurement processes.”

Lust said his role in the project is to further analyze the recipe he created for depositing VO₂ films on antenna arrays.

Meanwhile, Chen is studying and exploiting the electrical properties of VO₂. She is designing a highly sensitive millimeter-wave camera using a pixelated array of sensors.

“One pixel involved in the camera is a thermal sensor called a microbolometer. I will study the electrical property of phase change material VO₂ to improve the sensitivity of the sensor. In addition, I will implement micro-electro-mechanical systems (MEMS) suspension process to further improve the overall performance of the sensor,” she said.

In addition to research, the project includes the development of new courses at Ohio State, undergraduate and K-12 summer programs and outreach for under served students across Central Ohio.

Originally from China, Chen said her father is an engineer and this became her interest as well. She started in Mechanical Engineering and found her way toward microsystems along the way.

As a high schooler in Hilliard, Lust said he found an interest in electromagnetics and physics early on and sought out working with Ohio State's ElectroScience Lab as an undergraduate.

“Microfabrication, the process is really interesting. The challenge of the process too,” he said, “The designs must be realizable. We take on the challenge just to see if we can do it.”

The CAREER Program offers the National Science Foundation's most prestigious awards in support of early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization. ■

ECE UNDERGRAD WINS GOLDWATER SCHOLARSHIP

by Ryan Horns,

Mia Zhang, an electrical and computer engineering (ECE) undergraduate at The Ohio State University, just earned the most prestigious national award for STEM students.

Zhang is among four Ohio State honors students recognized by the Barry M. Goldwater Scholarship and Excellence in Education Program.

This is only the second time in university history in which all four Buckeye nominees won; the last occurrence was 2007. Juniors **Caroline Jipa**, **Thomas Porter**, **Vilas Winstein**, and Zhang were all named 2019 Goldwater Scholars. Each receives an award to cover the cost of tuition, fees, books, and room and board up to a maximum of \$7,500.

Even at a young age, Zhang said, her academic drive was motivated by a simple curiosity over how technology works – and more importantly, how it can benefit society as a whole.

“I have always been passionate about math and science, and ever since I was young, I always questioned how things worked,” she

said. “Witnessing the evolution of technology and how it completely changed our lives as I was growing up intrigued me, which eventually motivated me to study engineering.”

Zhang said it's the real-life applications of science, which continue to motivate her professional goals to discover how to improve and change people's lives in a positive way. This is what led her to the Ohio State ECE program.

“I chose electrical engineering because of its ubiquity in our lives, as many things involve electricity,” Zhang said. “I was excited to study ECE and find out my specific interest.”

Zhang is a junior in the ECE program, looking to earn an MD/PhD degree in biomedical engineering in order to conduct translational and clinical research using micro/nanoscale technology for medicine and biology. Her research is ad-

vised by Dr. **Jonathan Song**, Assistant Professor in the Department of Mechanical and Aerospace Engineering.

“Mia is truly an exceptional student in terms of her intelligence and drive for excellence. I am delighted that the Goldwater Foundation recognizes the same qualities in Mia and awarded her this most illustrious scholarship,” Song said. “Her future could not be brighter.”

Zhang's advice for her fellow students is to stay curious and motivated in their chosen paths.

“I would encourage everyone to explore various opportunities to gain new experiences and to believe in your hard work and commitment. There are many resources and programs that will help you discover your passion in local, national, and international

communities,” she said.

Asking questions from peers, upperclassmen, and teachers was essential for her growth, she said.

“Meeting new people who have the same interests and goals as I do, hearing their experiences, and receiving advice on how to navigate in the field of engineering had been very helpful to me by establishing a support system,” Zhang said.

It is estimated more than 5,000 students applied for their university's nomination for the award. However, each institution may only nominate four students. In total, 496 scholarships were awarded to sophomores and juniors on the basis of academic merit from a field of 1,223 mathematics, science, and engineering students nominated by colleges and universities nationwide.

Since the award's inception in 1986, Ohio State has produced 60 Goldwater Scholars. ■

For more information on the Goldwater Scholarship, visit goldwater.scholarsapply.org. Students interested in applying for the Goldwater Scholarship or other nationally competitive awards should contact fellowships@osu.edu.



ALUMNUS NAMED 2019 NEXT-GENERATION INNOVATOR OF THE YEAR

As society increasingly depends upon technology to overcome its adversities, recognizing young scholars is imperative.

With this in mind, Ohio State's Office of Research and the Corporate Engagement Office named electrical and computer engineering (ECE) alumnus **Wesley Thio** among the two winners of the 2019 Next Generation Innovator of the Year awards.

Thio received his ECE undergraduate degree from Ohio State and is currently pursuing a graduate degree in electrical and computer science at the University of Michigan.

He said Ohio State prepared him well for his work today.

"One of the things I learned while working at Ohio State is to never be afraid of tackling challenges that could improve people's lives," Thio said. "Ohio State also has a unique collaborative culture that has taught me how to work effectively with others to solve problems. These are skills that will help me in the years to come, and will be important factors in helping me accomplish my goals."

Thio is currently focused on a technology

called a "memristor," which he said takes inspiration from the human brain to solve challenges in modern computers.

"They have a lot of potential as we transition into an artificial intelligence-driven world where machine learning becomes used for critical applications, such as self-driving cars and diagnostic medicine," Thio said. "They work as an electronic neuron synapse, and can be used to build chips that perform image recognition and data classification."

The Buckeye sees the future of this technology as critical for next-generation healthcare.

"I hope in the long term I can pursue a startup that utilizes this type of technology in order to efficiently perform medical imaging," he said. "This would be a fulfilling accomplishment to me, especially if it leads to quicker life-saving diagnoses. It may even be possible to develop new medical tools by combining this technology with brain

probes or cardiac pacemakers to identify abnormal behavior such as arrhythmia much more efficiently."

Thio's undergraduate research studies at Ohio State centered on batteries and self-powered wearable technologies. He was awarded Ohio State's Tech Hub 2017 Student Project Grant and was selected as a semi-finalist for the 2018 Lemelson-MIT Student Prize for his research in development of flexible batteries powered by electrochemical fabrics.

He completed an internship at the Università degli Studi di Catania in Catania, Italy in 2015 studying chaotic circuits, and interned at the National Taiwan University in 2016 studying solid state devices. His work in electronics and batteries has resulted in 11 publications, and six pat-

ents, with three pending.

According to the Office of Research, the Next Generation Innovator of the Year award honors students (undergraduate and graduate) or postdocs, to help recognize the innovation and entrepreneurship they contribute to the development or commercialization of a new technology in Ohio. It may also recognize a trainee-initiated start-up company whose success is a result of entrepreneurial talent, creativity and energy. ■

PICTURED FROM LEFT TO RIGHT: R. Scott Osborne, Wesley Thio, and Dr. Morely Stone

ECE GRAD ATTRACTS ELECTROMAGNETIC AWARDS



Not quite satisfied with the opportunities for hands-on applications as a physics student, **Katrina Guido** decided to follow her muse into graduate school as an engineer at Ohio State.

Her goal now is to find ways to use her technical abilities for good.

"I knew I wanted to do something with my life that helped people, and I have always been interested in how the electrical impulses in our brains allow us to do everything from breathe to think complex thoughts," Guido said. "So, I started looking for research that was aligned with both of these ideas."

She took a chance and

hopped on the electromagnetic wave as a Ph.D. student in Ohio State's Department of Electrical and Computer Engineering (ECE).

It's clear her change in focus is already paying off.

Guido recently won the prestigious and highly-competitive 2019 National Defense Science and Engineering Graduate (NDSEG) Fellowship Award. She also won the Best Poster Award at the Chronic Brain Injury Research Day sponsored by the Ohio State's Discovery Themes Initiative, and this summer was selected to attend the National Institutes of Health BRAIN Initiative Summer Course.

Guido is studying under the guidance of ECE Assistant Professor **Asimina Kiourti** at the Wearable

and Implantable Technologies Lab (WIT) at Ohio State's ElectroScience Laboratory (ESL).

Kiourti said Guido is already an asset to the ESL team, working on developing wireless and batteryless brain implants designed to record neural signals.

Learning about Kiourti and the WIT Lab, Guido said, really opened up new doors.

"When I first found her lab, it seemed too good to be true, but luckily here I am today," Guido said. "I was really impressed with how even the rest of her research is primarily focused on implementing various technologies to help people."

Guido wants to advance the existing technology toward studying neurological disorders.

"The brain-computer interface technology currently in existence has way too many downsides to be considered close to being feasible for normal, everyday use. My current research aims to address some of these issues," Guido said. "If we can get a clearer picture of how electrical signals propagate through

the brain during normal, everyday life situations then it's possible that we can begin to better understand the underpinnings of disorders such as epilepsy, depression and anxiety, Parkinson's, addiction, and many others."

While she loved how physics offered answers to thought-provoking scientific questions, she said, electromagnetic engineering creates applications to solve those dilemmas plaguing society.

For the next three years, Guido is working to earn her Ph.D. at ESL. In the meantime, she's already learned to take every single day as a new adventure as a student at Ohio State.

"I used to try to plan every aspect of my life, but I would never have imagined I'd end up where I am today," she said. "So, I'm going to take the next few years as they come and see where my experiences take me." ■

EL GAMAL NAMED NATIONAL ACADEMY OF INVENTORS FELLOW



An Ohio State University scientist was awarded the title of Fellow by the National Academy of Inventors.

Hesham El Gamal, chair of the Department of Electrical and Computer Engineering, was one of 148 academic inventors to receive the honor this year.

The award is given to academic inventors and innovators who have “demonstrated a prolific spirit of

innovation in creating or facilitating outstanding inventions and innovations that have made a tangible impact on quality of life, economic development and the welfare of society.”

El Gamal is a world-renowned information theorist and inventor, with key contributions to wireless communications, game theory and machine learning. He holds 15 U.S. patents. He is the ninth Ohio State inventor chosen as a fellow of the NAI.

His most recent work focuses on improving and optimizing smartphones and other mobile technologies to more easily stream content.

“Imagine you are a ‘Game of Thrones’ fan, for example, and you are waiting for the new season to be released—the first episode always crashes because everybody is trying to stream it at the same time,” he said. “Our technology would, by

understanding your behavior, pre-download the material on your device and when you click it to watch it, it’s already there and you’re not competing on that spectrum.”

Morley Stone, senior vice president for research at Ohio State, congratulated El Gamal.

“Dr. El Gamal has pushed research forward in ways that have made life more enjoyable and technology more accessible,” Stone said. “This award is a testament to the innovation happening across Ohio State.”

El Gamal is also a Fellow of the Institute of Electrical

and Electronic Engineers; 31 other IEEE fellows were named Fellow of the NAI this year.

The 2018 Fellows were inducted on April 1, 2019, as part of the Eighth Annual Conference of the National Academy of Inventors in Houston. In honor of his accomplishments, El Gamal was presented with a special trophy, medal and rosette pin. ■

ESL ANNUAL AWARDS EVENT



Ohio State's ElectroScience Laboratory (ESL) celebrated its top faculty and staff accomplishments of 2018 during its annual awards event Dec. 6 at the Blackwell Inn on campus.

Based on Kinnear Road, ESL is a major center-of-excellence in Ohio State's College of Engineering. Established in 1942, it remains one of the largest radio frequency and optics research laboratories in the world.

ESL's most distinguished annual honor, The George Sinclair Award, went to retired Electrical and Computer Engineering Research Scientist **Eric Walton**.

According to the center, Walton's work over the years contributed major technical advancements toward automotive radars and antennas, noise radar (an area he pioneered), scattering signature analysis, processing of antenna/RCS test range probe data, wavelet-based time-frequency analysis (a major breakthrough), and near-field focusing of range probe data for mapping stray signals in antenna/RCS test ranges (a new territory in range diagnostics).

ECE alumnus **Eugene Lee** said it was an honor to work under Walton's mentorship as a graduate student at Ohio State for almost a decade.

"I spent six years as his graduate student and many years as his research colleague. Eric has been there for me, not only professionally, but personally as well. I am the engineer I am today

because of Eric Walton," Lee said.

ECE alumna **Dana Kohlgraf-Owens** said she was an undergraduate working with Walton in 2004-2005. His mentorship helped her on the path toward an engineering career she has enjoyed ever since.

Alumnus **Adam Hueve** said Walton had a tremendous impact on his career in RF engineering.

"At the time I really didn't have any clear career direction," he said. "(He) really showed me a new field that I didn't know anything about."

Today, Hueve is an RF engineer at Wright-Patterson Air Force Base, still using many of the skills Walton taught him.

Walton is a distinguished Fellow of IEEE, Fellow of Antenna Measurement Techniques Association, and received AMTA's Distinguished Achievement Award. He is also respected for his mentorship of many graduate and undergraduate students, as well as junior researchers.

The George Sinclair Award recognizes an individual for distinguished technical contributions and service to ESL. Criteria includes faculty who display international recognition for outstanding technical contributions, leadership on large ESL projects, administrative and leadership toward moving ESL into new research areas, as well as facilitating funding to meet current and future challenges of electromagnetic technology.



Students, faculty and staff at ESL were also highlighted for their achievements in 2018 through the following honors:

BEST DISSERTATION AWARD:

Jeonghwan Park, “Investigations of GNSS-R for Ocean Wind, Sea Surface Height, and Land Surface Remote Sensing.” Park is advised by ECE Professor Joel Johnson.

BEST PAPER AWARD:

L. Duncan, Brian Dupaix, J.J. McCue, B. Mathieu, M. LaRue, V.J. Patel, M. Teshome, M-J Choe, and Waleed Khalil for their work, “A 10-bit DC-20-GHz Multiple-Return-toZero DAC with >48-dB SFDR,” published in the IEEE Journal of Solid-State Circuits.

BEST PAPER AWARD -RUNNERS UP:

R.K. Rasel, CE Zuccarelli, QM Marashdeh, LS Fan, FL Teixeira for the work, “Toward Multiphase Flow Decomposition Based on Electrical Capacitance Tomography Sensors,” published in the IEEE Sensors Journal.

K. Ren, J Chen, RJ Burkholder, for the work, “A 3-D Uniform Diffraction Tomographic Algorithm for Near-Field Microwave Imaging Through Stratified Media,” published in the IEEE Transactions on Antennas and Propagation.

ABOVE AND BEYOND STAFF AWARD:

Jennifer McCord, Human Resources Associate at ESL, whose efficiency, reliability and positive interactions with faculty and staff were spotlighted this year.

ABOVE AND BEYOND STUDENT AWARD:

ESL Graduate Research Associate **Matthew Buchanan** was selected for his efforts and accomplishments in remote sensing investigations and international conference participation throughout 2018. Faculty pointed out his ability to foster a community at ESL, as well as his sense of humor.

ABOVE AND BEYOND RESEARCHER AWARD:

Alexandra Bringer was selected for her excellent service to the ESL community and contributions to the Soil Moisture Active Passive (SMAP) program.

The ESL awards committee this year was made up of Research Scientist **Chris Ball, Nima Ghalichechian, Teh-Hong Lee** and **Christopher Neese**.

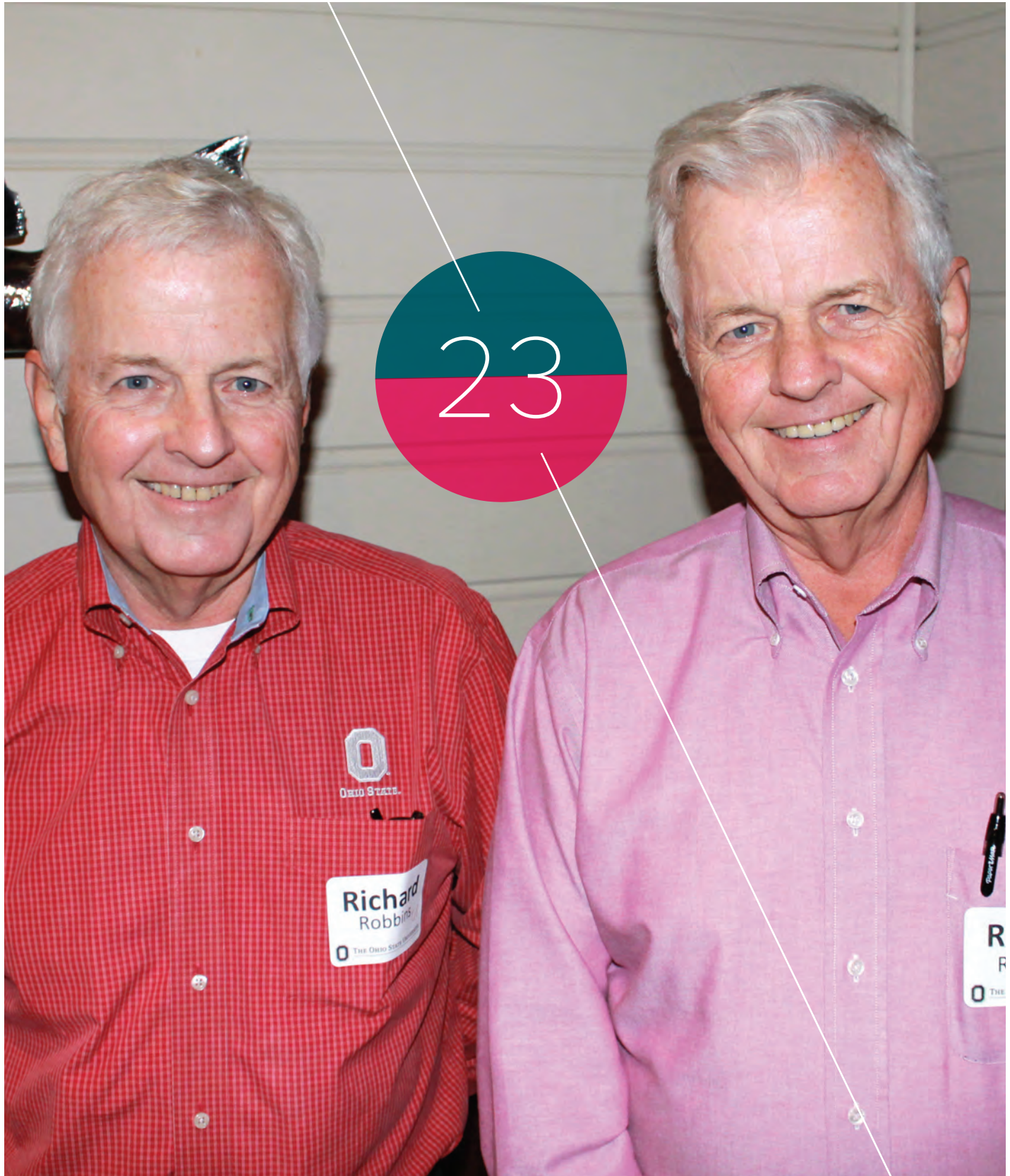
ESL faculty, research scientists, and students are involved in all aspects of electromagnetic and RF technologies, including satellite and ultra-wide-bandwidth communications, optics, remote sensing, ground penetrating radar systems, antenna engineering, electromagnetic compatibility and interference, as well as computational methods and measurements. ■

PICTURED FROM LEFT TO RIGHT: ESL Director **Richard Ridgway** (pictured right in each photo), hands awards to Alexandra Bringer, Graeme Smith and Eric Walton.



CULTURE

**ECE:
POWERING
TOMORROW**



PICTURED: **RICHARD AND ROBERT ROBBINS**

**OHIO
STATE
ECE
ALUMNI
CELEBRATE
50+
YEARS
OF
SUCCESS**



From wartime defense systems, to pioneering computer and radar development, every table at the annual Department of Electrical and Computer Engineering alumni dinner holds a depth of stories.

Fortunately, that's what the night is all about – telling stories, a shared history.

Originally organized as an evening to celebrate 50-year alumni of the Department of Electrical and Computer Engineering, the dinner on Oct. 5 this year expanded to include graduates anywhere

said seeing all these places after so many years really struck a chord.

"One thing that hit me today, when we started out this meeting, I couldn't remember the names of any of my professors," he said.

Simply coming back to his old stomping grounds in Caldwell brought back unexpected memories.

"I don't know where it came from. I don't know why all of a sudden I started thinking of all these guys, but they taught us well," Rhodes said. "These people were really excellent professors. Great teachers. They cared about you. Isn't that amazing? Out of the blue. These things came into my head."

Alumnus **James Cook** ('65, '67, '70) said he feels fortunate having gone to Ohio State. His father-in-law once asked him which courses were the most important to his career. He said all of them.

"It was confidence. I got confident I could solve any problem if I had enough time," he said.

Cook and his wife Sharon were celebrating their 50th wedding anniversary at the dinner.

"That's the most important thing that happened about me coming to Ohio State," he said, pointing to her. "We met."

Other alumni were celebrating birthdays and anniversaries that night. Together, the group spoke about fireballs in the labs; past mistakes and success in research, and lifelong friendships made.

A longtime aircraft engineer, alumnus **Jack Stieg** ('60) said he led an interesting career.

"My seat was often just a folding camp stool, right between the two pilots. There were occasional thrilling rides. Probably the most fun job I ever had," he said. "If something went wrong, the pilot would turn to me and say, 'What do you think of that?' and he expected an intelligent answer. Occasionally, I was able to provide one."

Retired 20 years, Stieg now enjoys being a Boy Scout leader,

helping youngsters earn badges in radio, electronics and electricity.

"It's more fun than you can imagine," he said.

Alumnus **Larry Rennie** ('65) was on the soccer team at Ohio State back in the 1960s. He said not many people knew what the sport was at the time. So, his team would practice on the fields near the football stadium the day of games. People on their way to the stadium would see this game of soccer and wonder what the heck it was they were playing.

Twin alumni, **Richard** and **Robert Robbins** ('68), attended the night as well.

Richard, of Powell, Ohio, is retired from IBM and has two grown daughters – both Buckeyes. His secret to keeping up the tradition?

"When they graduated from high school, I told them they could go anywhere they want for college, but I am only going to pay tuition for Ohio State," he laughed.

Just in case there were any questions, Robert joked, he is indeed related to his twin brother. After a career in government engineering, he started a small company in the late 1970s making test equipment for telephone companies. He worked there happily for over 30 years and retired in 2008.

ECE Chair and Professor **Hesham El Gamal** said the simple fact the 50-year alumni dinner keeps gaining attendance is because the department must be doing something right.

"You have good memories. You connect with it. My job, and the professors and everybody here, is to help keep the same spirit. To help create the same memories for the students," he said. "I am grateful that you are here."

El Gamal remarked how the alumni may have noticed on the tours that Caldwell looks exactly the same as when they graduated 50 years ago.

"We kept it that way just for you," he said to laughter. ■

“YOU HAVE GOOD MEMORIES. MY JOB, AND THE PROFESSORS AND EVERYBODY HERE, IS TO HELP KEEP THE SAME SPIRIT. TO HELP CREATE THE SAME MEMORIES FOR THE STUDENTS.”

from 1968 to 1958. They represent an extended family of Buckeyes scattered around the world.

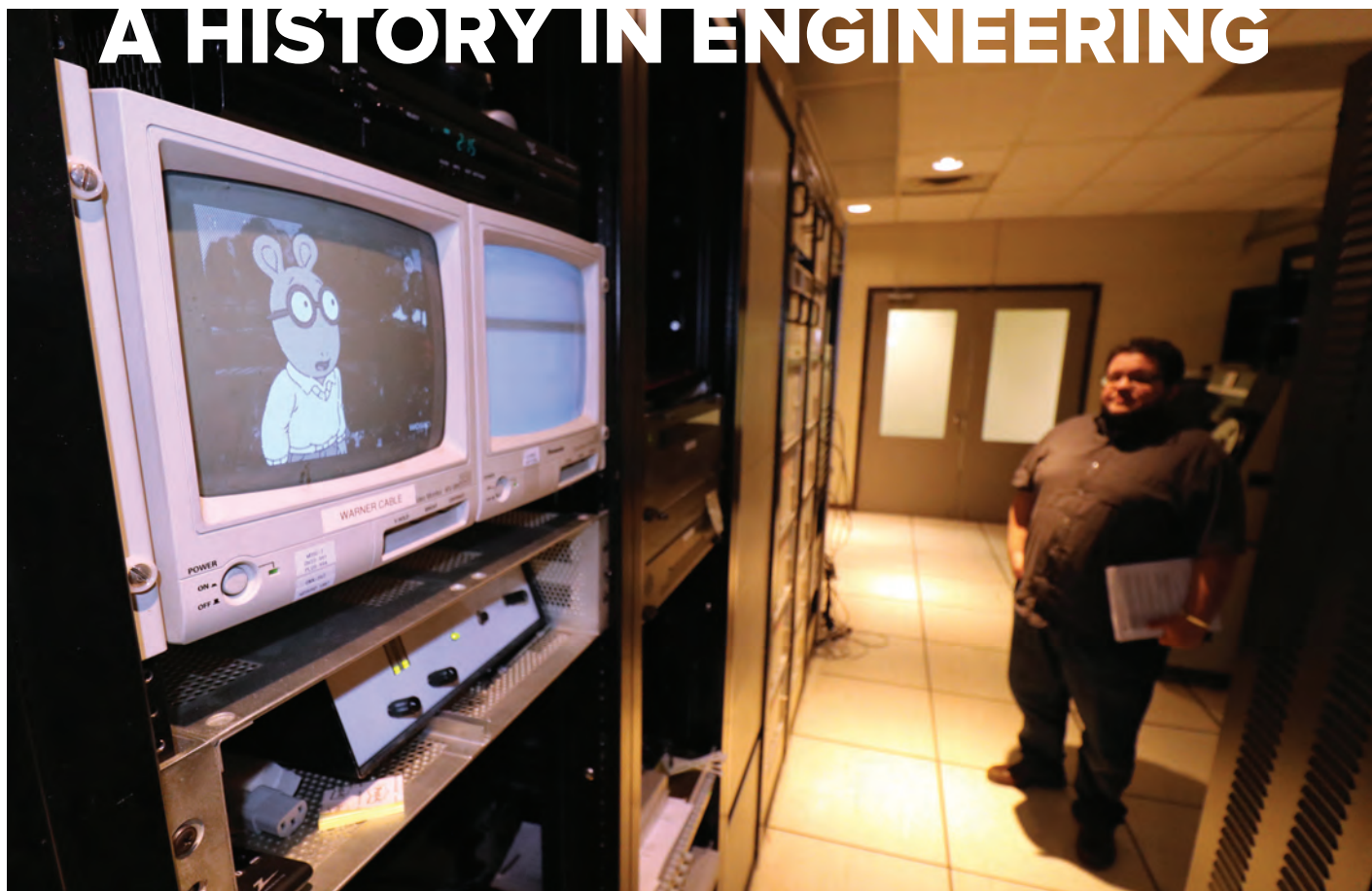
Ohio State ECE/EE Alumni Society member **Mark Morscher** ('89) said the point of the dinner was simple at first, to keep ECE alumni updated and engaged in their alma mater.

More than that, he said, seeing the labs and facilities gives them a chance to talk with current students about research and simply reminisce. The tours that day included Dreese and Caldwell labs.

Alumnus **Gene Rhodes** ('63)



THE FUTURE OF WOSU.



A HISTORY IN ENGINEERING



In 1900, when Morse code still ruled the airwaves, a rogue electrical engineering student holed himself up in a room at Ohio State to follow his research muse. His experimental work became the quiet beginnings of what we know as WOSU Public Media today.

That student, **Robert Marriott**, born in Richwood, Ohio, would go on to become one of the most celebrated wireless innovators in the United States. He was among the first to work in the field of radio communications.

Tom Rieland, general manager of WOSU, said it's this shared history with Ohio State he wants to tap back into. In October 2018, he announced a \$29 million plan to build a new WOSU headquarters at the corner of 14th and Pearl streets as part of the 15th + HIGH project – a proposed hub of activity on campus Ohio State dubs “University Square.” Ground breaking for the new facility starts in April.

With the expansion, Rieland said, comes a need for the next generation of Ohio State electrical engineers to help lead the way.

“We’re taking on a huge technical project over the next two years, moving into these new facilities,” Rieland said. “It’s going to be all hands on deck. We want and need to expand the electrical engineering talent around us.”

Rieland said WOSU is offering new summer internships and fellowships, showing students the pathway toward rewarding careers in broadcast engineering. WOSU set-up a one million dollar endowment to support student educational opportunities within the stations.

“We are beginning to re-forge the historic links WOSU has had to many Ohio State academic areas and this new relationship with electrical engineers takes us back to our roots as a broadcast station,” he said.

WOSU was operated under Ohio State electrical engineering faculty until 1927. The post-World War I boom in radio broadcasting marked a new high in scientific achievement for the university, bringing this new thing called radio to life.

Hesham El Gamal, Chair Ohio State’s Electrical and Computer Engineering (ECE) Department, said he wants to help, not only by showing how ECE integrates into all forms of modern technology, but by guiding graduates toward different industries and opportunities they might not have thought of before.

“We would like to be a department that helps the city,” El Gamal said.

It’s become serious, Rieland said. Experienced broadcast engineers are retiring and they aren’t being replaced

“IT’S GOING TO BE ALL HANDS ON DECK. WE WANT AND NEED TO EXPAND THE ELECTRICAL ENGINEERING TALENT AROUND US.”

with new faces. He said the entire media and communications industry stands to take a hit if this trend isn’t reversed. They depend upon novel ideas and technological advancements.

“There is a growing demand for broadcast engineers,” **Michael Meadows** said, WOSU Chief of Technology. “It’s all about the mentorship experience. I would have benefited from that when I was in school. That specific engineering knowledge is going away.”

He said Ohio State engineers can find welcoming careers in radio frequencies, signal propagation, antenna design, digital equipment, transmitters and consultation at radio and television stations across the country.

International students are especially being courted, Meadows said, as they often have more difficulty finding summer internships or careers that don’t require security clearance.

WOSU provides a variety of broadcast services to Central Ohio: the 89.7 NPR News FM station that started in 1949; the only classical music station in Columbus, and the community PBS station. The WOSU facilities are currently in the basement of the Fawcett Center located on Olentangy River Road.

Not only will the new location at 14th and Pearl offer WOSU room to grow, Rieland said, it provides a better platform for engaging and collaborating with the Ohio State community and Columbus.

Ohio State engineering students interested in joining WOSU internship and fellowship opportunities can apply via the Student Job Board and Engineering Career Services. ■

ECE SPOTLIGHT

SUBIKSHA MADHAVAN RESHIKESHAN



*Story by Isabel Hall
and Ryan Horns, ECE
Communications*

People choose where they study based on a variety of factors, and it's often a difficult decision to make. For **Subiksha Madhavan Reshikeshan**, it was easy Research led her toward earning a Ph.D. from Ohio State.

As a young student in India, Reshikeshan was drawn early on toward electrical power systems engineering. While other students went off seeking the newest technological trends, she saw a different opportunity to make a difference.

"The thing that drew me toward power engineering is we see problems with the electrical grid around us every day," she said.

In India, for example, power cuts happen regularly during peak seasons.

"They could not meet the demands," Reshikeshan said. "They had the technology, they had the resources, but the deployment was missing somewhere. You just have to plan properly and ensure things get deployed. That is something that an engineer needs to do. That is what drew me to this field."

While conducting work for her undergraduate thesis at the Indian Institute of Technology Madras, Reshikeshan discovered the power engineering research of Ohio State Electrical and Computer Engineering Associate Professor **Mahesh Illindala**. Interested in his achievements, she decided to contact him about studying under his guidance.

"He was the one who said 'Apply to Ohio State and come here. It would be good to have you here,'"

Reshikeshan said.

Apply she did. Today, Illindala serves as her Ph.D. advisor on a variety of research projects associated with Ohio State's Center for High Performance Power Electronics (CHPPE), a facility focusing on new technologies in power electronics and systems. She is part of a group studying flexible distribution of energy and storage resources.

Within CHPPE, Reshikeshan also does research on evaluating the robustness of power system configurations, in which she tries to find microgrid islands to handle disturbances, which are also not susceptible to collapse.

Another project she is working on involves distributed generation penetration in the electric grid; trying to figure out how multiple smaller generation units, which help tackle high energy demand, could fit into a distribution grid.

After earning her Ph.D., Reshikeshan wants to continue new research while working in academia and then start pursuing teaching.

One thing is certain, she said, coming to Ohio State as a graduate student truly changed the trajectory of her life for the better.

"A good Ph.D. program can help you get confidence," Reshikeshan said. "I feel if you are fundamentally interested in science then you should take up research. For me, it has helped me get time to explore

things I am very interested in, which I don't think I would have been able to do if I went into industry. Here, I have the freedom to dwell deeper into things that fundamentally interest me, which I find I am really liking here."

Choosing power systems engineering was more a result of finding herself, Reshikeshan said, as opposed to following the crowd. As an undergraduate, power engineering wasn't a popular field.

"Power is a very old system. It's been around for hundreds of years now. There are more fields developing new, like communications - every day wireless communications is developing something new," she said.

Her advice to ECE undergraduate students seeking more direction in their careers? Follow their hearts.

"I feel if something interests you, you should take it up irrespective if you see a future for it or not. You can make a future for it, if you are really interested in it. It's not really necessary to stick to the conventions."

Illindala sees a strong future for her in academia.

"Subiksha is a quick learner. She has the potential to become a brilliant teacher and researcher," he said.

Working with Illindala has been a great experience, Reshikeshan said. He is always stressing the importance of becoming an independent researcher while working toward her doctoral degree.

"Once you've graduated, you no longer have your advisor to always fall back upon or take advice on your papers. You've got to start publishing by yourself," she said. ■

ECE SPOTLIGHT
**SAEEDAH
ZIAEEFARD**



Story by Isabel Hall

With her extensive education, **Saeedah**

ZiaeeFard is used to being in the classroom as a student at Ohio State.

However, now she steps into a new role - faculty member.

ZiaeeFard joined Ohio State's Electrical and Computer Engineering (ECE) department as a lecturer in September 2018 and currently teaches two courses.

While instructing at the undergraduate level is new to her, ZiaeeFard credits both students and faculty colleagues for helping to make the transition smooth.

"I think all the students here at Ohio State are very sharp, and they take their classes very seriously... and that's good. As a teacher, when I go to class I see their interest and it motivates me to come up with new ideas for my lectures," ZiaeeFard said. "I really like this department. Everyone is really friendly, so my transition from being a student to being faculty was very easy."

ZiaeeFard's academic past has taken her all around the world. She earned a master's degree at Amirkabir University of Technology in Iran,

where she studied marine engineering. She then moved to China and worked for a ship building company, helping to monitor quality assuredness.

After spending five years doing industry work, ZiaeeFard decided to apply to schools in the United States and ended up attending Michigan Tech University, where she studied mechanical engineering with a focus in controls and robotics. She earned both a master's and Ph.D. from the university. Her husband recently moved to Columbus for his job, which is what led her to explore new opportunities at Ohio State.

Although she is focused on teaching, research still remains an interest. While she has no current plans to conduct new projects, in a few years she wants to research robotics and controls, then share her findings with future students.

Outside of her ECE course material, ZiaeeFard hopes her students learn effective communication,

something she finds very important no matter what class they are in.

"I like my students to come and talk to me. I think effective communication is very important and it doesn't matter if it's a technical communication class or it's a technical class like a control or robotics," ZiaeeFard said. "Sometimes the way that I teach may not be the same method as what a student learns, but with effective communication we can come to a point where we both agree, and (the) student will understand and learn more effectively. At the end of the day, I want everyone to learn something from my lectures when they go out of my class."

Going into teaching was a leap of faith, ZiaeeFard said, but she is enjoying the experience and discovering it may be her passion.

"I always wanted to work in a company. I did have that experience, but now I think I like teaching because I like to tell students about the fundamentals. So, if they are doing any research, they have learned those building blocks and concepts related to their research," she said. ■

"I think all the students here at Ohio State are very sharp, and they take their classes very seriously... and that's good. As a teacher, when I go to class I see their interest and it motivates me to come up with new ideas for my lectures."

ACADEMIC IMPROV

ONE OF THE MOST IMPORTANT TALENTS AN ENGINEER CAN POSSES IS THE ABILITY TO THINK ON HIS FEET.

Jackson Donaldson takes this theory to a whole new level. Not only is he a fourth-year in electrical engineering at Ohio State, he is the president of a student-run comedy group.

Always interested in comedy, it wasn't until he started exploring performance as a way to navigate the stress of college, did he find an entirely new path – improv.

A high school friend told him about student improv groups at Ohio State. Unsure of what it actually entailed, Donaldson took a class his first semester through the Department of

Theater. He enjoyed it so much he tried out for Fishbowl Improv, a student comedy organization, the very next semester.

Fast forward, Donaldson is now president of Fishbowl Improv.

"When I got in the group, I always was really engaged with it," Donaldson said. "Last year I was the treasurer, and I wanted to be on the e-board of the group just because I thought I had good ideas and could make the group more well-known and bigger on campus."

Some of the changes Donaldson

brought to Fishbowl Improv included expanding its social media presence and doing flyer campaigns on campus, both of which helped increase the attendance at the group's bi-weekly shows.

While it's admittedly difficult for Donaldson to balance performing with his engineering class workload, he said the challenge is worth it. Improv provides him with a well-needed break and a bit of freedom.

"Improv is very fun because you just make stuff up and you perform in front of people," Donaldson said. "A lot of times, in engineering and college in general, you're always just studying... Fishbowl gives me an outlet to be creative and do whatever I want."

With an eye on the future, Donaldson hopes to continue incorporating comedy into his post-graduate life; he has an engineering position with Proctor & Gamble lined up and credits his experience within the Ohio State ECE department for helping him land the job.

"ECE here has given me a very valuable thought process on everything," Donaldson said. "It's just taught me how to think about things in a new way, and I think I've been able to apply the thought process of electrical engineering and the problem solving of it to a lot of different things I've done." ■

*Story by ECE Student PR Writer,
Isabel Hall*





OHIO STATE 2019 SESQUICENTENNIAL STUDENT SCHOLARS

More than a motto at Ohio State, graduates face a responsibility born out of its founding land-grant mission to improve society in honor of its sesquicentennial.

Two Buckeye majors in electrical and computer engineering were named Ohio State Sesquicentennial Student Scholars in their quest to help further their communities in 2019. ECE students **Mathias Dawit** and **Sarah Greenbaum** were among the 150 students named this year.

“(These) students share an extraordinary passion for our university and will participate in a special leadership program as part of our 150th anniversary,” Ohio State President **Michael V. Drake** said.

Since its founding in 1870, he said, Ohio State has empowered generations of Buckeyes to become leaders and create ideas that change the world. The Sesquicentennial Student Scholar Leadership Program builds upon this legacy by providing participants a \$2,500 scholarship, lead-

ership training and opportunities to serve as a university ambassador.

“I look forward to celebrating this wonderful milestone with the entire Buckeye community and with our Sesquicentennial Scholars — the next generation in Ohio State’s proud tradition of service and excellence,” Drake said.

Greenbaum plans to focus on radar applications in space as her academic career progresses, hopefully pursuing her studies further at the ElectroScience Lab. DaWit majors in electrical engineering, with an interest in neuroscience.

The total 150 students come from 5 continents, 9 countries, 22 states in the U.S. and 42 counties across Ohio and represent every campus and college in the university. Most importantly, their Buckeye passion brings them together to drive the land-grant mission forward. ■



FIFTH ANNUAL IEEE WINTER BANQUET

2 Management is doing things right. Leadership is doing the right things.

These are the words **Shubho Bhattacharya** shared at Ohio State's Fifth Annual Institute of Electrical and Electronics Engineers (IEEE) Winter Banquet held Jan. 25 at the Longaberger Alumni House.

Associate Chief Engineer at Honda North America, Bhattacharya served as keynote speaker.

His advice to electrical and computer engineering (ECE) students? Live with a sense of purpose.

"Ohio State has prepared you to be successful in any situation," Bhattacharya said. "The most important thing now is to learn for the rest of your life. You are here to make the world a better place."

IEEE Ohio State Chapter President **Autumn Mathias** said the Winter Banquet is an opportunity to say thank you to industry sponsors and faculty mentors for their support throughout the year. Also attending were Ohio State ECE Assistant Professor and IEEE Faculty Advisor **Tawfiq Musah**, ECE Department Chair **Hesham El Gamal**, IEEE Columbus Chair **Carl Lee**, and numerous student officers.

Industry representatives from

sponsors like ArcelorMittal, Vertiv, Marathon, CAT, Texas Instruments, Schweitzer Engineering Laboratories and Honda attend each year to help bridge the gap for students seeking employment or internships.

As IEEE members, El Gamal said, everyone in the room is tied together by a collective goal.

"We are very passionate about what we do here," he said.

Bhattacharya told the engineering students their learning does not end after graduation. They must keep striving to know more.

"Do what you are passionate about and your life will be filled with joy and you will have a true sense of meaning," he said, "and then make people successful in your orbit."

At Honda, Bhattacharya said, the role of electrical engineering remains vital. It is a part of important applications in every vehicle, from lighting systems to control systems and more.

Even on the factory floors, he said, facility high voltage power engineers are important in preventing downtime and malfunctions. Even the painting system robotics depend upon intense electrical engineering skills.

Moving forward, Bhattacharya said, Honda relies on new game-chang-

ing ideas from graduates to keep the company vital. Its ties to Ohio State are strong. He said the company employed 51 Buckeye co-ops this past summer and provided 23 capstone projects to students within the College of Engineering.

Bhattacharya said their educational life should focus on going from reactive to creative. If they can remove the technical barriers they face, it allows more room for new ideas.

In 2015, the Honda and Ohio State Partnership announced a new direction to build upon innovations in the mobility industry to benefit society. Honda companies involved in the partnership with Ohio State include Honda R&D Americas, Inc., Honda of America Mfg., Inc. and Honda North America, Inc. During the banquet, ArcelorMittal was presented the IEEE "Undisputed Champion Donor Award."

Founded in 1884, IEEE is currently the world's largest technical professional society. The organization helps students grow in the engineering process of creating, developing, integrating, sharing, applying knowledge about electrical, electronic, and information technologies, and sciences for the benefit of humanity and the profession. ■

For students interested in learning more about Ohio States IEEE Chapter, head online to: ieee.osu.edu

OHIO STATE ECE HONORS ITS RETIRING MARATHON MAN

Sure, engineers are known for their love of details. However, at Ohio State, one man's reputation precedes him.

After more than three decades in the Department of Electrical and Computer Engineering (ECE), its staff, faculty and administrators honored the work of retiring Associate Professor **George Valco**.

Colleagues and friends say Valco's professional legacy is an admirable one, filled with a curiosity for details many engineers easily overlook. When others see a mountain of work, he sees a challenge. More than that, it's his drive to always do the right thing that defines him as a person.

ECE Professor **Ayman Fayed** said without having Valco as a professor many years ago, he may not be where he is today.

As an international student, Fayed showed up at Ohio State knowing he was accepted to the program, but also knowing he had no money to pay for the graduate degrees he sought. Valco took the graduate student under his wing and hired him as a Teaching Assistant, which covered tuition costs, only after sensing Fayed had the drive to do well (even if he lacked the experience).

"I only had something like \$20," Fayed said. "Every Monday of every week George would take me to the clean room in Dreesse Lab and spend maybe 10 to 12 hours teaching me the lab process as a student. Then, I

would turn around on Tuesday and Thursday, and teach it to the other students."

Fayed stayed on as TA over the next four or five years, until he finished his Ph.D.

"Without that course, without the opportunity George gave me to be his TA, I would have struggled a lot to pay my way through school," Fayed said. "He was extremely crucial for my life and career in general."

Any story about Valco, of course, must reference his love for long-distance running. Not only because it shines a light on the level of his drive, but also because he dedicates the same effort toward marathons as he does to his role at Ohio State.

"I think George is the only person left in the department who knows the difference between an objective and an outcome," Associate Professor **Betty Lise Anderson** said, then joked, "So, basically, we're all going to die."

"I do have mixed feelings about this," ECE Chair **Hesham El Gamal** said. "When he told me about his retire-

ment, it was perhaps the first professionally bad news of my term as chair. I can't say enough about his contributions to the department."

ECE Associate Professor **Steve Bibyk** said Valco is one of those people everyone is glad exists; a person who enjoys diving deeper into problems, who possesses the patience and work ethic to pursue the details and see each dilemma resolved. He said Ohio State's Solid State program owes its existence and success to Valco, who helped give it life with ECE Professor **Steve Ringel**.

"I appreciate all your effort, and I appreciate you being able to do all the jobs that most people are not fond of doing," Bibyk said.

Valco said the friendliness of the Ohio State ECE department helped make his career vibrant.

"I will miss the people, particularly. It's been a great environment, a very friendly department," he said. "I'm going to miss you all."

Who knows, Valco said, there could be another official role for him at the department in the future, but joked, "only part time or temporary." ■

"When he told me about his retirement, it was perhaps the first professionally bad news of my term as chair. I can't say enough about his contributions to the department."

—ECE Chair
Hesham El Gamal

**GEORGE
VALCO**



BUCKEYE CURRENT

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THE 2019
BUCKEYE
CURRENT
TEAM

BACK TO ITS ROOTS

By Ryan Horns

The core of Buckeye Current, the electric motorcycle racing team at Ohio State, is the thrill of engineering. To build a winning bike.

That's why they are going back to their roots.

Mason Hayes, team operations manager and Materials Science Engineering major, said Buckeye Current is returning to the race that matters

most in 2020 – the Isle of Man Tourist Trophy Race, situated between the islands of Great Britain and Ireland.

After the 2018 season, students on the team realized something was missing. Reclaiming that missing piece is their mission for 2020. Hayes announced Buckeye Current is not going to race in 2019. Instead, the team is spending the next year raising funds, designing a brand-new motor-

cycle from the ground up, plus adding a second project for more students to get involved with.

"That was our big question for this year. Do we rebuild and try to go back to Pike's Peak? Or maybe do some other road race?" Hayes said. "We decided we are an engineering team, not simply a modification or rebuilding team."

Based out of the Center for Automotive Research at Ohio State, Buck-



Watch short video interview with the team: <http://go.osu.edu/current2020vid>

eye Current is made up of interdisciplinary engineering students. They independently manage, fundraise, design, build, and professionally race electric motorcycles on both the national and international stage.

The point is to create the next generation of high-tech automotive engineers through the design and manufacturing of a cutting-edge electric vehicle.

Electrical and Computer Engineering team member, **Chris Liu**, spent 2018 characterizing battery cell options for the 2018 Pikes Peak bike, and conducting statistical simulations for the 2020 motorcycle.

The goal for Buckeye Current, as always, remains educational.

"The reason I came to Ohio State is because it's a really huge campus and there are a lot of opportunities I can explore. I'm an engineering major, first of all. I really like designing, especially software engineering," Liu said. "I think the work I do here relates to the work I want to do after I graduate. That's why I got involved in this project. To get hands-on experience. To better prepare myself for future internships, or full-time positions."

Applied Mathematics major **Tyler Stoltzfus** said the experience of working on an electric motorcycle is exciting in itself.

"How many people get to work on an electric motorcycle in college?" he said. "There are maybe a handful of schools who have anything like this program. Nobody's got an electric mo-

torcycle team. If I get to apply that later on to a job, great. If not, I'm having fun right now."

Quincey Patterson, fourth-year Agricultural Engineering major, said they are realistic about their goals and what they want out of Buckeye Current.

"It's an electric motorcycle and a race bike. We want to go fast. We want to win," he said. "So, a big part of that is how we are going to generate enough power to win in an appropriate form factor. That ties in a lot toward what I'm studying. It helps take it from the classroom into a real-world place."

The results of Buckeye Current back up this notion. Ohio State became the only U.S. collegiate team to podium at the Isle of Man TT placing third in both 2013 and 2014, with an average speed of 90.4 and 93.4 mph, respectively, besting both professional and university competitors.

Looking for a different challenge, they picked their next target - the Pikes Peak International Hill Climb in Colorado, the most grueling road race the nation has to offer.

Buckeye Current spent the next year building a bike to compete at the challenging road race that leads over 14,000 feet straight up a mountain. Through crashes during testing and adverse road conditions, the team podiumed in both 2015 and 2016 and won the electric class in 2017.

"Pikes Peak is a really interesting race," Hayes said. "It's difficult. You have to really gear your vehicle specif-

ically for that race. But it's not as well known. It doesn't have that aura that the Isle of Man has. If you race bikes, you go to the Isle of Man. Nobody on the team now has ever been to it."

Many of those student engineers who took the team to such heights graduated, and are now employed at places like Cummins, Honda, Bosch and Harley-Davidson.

After the 2018 race up Pike's Peak was cut short by a crash, Hayes said, it was a prime opportunity to explore new options.

This leads to the second goal of Buckeye Current 2020. Students aren't allowed to ride the race bike because it's too powerful and requires an expert's touch. So, they launched a new project to design and build their own electric dirt bike.

"We wanted to do something on a smaller scale. Something that anyone could take out on a test ride. Let them get on an electric vehicle," Hayes said. "The hope is that it becomes sort of a lead-in project, where people who haven't been on the team yet can come in and learn in a low risk environment. If they break a component, or something doesn't work, it's not mission-critical for the race bike."

Financially, Hayes said the team has what it needs for its base-level plans, but they're always looking for more financial support to purchase components, test their designs and outsource to ensure the highest quality vehicle is produced. ■

TO LEARN MORE ABOUT BUCKEYE CURRENT, DONATE TO ITS CAUSE, OR JOIN THE TEAM AT THESE LINKS:

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THE DREAM SYSTEM

A mineral found in stardust helped electrical engineers at Ohio State win a large-scale power efficiency project sponsored by the United States Department of Energy.

“The dream system now is in front of us,” **Longya Xu** said, director of Ohio State’s Center for High Performance Power Electronics (CHPPE). “We have operat-

ed the system. It does reach the goal.”

Electrical and Computer Engineering (ECE) professors Xu and **Jin Wang**, along with Assistant Professor **Julia Zhang**, make up the Ohio State team that created the first, next-generation, silicon carbide-based medium voltage megawatt level converter -A 7 kV, 1 MVA SiC based Modular Multilevel Converter, or MMC. ■

Watch a video of the team explaining their groundbreaking power efficiency work online. go.osu.edu/CHPPE-MMC



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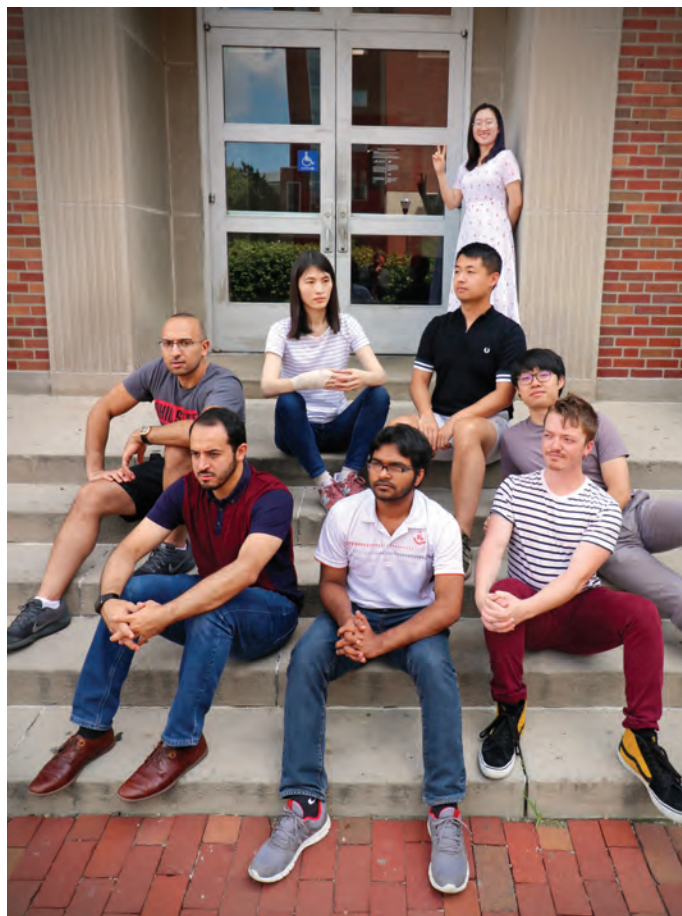
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DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

SPRING GRADUATE & UNDERGRADUATE

CLASS *of* 2019!





OHIO STATE ECE STUDENTS ON CAMPUS THIS SUMMER HELPED RECREATE THIS ICONIC PHOTO OF ELECTRICAL ENGINEERS PRESUMABLY TAKEN ON CAMPUS IN 1893. Showcasing the diversity blossoming in the field today are, clockwise from top, Xiaodan Wang, Peng Peng, Yue Zhang, Mark Lust, Reza Karim, Yousef AlHassoun, Yahia Ahmed Shabara and Xintong Lyu. (Photo: Ryan Horns)

TAILGATE WITH THE EE/ECE ALUMNI SOCIETY AND THE COLLEGE OF ENGINEERING HOMECOMING WEEKEND: SATURDAY, OCTOBER 5TH.

Join the EE/ECE Alumni Society as we celebrate our alma mater with fellow engineering classmates at the College of Engineering tailgate from 4:30 to 6:30 p.m. prior to the Ohio State vs Michigan State

game. The event promises good food, fun, and festivities for all ages. For more details and registration, visit engineering.osu.edu/events by September 27th.

ECE Priorities

RECRUIT OUTSTANDING FACULTY:

The new faculty we are recruiting will perform cutting-edge ECE research to impact our future in autonomous vehicles, smart robotics, cancer treatment, concussion prevention/diagnosis, energy systems, and the internet-of-things. Support from our alumni is crucial for helping us to provide startup funds and endowed chair support to enable these innovations and endowed chair positions to attract outstanding new faculty.

STUDENT-LED INNOVATION:

Our graduate students are the driving force behind Ohio State's research progress. Their success builds not only their future career, but also the university's reputation and our nation's critical technologies. Support from our alumni helps us to provide fellowships for the graduate program that enable these students to concentrate on their research rather than day-to-day financial concerns.

UNDERGRADUATE ACCESS:

Department scholarships enhance the ability of our students to pursue their dreams of an ECE education. These are especially important during freshman and sophomore years, as students build their skills to pursue future internships and co-ops. We are proud of the generous support ECE alumni have provided to our undergraduate students and hope to build upon this success to further reduce college costs for deserving students in our programs.

MODERN LEARNING ENVIRONMENTS:

ECE facilities are meeting the needs of our student body, but face challenges moving forward. The replacement of Caldwell Laboratory is a long-term goal; more immediate needs include smaller renovations of the Control Systems Laboratory, relocation of the electronics group, improvements in equipment for the sophomore teaching laboratories, enhancements to the laboratory space for our project-based master's program, and the creation of a "maker" space for our undergraduate students to pursue their innovative ideas. Alumni support helps us meet our facility needs going forward.

OTHER OPPORTUNITIES:

Many opportunities exist for our alumni to make significant impacts. These include endowments to support annual awards recognizing outstanding performance by our graduate or undergraduate students, support for expansion of the ECE-led Humanitarian Engineering program (including support for students to participate in humanitarian projects) and support for the ECE K-12 Engineering Outreach Program that has already taught more than 13,500 young students across Ohio about STEM topics applicable to society.

SUPPORT

WAYS TO GIVE

There are many ways to give to the Department of Electrical and Computer Engineering, including establishing an endowed or support fund, or contributing to the ECE fund of your choice.

You can contribute directly to an ECE fund through The Ohio State University Online Giving secure website giveto.osu.edu. Visit our list of ECE department program support and scholarship funds to find out more: ece.osu.edu/alumni/support

CONTACT US

Please contact **Katie Coen**, ECE Director of Development, at coen.40@osu.edu or (614) 688-2212, with any questions or to discuss giving opportunities.

Department of Electrical and Computer Engineering
205 Drees Laboratories, 2015 Neil Avenue
Columbus, OH 43210-1272

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