The Ohio State University | Department of Electrical and Computer Engineering

BITS & SPARKS

ALUMNI MAGAZINE | FALL 2018

PIONEERING ENGINEERING

OHIO STATE BREAKTHROUGHS IN SCIENCE

ANNOUNCING
New Ohio State ECE Chair
Hesham El Gamal

With a background in both industry and academia, professor **Hesham El Gamal** was appointed to become the new chair of the Department of Electrical and Computer Engineering (ECE) at The Ohio State University, effective Sept. 1, 2018. He succeeds professor **Joel Johnson**, who has served as chair since 2014.

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.

The ECE chair position is a four-year term. He said Johnson served as an excellent leader for the department and made great strides. As a result, the department is now well-positioned to grow and get to the next level. His goal is to pursue a focus on quality by empowering students, promoting our culture of diversity and inclusion, while expanding community outreach.

"Whether through research, teaching or service, we have a lot of strengths in all those areas. Perhaps we can now have a collective discussion on how to capitalize on those," El Gamal said. "I also think we can get more engaged with our community here in Ohio, to be relevant and have an impact."

Another aspect, he said, is further aligning the ECE department with the priorities of the Ohio State College of Engineering and the university as a whole. He wants to ensure students graduate with the confidence they are on par with the top scholars in the world.

"Perhaps we can raise their own expectations, make them more ready for a world that is going to change much faster than in the past," El Gamal said.

The Ohio State ECE program is well-regarded nationwide as having one of the most collaborative and supportive environments in academia, he said.

"I strongly believe that we are one of the most friendly and collegiate departments in the nation. We deeply care about the students. That's very important to me," El Gamal said. "The ecosystem now actually seems ready to go to the next level. I see change that is positive, and we can play a role in that. That will be a big focus for me going forward. To maintain and improve our collegiality, the ability to work together, having harmonious staff and faculty relations."

David B. Williams, dean of the Ohio State College of Engineering, said El Gamal is both innovative and entrepreneurial-minded.

"(He) understands and values the increased role of industrial partnerships in both education and research," Williams said. "His vision for electrical and computer engineering is appropriately creative and novel, and will build on the legacy of Joel Johnson, who has propelled the department to new heights."

El Gamal said he values the support placed in him by the dean and the College of Engineering. Over the past six months, El Gamal and Johnson worked together to make for a smooth transition in leadership.

In addition to his role as professor, El Gamal is also the co-founder and CEO of Inmobly, an Ohio State spinoff pioneering artificial intelligence for enhancing mobile video delivery.

While earning his Ph.D. in ECE at the University of Maryland at College Park, El Gamal said he worked as a research assistant and taught classes. He then became a senior member of the technical staff of Hughes Network Systems' Advanced Development Group. He also served as the founding director for the Wireless Intelligent Networks Center and an acting vice president of research at Nile University, Cairo.

Ultimately, El Gamal said, his true heart was in academia and teaching. He joined Ohio State as a faculty member in 2001.

Why the switch back to education?

"That's easy. The students. The best thing ever is to find something you said making it into the heads of the students. That's the big challenge and the big reward at the same time," he said. "Of course, scholarly activity is a big priority for faculty, but in my own view, the big gain is not necessarily in the papers we write, but the change in the students who write the papers."

El Gamal earned numerous recognitions and honors, including Ohio State's Innovator of the Year Award in 2013 and the National Science Foundation's CAREER Award in 2004. He was also named a Highly Cited Researcher over four consecutive years (2014-2017) by Clarivate Analytics (formerly Thomson Reuters). El Gamal is a Fellow of IEEE. ■

Find this story and more in the ECE department newsletter, **ECE Weekly at: http://ece.osu.edu/ece-weekly-newsletter**

Watch a short video of El Gamal discussing his ideas for the future of the department: **http://go.osu.edu/gamalvid18**

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Michael V. Drake
University President

Hesham El Gamal
ECE Department Chair

Kathleen Coen
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ECE/IMR Communications Specialist

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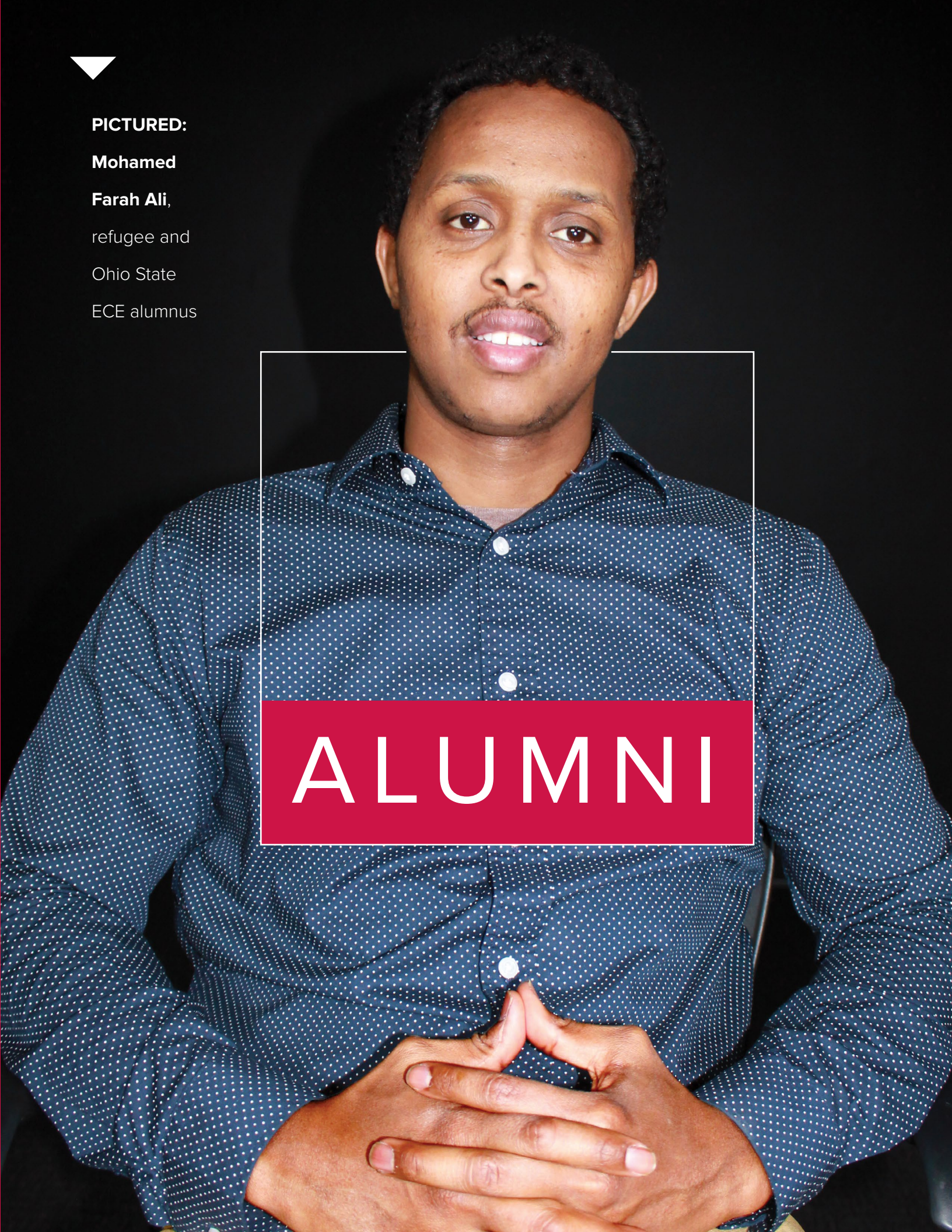
Design and Layout:

“I WANT TO LIGHT UP AFRICA.”

ECE graduate and refugee,
Mohamed Farah Ali



PICTURED:

Mohamed Farah Ali, refugee and Ohio State ECE alumnus

ALUMNI

OUT OF THE DARKNESS, INTO THE LIGHT

Sitting under the shade of a tree in the remote Kakuma refugee camp in Africa, a young **Mohamed Farah Ali** studied his school books until the sun went down. When it grew dark, he stopped. Electricity is as scarce in the camp as the trees are.

In order to keep reading after nightfall, Ali taught himself how to make a solar-powered light. It only bought him two more hours of work, but it helped.

Ali's passion for learning never really stopped from there.

On May 6, he joined a record 11,700 students receiving diplomas during The Ohio State University's Spring 2018 Commencement at Ohio Stadium.

As a refugee, Ali's journey to a diploma in electrical and computer engineering (ECE) took him out of the darkness, out of poverty, across several thousand miles of ocean and into a world of technology he never knew, but was determined to understand.

This summer, Ali begins the next chapter of his life as a professional power systems engineer.

With his hard-fought education in place, his goal is simple: To return to Africa one day and help deliver electricity.

"My goal is to light up Africa one day," he said. "I never dreamed of becoming an engineer. I always thought I would remain as a refugee kid. I came from a humble family."

Years earlier, when civil war broke out in Somalia in 1991, he said, his mother and father took their children and fled to Kenya to seek refuge from the war.

"I don't remember much about the journey because I was only two years old then," Ali said.

The family ended up in a refugee camp called Marafo, and remained there for years until it was closed. The refugees were then given the choice to return to war-torn Somalia or move into a new camp, Kakuma, in Kenya.

"My dad was tired of the life in camp because of the harsh conditions and the struggles, and he was ready to go back home to Somalia," Ali said.

His mother, however, was not ready to send her family back into a war zone.

"She never wanted us to experience any harm, so we chose the new camp," he said. "My mom had hope that one day her kids would have a better education."

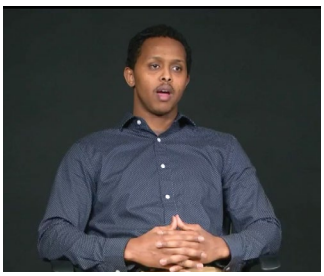
It was in Kakuma where Ali's education began under a tree, sitting on a stone, learning his ABCs.

The refugee camp life was not easy. Stories of un-

Kakuma photos courtesy of U

FROM WAR AND POVERTY TO DREAMS FULLFILLED, A REFUGEE ALUMNUS SHARES HIS JOURNEY *By Ryan Horns*

"English doesn't determine how intelligent you are. It's just a language."



Watch a video interview with Ali here: https://go.osu.edu/ali2018

rest, crime, violence and desolation were part of the Kakuma landscape. At night, law enforcement officials were known to turn a blind eye.

"Life there is different from here," Ali said. "Sometimes even getting a meal three times a day is very difficult. The necessary stuff is very hard to find."

After 15 years, however, the United States began assigning refugee status for this situation. The family knew it was time to leave.

"We were among the lucky ones to get the chance to come to the states, where all dreams of success are possible," he said.

Knowing he was skilled in mathematics and prone to understanding technology, Ali chose to pursue electrical engineering.

While some of his peers struggled with homework assignments, Ali had an even further uphill climb. He didn't grow up using computers. He didn't grow up with electricity. He didn't speak English. He never owned a calculator. His past did not include a reference to the American culture he found himself adapting to.

Ali struggled with assignments and took classes to learn how to speak fluent English; even learning how to use a computer for the first time presented setbacks.

It didn't help that ECE remains among the more challenging majors to undertake at Ohio State.

The voices warning he should pick an easier major began to grow.

"English doesn't determine how intelligent you are. It's just a language," he said. "So, I continued."

Ali already spoke three languages. He escaped a war. He made it to America with his family. He was self-taught and determined to succeed.

"Sometimes you have to be real strong to overcome the obstacles and not listen to the naysayers," he said.

By graduation, Ali pulled through and was among the thousands wearing caps and gowns that day.

Now a mentor, Ali wants incoming international and refugee students to look around and find the resources and community available to help them at Ohio State.

He remains hopeful for the future of Africa.

"My advice to my young refugee brothers and sisters is simple: Education is the key to success. Education makes you stand out from the rest," he said.

After five years of struggling through Ohio State ECE, Ali said his goal now is simple.

"I need a vacation," he laughed. ■

UNESCO (unesco.org)

Garden of Constants

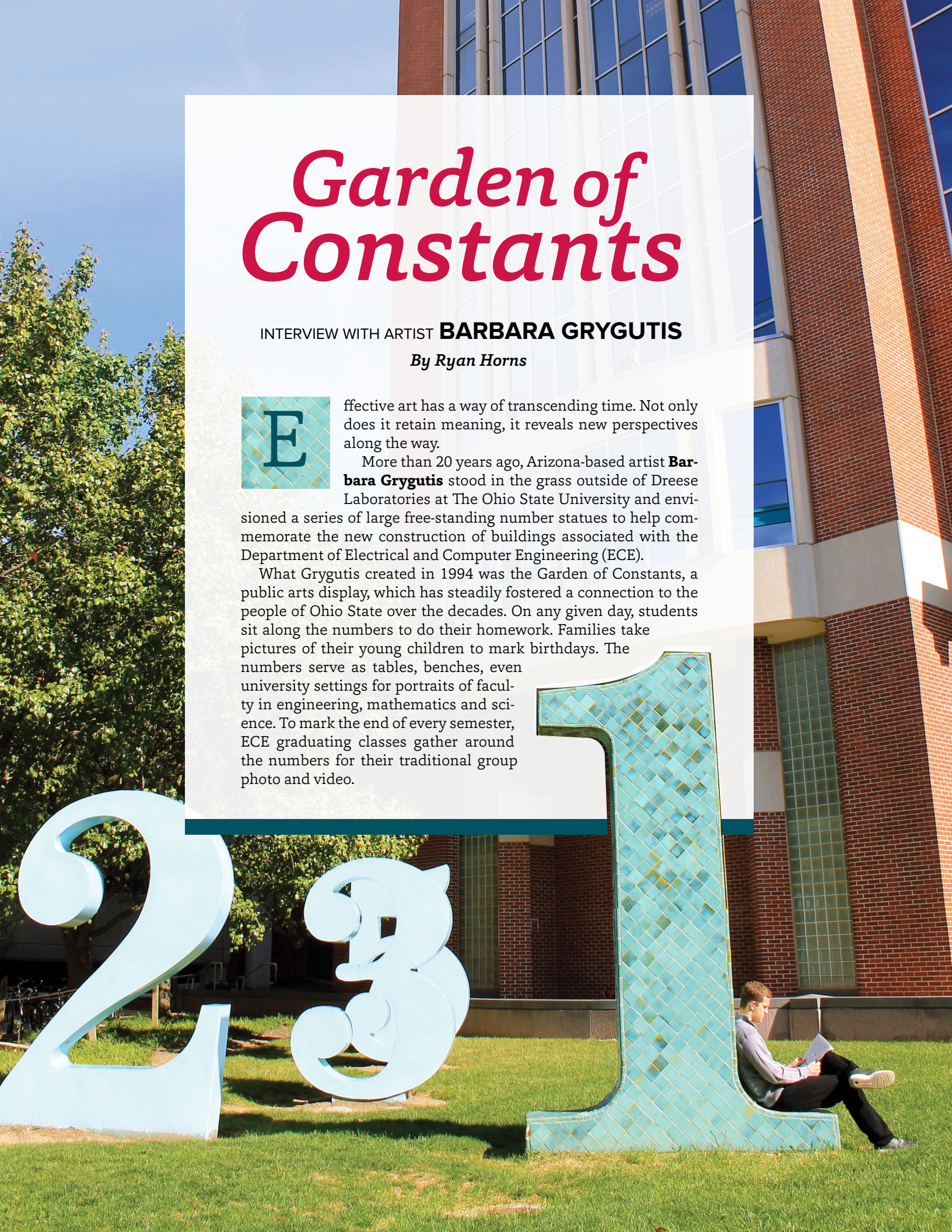
INTERVIEW WITH ARTIST **BARBARA GRYGUTIS**

By Ryan Horns

Effective art has a way of transcending time. Not only does it retain meaning, it reveals new perspectives along the way.

More than 20 years ago, Arizona-based artist **Barbara Grygutis** stood in the grass outside of Dreese Laboratories at The Ohio State University and envisioned a series of large free-standing number statues to help commemorate the new construction of buildings associated with the Department of Electrical and Computer Engineering (ECE).

What Grygutis created in 1994 was the Garden of Constants, a public arts display, which has steadily fostered a connection to the people of Ohio State over the decades. On any given day, students sit along the numbers to do their homework. Families take pictures of their young children to mark birthdays. The numbers serve as tables, benches, even university settings for portraits of faculty in engineering, mathematics and science. To mark the end of every semester, ECE graduating classes gather around the numbers for their traditional group photo and video.



"It's like a flower bed of giant numbers stretching to the sky," **Taylor Anderson** said, a Westerville teen who visited the sculpture while touring Ohio State campus with her family.

Grygutis said the connection between people and art is at the heart of what she does, so hearing the space still gets so much use is thrilling for her.

"You always want to know that people are having some interaction with what you've created," she said.

Grygutis also explained the thought process behind the creation. The Garden of Constants consists of two major components: 10 large number sculptures scattered throughout the site, and a collection of numbers and symbols set into the main walkway pavement. These insets are the mathematical and formulaic constants used primarily in electrical engineering and computer science.

Her overall goal was to draw a wider pedestrian audience into the art, taking advantage of the different viewing opportunities from surrounding buildings and walkways.

"This is a garden that invites and encourages us to ponder the meaning of numbers in our lives," she said.

Grygutis envisioned large number sculptures in copper green and bronze, colors meant to pop in different ways during different seasons, changing the feeling in the space month after month. For example, "(becoming) beautiful and reflective when snow is on the ground."

When designing the artwork, Grygutis learned an amphitheater was already being incorporated into the garden.

"It made sense to place the large zero there," she said. "I later learned that a lot of people have their picture taken inside the zero because it looks like a big Ohio State logo. I never thought about that."

When told the base of the large number "1" makes for a perfect homework chair, she laughed, "I didn't think of that either."

Most of the public artworks at Ohio State were paid for via the Ohio Percent for the Arts Program, created by lawmakers in 1990 to encourage the development of craftspeople in the state. Whenever the state legislature dedicates more than $4 million for a public building, 1 percent of the total is designated for public artwork.

Ohio State ultimately chose Grygutis to create her Garden of Constants among 130 artist submissions for the project, because her design best reflected the academic disciplines – Computer and Information Science and Electrical Engineering – now housed within Dreese Lab. When creating art for public spaces, especially universities, Grygutis said, educators either take a hands-on or hands-off approach. In the case of Ohio State's College of Engineering, she was happy to have quite a bit of input on the concepts behind the numbers from faculty.

"The engineers were very interested at the time. The piece was really all for the engineers," she said. "It was really based on the Number Theory. Of course, this was before all this tech and computer stuff, all the ones and zeros and binary."

ECE Professor **Bradley Clymer** said he often incorporates the Garden of Constants into his classes.

"For several years, I have been using the large number sculptures in the Garden of Constants to demonstrate to my sophomore signals and systems classes how you can use multiple channels to convey information," he said.

Not only do the numbers reflect amounts, Clymer said, they also convey information about color, materials and placement across the garden. Some are made of tiles, others granite or metal.

"For example, all of the turquoise numbers are noncomposite numbers," he said. "Perfect squares and perfect cubes are lying down to be viewed from above. Perfect powers of two are constructed from granite because they represent digit places for binary number codes."

Clymer said there is a special reason for the golden number six, but he likes to keep that a secret for his students to figure out themselves.

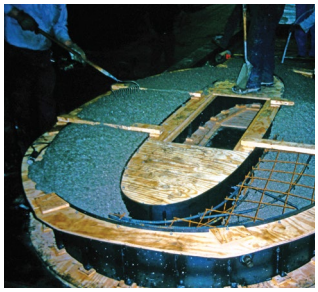
Grygutis also created the hundreds of tiles used in the artwork by hand.

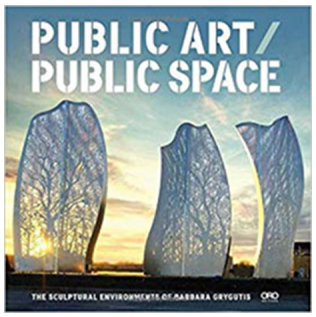
"At the time, quite a bit of my artwork incorporated tiles in some way," she said.

Ohio has a 200-year-old tradition of manufacturing and using ceramic tiles in building construction, she said, which she hoped to honor.

Grygutis said it feels good knowing her sculptures in the garden have retained such a tie with the people of Ohio State. Art has a way of being relevant sporadically, she said, perhaps it was significant once, but the concept was lost over time as society changes. Twenty years later, she said, the artwork may become relevant all over again as the cultural context changes.

"I'm glad they like it that much," she said. "It's very exciting to see this much time pass and it still be relevant in some way." ■





The Garden of Constants is featured in a new art book Grygutis released called "Public Art/Public Space."

@OhioStateECE MeetUp

Neural Tech

When Department of Electrical and Computer Engineering graduates leave The Ohio State University for the workforce, they often scatter across the nation to fill industry roles. To help bridge that gap, faculty, staff, alumni and students gather together a few times a year for the Ohio State Electrical and Computer Engineering Alumni MeetUp Social/Tech series.

In September, faculty and students involved in Neural Implant Technology held an open house, explaining their achievements and offerred tours of their labs.

Other technological areas explored in recent MeetUps included a look into ECE's Mobile Health Sensor Big Data Research, as well as the John D. and Alice Nelson Kraus Memorial Student Poster Competition.■

Learn more or register to attend the next **ECE MeetUp** event here:

https://www.meetup.com/OSUECE-Alumni/

EE/ECE Alumni Society

Note from the President - **Aaron Joseph**

It has been another great year for EE/ECE Alumni Society at The Ohio State University. We're making strides in growth and engagement, so I look forward to seeing this trend continue as we move into the next year.

An example of this growth is the upcoming 50th reunion. Only in its second year as an event, involvement is already surpassing our expectations.

There is no more perfect time than the present to start getting involved as alumni. With fall semester about to kick into gear, events are being planned, students need mentors, plus faculty and staff could always use the support.

For example, going into its fifth year, the Ohio State ECE MeetUp social-tech series has proven a great place for alumni to reconnect. Find the link here: **www.meetup.com/OSUECE-Alumni**

Organizers are always seeking topics, locations and volunteers who want to get involved. The MeetUps are typically technical in focus, and as a result often qualify for continuing education credit. Certificates are provided upon request. Interested? Contact program lead **Mark Morscher** with any questions or ideas at: **markmorscher@gmail.com**

In 2009, I received my undergraduate degree in ECE from Ohio State. Today, I work in the R&D group for a large global company making driverless trains. Constantly dealing with such a wide array of technologies would be unmanageable without the strong foundation I was able to collect through the Ohio State ECE program.

The reason I started getting involved with the ECE Alumni Society was because I wanted to give something back to the program that has given me so much already. As an added bonus, I get to stay up-to-date on what's going on within the department; along with having one of the greatest networking resources possible. What could possibly be better than networking with a group of people who not only share your love for ECE – but also share your love for The Ohio State University?!

Every EE and ECE degree holder from Ohio State is automatically a member of our society. We continue to grow our events, and become more creative at serving your interests. Let us know how we are doing! The Society is always seeking new names and faces to serve on our committees and Board of Directors.

Please contact eeecesociety@osu.edu if you are interested in learning more about any of these opportunities, or simply wish to provide feedback or ideas. ■

EE/ECE
Alumni Society

TAWFIQ MUSAH

By Ryan Horns and Lydia Freudenberg

As a child growing up in an artisan community in the Republic of Ghana, West Africa, **Tawfiq Musah** found his path toward engineering in the most unlikely place - inside an aluminum pot.

Recently joining the Department of Electrical and Computer Engineering at The Ohio State University as assistant professor, Musah spent his early years learning how to make kitchen wares: designing molds using clay, smelting and pouring aluminium to create handmade cooking pots and utensils.

"It was a rich lab experience all around," Musah said, "with lessons ranging from principles of design, to the chemistry of manipulating aluminium."

Entering high school, Musah followed this passion of working with his hands. He sought out ways to keep it going, with studies focused on physics, chemistry, biology and mathematics.

His parents wanted him to be a doctor, Musah said, but his heart wasn't quite in that. Instead, he took his gift of creating and turned it into a career in electrical engineering.

"I loved the math more than anything else," Musah said. "I was drawn more to engineering for that ability to create and innovate, to play with things, to be able to mathematically conceive of something and be able to build it and see it realized."

To further his goals, Musah saw more opportunity in the United States.

"I decided to come to America for higher education because I wanted to be at the frontier of engineering innovation. I wanted to have the ability to study under, and potentially work with, the best people in engineering," he said.

Realizing his gift for circuits at Columbia University during his undergraduate years, Musah stuck with electrical and computer engineering all the way through his doctoral program at Oregon State University.

"Electronics allow you more ability to tinker," he said. "You play with a few devices and you create something new."

After a stint at Intel for eight years, Musah made the move to the Midwest and Ohio State. His current research is a combination of his Ph.D. studies and his industry experience.

The academic work focused on data converters like analog to digital converters (ADCs), and at Intel, he dealt with improving the speed and power efficiency of high-speed communication links. The research led him to find new realms to expand upon.

By creating a mostly digital design, he said, devices can make more significant leaps in the future, allowing for easier control and delivering more efficient power than current designs.

"What I want to spend time on is to see: can we redesign the ADC to make it specific for these communication links?" Musah said, in terms of his Ohio State research. "If I can come up with something that is easy to program to meet any application, then you just have one circuit."

Since techniques at the circuit level are thoroughly explored, he said, innovations at the systems could open up new capabilities and enable cost and power-efficient approaches to meet current and future device specifications.

QUDSIA TAHMINA

By Ryan Horns

With her work at The Ohio State University Marion branch, **Qudsia Tahmina** not only sees her role as a teacher, but a voice in the community.

An assistant professor of practice in the Department of Electrical and Computer Engineering (ECE), Tahmina said her passion for mathematics and physics led her to engineering at a young age.

As a teacher, she hopes to guide students toward careers where they will succeed most. She currently teaches ENG 1181, which deals with engineering fundamentals and skill development to promote teamwork, values and communication.

It's a role that fits well for Tahmina because she values helping students learn their potential and strengths in engineering as they move forward at Ohio State.

"I'm so fortunate to be able to lead them in their pathways," she said.

At Marion, she said, students have a unique opportunity over their main campus counterparts.

"They have better opportunities because the class sizes are small and they can get more attention. I wouldn't say one-on-one. It's just easier to reach out to your instructor. I spend more time with my students," she said.

STEVEN BIBYK

By Lydia Freudenberg

Reverse engineering is a method of analyzing a product or design and recreating it, rather than producing it from scratch. At an early age, **Steven Bibyk** discovered his passion for it.

Before leaving for work each morning, his father would remove the vacuum tubes from the television so Bibyk and his siblings would find other activities besides watching shows.

The young Bibyk was smart, though; after discovering the instructions inside the television, he learned to place the tube back in the set, watch TV all day, and remove it before his father returned.

"That was empowering," Bibyk said. "I outsmarted my dad ... and I figured out how to make electronics do something really useful for me."

Today, Bibyk is an associate professor at The Ohio State University in the Department of Electrical and Computer Engineering (ECE), where he teaches several courses, conducts research in reverse engineering, and is highly involved in several student organizations.

He went on to obtain his bachelor's, master's and doctoral degrees in electrical engineering and applied physics at Case Western Reserve University in Cleveland. After gaining some industry experience during his doctoral program, he decided to return to academia.

Shortly after starting, Bibyk noticed Ohio State lacked a chip design program, which ultimately launched the Analog and Mixed-Signal VLSI (very-large-scale integration) design course. It led the Research Laboratory at Wright-Patterson Air Force Base to start up a successful division creating cybersecurity technology for microelectronics or chips.

Bibyk's research has since morphed from signal processing to cybersecurity within reverse engineering concepts. He explores how to create an even safer chip that is not corruptible; this requires the engineer to work backward and think like a hacker, removing target paths.

Teaching students to think like a criminal, however, is tricky.

"I have to make sure the students don't go to the dark side," Bibyk said, smiling. "But I say, 'No, that is not the point of this knowledge.'"

Within the past several years, Bibyk began dedicating more of his time to inspiring students, rather than conducting research. His primary involvements consist of three organizations.

He helps oversee the STEP (Second-year Transformation Experience Program) maker program focusing on student success by providing educational opportunities and funding to students who propose ideas beneficial to their well-being or professional experience. He is also the Electronics Club advisor, which collaborates with the OHI/O hackathon-based program helping to fund and host events for students to create original designs or tech products.

Bibyk said he wished he would have become more involved with stu-dent organizations earlier on in his Ohio State career, but he loves every moment now.

Tahmina's own career started much like her students, after understanding how engineering really has the potential to advance society as a whole.

"I wanted to do something good in the world, to benefit people, create some applications that would help," she said.

Her goal soon focused on electrical engineering, so she could work in project development.

Tahmina earned her master's degree in ECE at Purdue University in 2007, and later her Ph.D. in electrical engineering at the University of Wisconsin-Milwaukee in 2016, before joining Ohio State.

In the city of Marion, she said, teachers feel a strong purpose to help guide new students toward STEM careers, getting them focused on their future. It is a community still rebuilding after the national recession. As faculty from Ohio State, she is trying to do her part to help.

"Every drop helps. We think we are small in the world, but the impact we have adds up," she said.

OHIO STATE ECE HAD A GOOD YEAR.

WORLD RECORDS IN

SEMICONDUCTOR DESIGN.

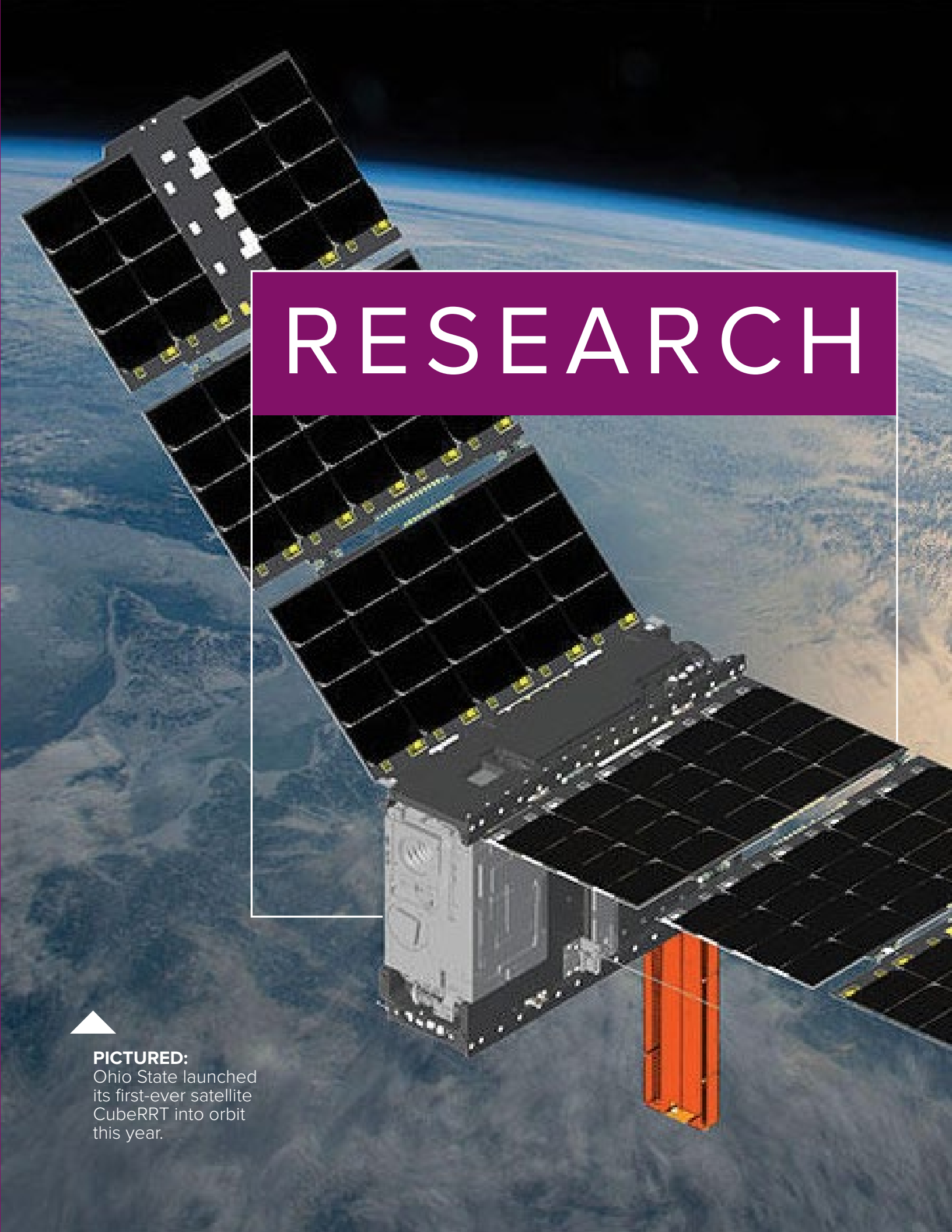
ADVANCING SATELLITE TECHNOLOGY.

LEADING AUTONOMOUS VEHICLE RESEARCH.

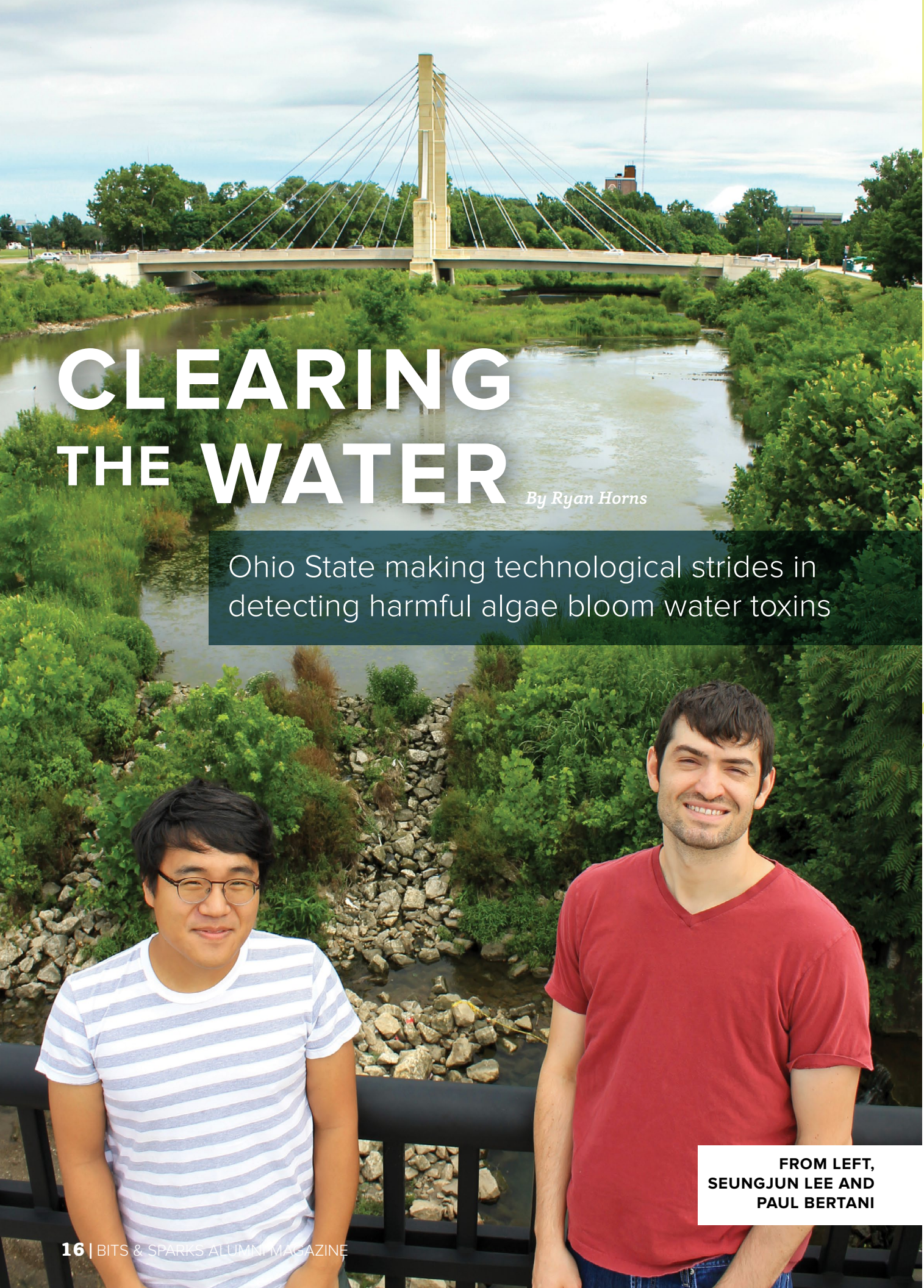
FURTHERING NEXT-GENERATION

NEUROLOGICAL SCIENCE AND ROBOTICS.

RESEARCH



PICTURED:
Ohio State launched its first-ever satellite CubeRRT into orbit this year.

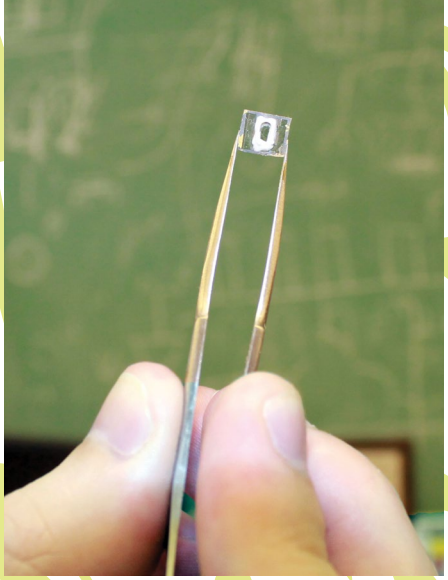


CLEARING THE WATER

By Ryan Horns

Ohio State making technological strides in detecting harmful algae bloom water toxins

FROM LEFT, SEUNGJUN LEE AND PAUL BERTANI



Not even a boil alert could help residents of Toledo, Ohio, when its mayor declared a water quality emergency in 2014. The message: Don't drink from the tap.

It was the moment when the issue of harmful algae blooms (HAB) pestering lakes and rivers across the Midwest became more than just dirty water headlines in the national news.

Electrical and Computer Engineering Professor **Wu Lu** said The Ohio State University entered into the scientific research of detecting HAB water toxins a bit late in the game – but they are making up for lost time.

"It became a serious issue," Lu said.

Seeing the writing on the wall, the Ohio Department of Higher Education (ODHE) began its HAB program after the Toledo water supply became contaminated. Lu's team applied for ODHE funding and received $100,000 via the Ohio Sea Grant Program. Ohio State earned a second line of funding by renewing a grant already in action through the National Sea Grant Program. Both grant programs are managed by the Ohio State Stone Laboratory.

The Ohio Environmental Protection Agency (EPA) put the problem out to scientists – current sensors used to detect harmful algae toxins are not accurate enough and must be more user-friendly out in the field.

Lu found a collaborator and laboratory space in Ohio State's College of Public Health, and got to work. Lu and his engineering students went on to earn media attention in 2017 after achieving something no other industry or university was able to do yet: create a simple, cheap, user-friendly and effective electronic device making it possible to test for specific toxins at a more precise level than the safety requirements set by both the EPA and the World Health Organization.

"Our technology is fast and much more sensitive and also highly-specific. It does not require sophisticated operation procedures or equipment. You don't need a microscope. It's just not feasible to take expensive equipment into a boat and do a field test," Lu said.

Ohio State Ph.D. student **Paul Bertani** was busy doing electroporation research in biomedical-related projects, when he decided to join Lu's team by fabricating devices to bring their research to life.

"He made very good progress on the devices he fabricated," Lu said.

Initially, he said, the first device they designed was intended to detect one contaminant.

"Now, we are developing sensors capable of detecting multiple agents – the four common toxins that are found in HAB. These will be sensors for the detection of these toxins, so they can be used in the field or in rivers, and also in the watershed and water factories," Lu said.

This summer the group conducted field tests in several water infrastructure facilities in central Ohio as well.

Ohio State also joined another program available through the National Ocean and Atmospheric Agency (NOAA), which has four water testing sites. One is on Long Island, another on Lake Erie, the third near San Francisco bay, and the last in Hawaii.

"We are going to have devices ready in July to field test in Lake Erie, working with Professor **Tim Davis** at Bowling Green State University. They are going to drive boats and we are going to bring sensors into the field, and maybe even the Maumee River – that's one that has serious issues," Lu said.

A new funding award through the National Science Foundation is seeking integrated devices for multi-toxin detection. This work began in August.

Bertani is specifically looking at how water toxins change at different pH levels.

Lu said no one really knows the binding connections of the toxins inside HAB. He is working to produce a theoretical model because NOAA is highly interested in this technology.

Out of 17 proposals accepted, Lu said, Ohio State is the only university involved. The other teams are all companies.

In terms of the electrical engineering involved, Bertani explained how there are typically two electrical contacts, and between the two is a current flow.

"When you put a solution containing some sort of charged particle on the surface, the top layer begins to collect used antibodies," he said. "What you do is take a sample of water or urine, containing all these particles and then put it into a reservoir to measure. It can take very small samples, but also adapt to larger areas. You put down a small level of that and you wait for the binding, and once you get a signal for it you can determine the concentration."

The presence of a toxin either makes the current increase or decrease, Bertani said, which is measurable. Rather than change color if it contains toxins, as some kits are designed, their devices measure electrical charge. He said this is actually more sensitive and accurate.

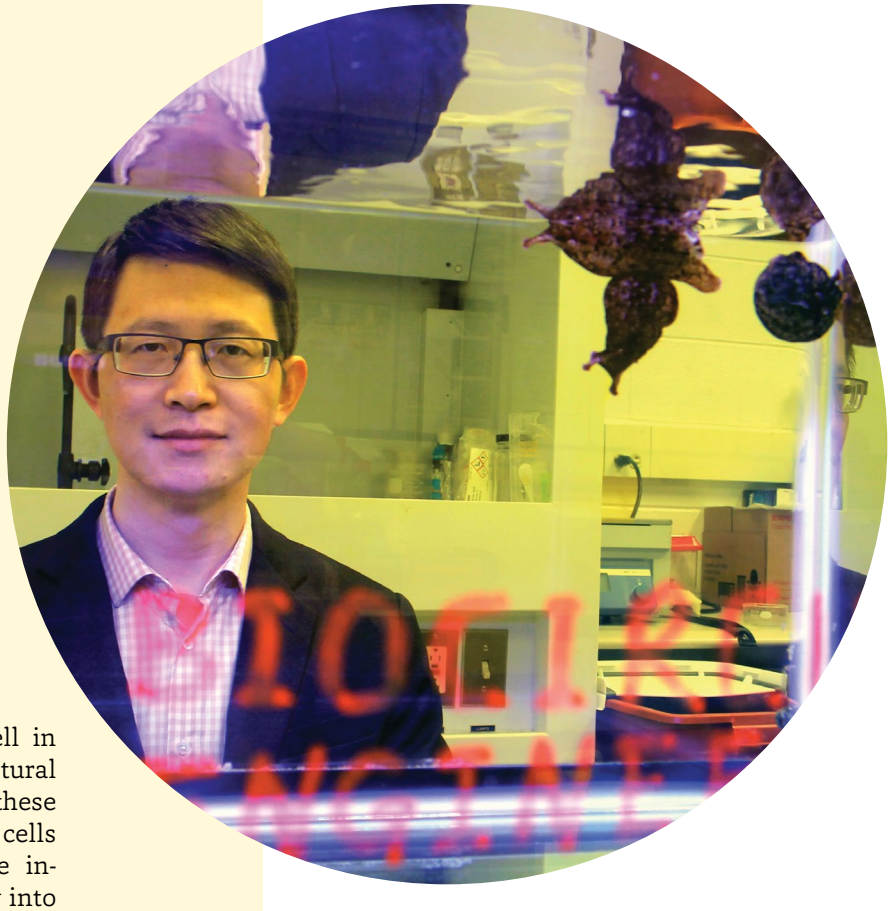
Yet another Ohio State HAB project deals with finding water toxins in biological tissues.

"They don't have viable technology for this yet. Say, for example, if the water is contaminated, the fish are also contaminated. People eat fish. Will the toxins be accumulated inside the body? Or, will they be flushed out? You want to see what is the impact. There is a need for sensors to detect toxins in body samples, urine samples and blood samples," Lu said.

Bertani said the toxin levels in humans might be much lower, but perhaps there is a correlation between the toxin levels in the water and the levels detected in people.

"That's the next step," he said. ■

GUO WINS NSF CAREER AWARD TO BOOST BIOCIRCUIT ENGINEERING



By Ryan Horns

Dr. **Liang Guo** has some interesting lab mates, not typically associated with electrical and computer engineers (ECE) at The Ohio State University.

Sea slugs move around slowly inside aquariums. Microscopes are hooked up to computers. Petri dishes hold specimens behind glass.

In the quest to find a cure for Parkinson's and other diseases, Guo is pioneering an entirely new pathway for neural implant science. He is at the forefront of what he calls biocircuit engineering.

The research recently earned him the coveted National Science Foundation (NSF) Faculty Early Career Development (CAREER) Award. It is given to support the work of the nation's most promising junior faculty who exemplify the role of teacher-scholars through the integration of outstanding research and excellent education.

Guo earned $500,000 over the next five years to advance his research proposal, "CAREER: Multicellular Biological Neural Pacemaker."

To describe biocircuit engineering, Guo explained how each cell in the body has a natural function. What if these specific-functioning cells are placed elsewhere inside the body to grow into nerves to assist a diseased organ, or to stimulate a neural pathway in the brain to help restore activity? Feasibly, he said, the cell could connect to a rat's skeletal muscle to pace the animal's muscle contractions and control breathing functions.

From there, he said, imagine implanting a cardiac pacemaker, grown from the patient's own cells, back inside the body where it can assist a diseased organ – powered simply by the natural flow of blood.

The concept is an innovative realm of research, which Guo hopes will cure neurological diseases.

"The best way is to learn from nature," he said. "In this process, we can learn how the neurobiological circuits are designed from living cells. Once we learn enough, we may be able to expand to artificial designs on those biological principles. That's my whole philosophy."

In one project tied to his biocircuit engineering program, Guo and his team are researching how simple sea slug cells might help create new circuits inside the body to cure neurological diseases.

"We understand this circuit very well. Cell by cell," he said about the sea slug cellular structure. "Can we isolate those cells and reconstruct the circuit in a culture dish? Furthermore, can we re-implant the constructed circuit back into the animal to see if it can substitute?"

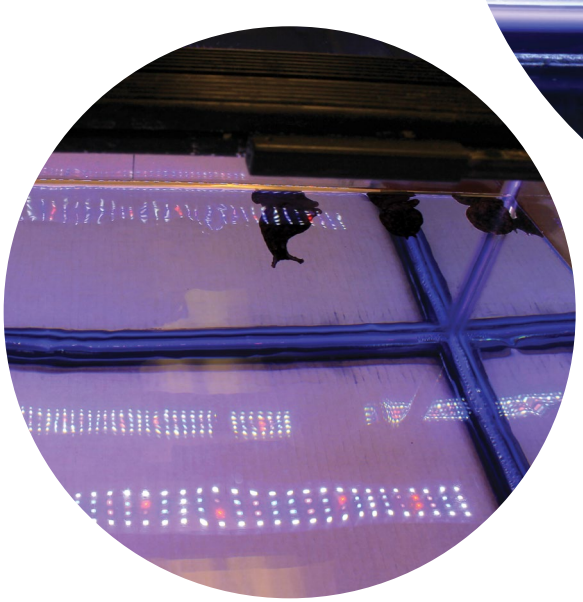
Student team member **Jordan Prox** said the opportunity to work with Guo is unique.

"When I was looking for research opportunities in neural engineering, I wanted to find a researcher who had ambitious ideas and was willing to take the risk to make them happen. Dr. Guo was just that when I met with him. His biocircuit approach is the type of project that I believe could have profound significance in developing the next generation of implantable bio-devices," Prox said, a graduate research associate and Biomedical Sciences Graduate Program student.

Fellow team member **Aaron Argall**, also a BSGP student and graduate research associate, said what initially drew his attention to Guo's work was the interdisciplinary nature of his research.

"Leveraging principles from electrical and tissue engineering to find solutions to neuroscience problems with a focus in neuroprosthetics, I found a unique niche that I could contribute to based upon my previous research ex-

Watch a video of Guo explaining his work in the lab:
http://go.osu.edu/guo-vid



periences," Argall said. "I knew from the beginning a lab solely using one field to answer a question wasn't what I wanted out of a Ph.D. It was with great joy that I came across Guo's research that seemed to coalesce my research interests."

Argall said he hopes to do transformative research to have a positive lasting impact on human health and disease.

"My current aspiration is to be a physician scientist studying neural regeneration, using a multifaceted approach going from bench to bedside," he said.

For NSF, Guo is looking at utilizing heart cells and neurons from rats to create an artificial neural stimulator in a petri dish.

"That's how this project was originally envisioned. But before we can test it in the brain, we need a much simpler model to demonstrate the functional feasibility. So, we chose a skeletal muscle as the testbed. In doing so, we will harvest the heart cell as a signal source. It will beat automatically," he said.

From there, the artificial circuit can target a skeletal muscle.

"But we need something in between as an interconnect. We know that skeletal muscle is connected by motor neurons. Our idea is, can we connect the heart cells to motor neurons and then allow the motor neurons to connect to the muscle," Guo said.

Powered by the heartbeat, the motor neurons cause the muscle to contract.

So how do they use this technique to help people? Is there any disease affecting respiration they could focus on?

Guo said they centered on curing chronic hypoventilation, which is caused by damage to the phrenic nerve in the diaphragm muscle. This leads to the inability of the respiratory musculature to exchange gases, resulting in excessive carbon dioxide and lack of oxygen to the tissues.

"Even if the muscle is intact, the patient cannot breathe. They will rely on a ventilation machine. They need to be tethered to the machine," Guo said. "Can we use this biological neural pacemaker, built by the patient's own cells? If we can harvest the patient's skin cells, convert them to induced pluripotent stem cells (iPSC), and then reconstruct them into either heart cells or motor neurons. Then, if we can create such a biocircuit using these iPSC-derived cells, and we connect our circuit to the distal terminal of the phrenic nerve, then our motor neurons will automatically grow into the diaphragm muscle. We have the possibility to pace the breathing at approximately 1 Hertz."

The studies right now are done in the lab, he said, just to show the possibility. The immediate goal is to see if they can pace a muscle in a culture dish.

"By the end of the project, we hope to have the skills and knowledge to advance to implantation studies," he said.

In some cases, Guo said, many universities are pursuing conventional electronic neural implant research toward treatments to neurological diseases. In the case of his team, they are entirely pioneering the emerging field of biocircuit neural implants.

The reason their work stands alone, he said, is the integrative scientific knowledge it requires.

"The challenge is people need a multi-disciplinary background. We are creating circuits, but we are not using conventional materials. It requires people with an electronics, or electrical engineering background, who can also work with biology," Guo said. "These types of scientists are rare in the field, which creates a technical barrier for people to jump in. We need people to develop these types of details. We are at the forefront of this emerging direction." ■

OHIO STATE SETS SPEED RECORD FOR UNMANNED AERIAL VEHICLE

By Ryan Horns

This summer, the Ohio State University Aerospace Research Center set a world speed record for an unmanned aerial vehicle (UAV) of any size.

In a path over Lake Erie, Ohio State's UAV flew autonomously with sustained average speeds of 147 mph over an out-and-back course approximately 28 miles long, which also set a record for the longest UAV flight over an out-and-back course.

Led by Ohio State Mechanical and Aerospace Engineering's Professor **Jim Gregory** and Research Scientist **Matt McCrink**, the university's team collaborated with industry partners Ligado for the satellite communications and with uAvionix for the ADS-B transponder.

Integral to the mission, Gregory said, was the involvement and advice from faculty and researchers in Ohio State's Department of Electrical and Computer Engineering and

"AVIATION RECORDS HAVE A RICH LEGACY GOING ALL THE WAY BACK TO THE WRIGHT BROTHERS, AND WE'RE BUILDING ON THAT TRADITION. WE'RE HOPING TO SPEARHEAD A COMPETITIVE TECHNOLOGY PUSH FOR HIGHER SPEED, LONGER RANGE, AND ENHANCED SAFETY FOR UAVS."

ElectroScience Laboratory (ESL).

"Our fundamental concern was maintaining the control link throughout the flight," Gregory said. "Testing in ESL's compact range provided data on the antenna radiation patterns, giving us confidence that this would work."

One of the largest radio frequency and optics research laboratories in the world, ESL conducts research in all aspects of electromagnetic and RF technologies, including satellite and ultra-wide-bandwidth communications, optics, remote sensing, ground penetrating radar systems, antenna engineering and more. Researchers are also pursuing a number of emerging areas, such as those related to bioelectromagnetics, metamaterials, polymers and packaging, micro-device modeling and multi-physics engineering.

The Ohio State-designed jet UAV is uniquely equipped to handle this mission, with a custom-built flight controller, long-range fuel tanks, redundant radio control links, control via satellite communications link, and ADS-B in/out transponder technology for avoiding collisions with other aircraft.

The record flight occurred on Wednesday, August 30, 2017 from Kelleys Island Airport, Kelleys Island, Ohio, with the course extending to the east over Lake Erie. The Ohio State team of engineers overcame technical challenges such as fuel limits for the 17-minute flight, radio range for maintaining positive vehicle control, and collision avoidance. The 70-pound autonomous jet aircraft opens up new capabilities for applications such as rapid package delivery or search-and-rescue, where both high speed and long range are mission critical.

"Setting a world speed record is a fantastic way to push technology forward," Gregory said. "Aviation records have a rich legacy going all the way back to the Wright brothers, and we're building on that tradition. We're hoping to spearhead a competitive technology push for higher speed, longer range, and enhanced safety for UAVs."

The official record was certified by the National Aeronautic Association (NAA) and by the Fédération Aéronautique Internationale (FAI). An official observer representing the NAA was present for take-off and landing.

The Ohio/Indiana UAS Center was instrumental in supporting the record attempt by coordinating FAA approval through a Certificate of Authorization/Waiver (COA). This lengthy process involved many safety reviews of the airspace, operating procedures, vehicle systems, chase plane operation and contingency planning. An effective collaboration with the test center and the FAA resulted in a safe record-setting flight.

Ohio State is a world-leader in the area of UAV technology and policy. Over 40 faculty are actively involved in research related to UAVs, spanning the domains of all-weather operations (robust flight in wind gusts and icing), flight testing, human factors, control link security, precision agriculture, regulatory policy, navigation system performance, vehicle control and networked operations. Ohio State also is a core member of the FAA ASSURE Center of Excellence, with a research focus to enable safe and efficient integration of UAVs into the National Airspace System.

In 2014, Ohio State and Sinclair Community College formed a partnership to prepare students for careers in the unmanned aircraft systems industry, which is expected to grow to $100 billion by 2025. There are now pathways from existing Sinclair Unmanned Aerial Systems (UAS) certificate and associate degree programs into Ohio State data analytics and geospatial precision agriculture programs. Last year the partners acquired FAA COA to operate UAS at The Ohio State University Airport in northwest Columbus. ■

OHIO STATE'S FIRST SATELLITE LAUNCH SUCCESSFUL

CubeRRT

By Ryan Horns

Its name may playfully give homage to a 1980s video arcade game, but the technology on board The Ohio State University's first satellite, CubeRRT, could be vital for Earth science missions into the future. The launch to the Imternational Space Station was successful on May 21 at 4:39 a.m. and it was later deployed into orbit on July 13.

Project leader, **Joel Johnson**, professor and chair of electrical and computer engineering (ECE) at Ohio State, said the CubeSat Radiometer Radio Frequency Interference Technology Validation mission (CubeRRT) contains advanced sensors for observing Earth's environment from space.

The Ohio State team named the CubeRRT satellite after "Q*bert," one of the most popular video arcade games of the 1980s.

The technology on board is designed to solve a major problem for researchers by breaking through noisy radio transmissions that can interfere with efforts to detect from space what's happening on Earth.

Johnson explained how Earth emits natural microwave frequencies, which scientists study with sensors called radiometers. The data from these sensors helps determine soil moisture, sea temperature, sea ice coverage, weather, and much more.

Meanwhile, humans are busy making a racket on Earth.

As the need for wireless services worldwide continues to increase, Johnson said, the growth of manmade radio transmissions is making it increasingly difficult to detect Earth's natural microwave radiation. This influx is called radio frequency interference, or RFI.

"The problem is only getting worse over time," Johnson said. "The spectrum is getting more and more crowded, due to the continued rapid growth in demand for wireless services."

The team has high hopes for this new radiometer technology. There are multiple radiometers without RFI filtering capabilities observing Earth right now, Johnson said, measuring weather and gathering data for oceanographers and atmospheric science.

"(Existing radiometers) suffer very much from RFI and in many cases they can't correct for it very well. They can get swamped by the man-made transmissions," he said. "CubeRRT is a mi-crowave radiometer that has a greatly improved processor to get rid of the RFI. The goal is to demonstrate this processor so future satellites can use it. The success of CubeRRT in space will demonstrate a new processing technology that will be very valuable."

Soon, Johnson said, every Earth observing radiometer may require special processors to separate the RFI signals from the environmen-tal data scientists need. His team specializes in such processors.

CubeRRT launched out of NASA's Wallops Flight Facility in Wallops Island, Virginia, to in-tegrate into a CubeSat deployer, the mechanical assembly sent to the International Space Sta-tion on a resupply mission, which ultimately set the satellite into orbit over the summer.

At the ElectroScience Laboratory (ESL), Ohio State leads the CubeRRT project, in collabora-

tion with team members from NASA Goddard Space Flight Center in Maryland, NASA Jet Propulsion Laboratory in California and Blue Canyon Technologies in Colorado, which provided the CubeRRT spacecraft with solar power, communication, guidance and navigation systems. Ohio State ECE Research Associate Professor **Chi-Chih Chen** also developed an innovative antenna design for the radiometer.

One Earth-observing radiometer currently in orbit on NASA's Soil Moisture Active Passive (SMAP) satellite serves as an example of how an RFI processor can provide better performance.

Days before Hurricane Matthew struck in 2016, Ohio State researchers used satellite maps of soil moisture to help forecast where power would go out along the East Coast.

Steven Quiring, professor of atmospheric sciences in the Department of Geography at Ohio State, said their results were 91 percent accurate – predicting 4.5 million people would be without power in Georgia, North Carolina, South Carolina and Virginia.

Quiring said their work was possible because of data from the SMAP satellite mission and its radiometer RFI processing technology. He was able to cross reference SMAP data with population density, land use, average wind speed and the duration and intensity of storms to make their forecast model.

"Many of our team members worked together on the RFI processor used in the SMAP mission," Johnson said, "The CubeRRT RFI processor greatly expands capabilities and enables operations in higher frequency bands than were used in SMAP."

Ohio State ECE research associate engineer **Christa McKelvey** said the CubeRRT radiometer operates with a bandwidth 50 times greater than that of SMAP. Its processor is able to remove RFI for signals at a 1 gigagertz bandwidth, well above the possibilities within the 20 megahertz used in the SMAP processor.

Research Scientist **Chris Ball**, also at Ohio State ECE, said CubeRRT will remain active in orbit for approximately one year, providing valuable data during its lifetime to demonstrate the validity of their technology.

Deployed from the International Space Station at 400 kilometers above Earth, the satellite will eventually burn up as the orbit diminishes during reentry.

A test mission on a smaller scale like this is a good idea, Ball said.

"Satellites are expensive," he said, "and it is important to ensure new technologies have been validated in space before their large scale deployment."

Ball also described how CubeRRT is able to collect and process data onboard the satellite – as opposed to sending the information down to the ground for scientists to decipher, the method used for processing SMAP.

"Doing RFI processing on board the spacecraft is a major game changer," Ball said. "CubeRRT collects a lot of raw data to improve RFI removal, more data than there is the capacity to send down for processing on the ground. Only by processing on board the spacecraft can we make this work."

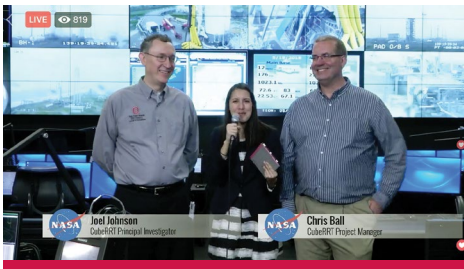
The CubeRRT project is funded through NASA's Earth Science Technology Office (ESTO). Space access is provided by NASA's CubeSat Launch initiative, which helps make satellite research more accessible to scientists by providing lower-cost pathways to space. CubeRRT's RFI processor was installed on a CubeSat, which is approximately the size of a shoebox.

For the Ohio State team, being able to see their scientific goals achieved is a professional milestone.

"This is my first space-focused project," Ball said.

McKelvey performed previous satellite development at Northrop Grumman, but never got the chance to see it function in orbit.

"Large satellite projects require a much longer process, at least 10 years, and I left the company before I was able to see my project launch," she said. ■



Watch a short video of the CubeRRT team explaining their work: **https://go.osu.edu/cuberrtvid**

WORLD'S LARGEST **DRIVERLESS VEHICLE TESTING CENTER** COMING TO OHIO

A new state-of-the-art testing ground for autonomous and connected vehicles is one step closer to reality.

By Chris Booker, assistant director of media relations

Gov. **John Kasich** joined leaders from The Ohio State University, the Ohio Department of Transportation, JobsOhio and other organizations to break ground on the Transportation Research Center's new SMART Center this summer in East Liberty.

The 540-acre vehicle testing area will be the largest facility of its kind in North America, offering year-round testing in all weather conditions. The first portion of the proving ground is expected to open later this year.

"What this is going to do is give people the opportunity all over the world to be going 24/7, to test in all conditions and to have multiple cars on the road," Kasich said. "This is going to be the coolest place to go with your kids."

Last year, Kasich joined President **Michael V. Drake** to announce a $45 million investment in TRC to build the new SMART Center. The College of Engineering has committed $24 million over five years to hire faculty and staff to support research into autonomous vehicle technology.

Ohio State Interim Senior Vice President for Research **Randy Moses** said the new center will be a boon to students and faculty in fields from engineering to computer science.

"All of the students that will be out here will get a hands-on-experience and learning opportunities that are really unprecedented," Moses said. "With smart vehicles, it's not just about mechanical engineering anymore, it's electrical engineering, it's sensing, it's the network. It is also communications and the social aspects of the human-machine interface. And so this allows teams much broader than in any college or discipline who can come together and work on these kinds of problems."

The SMART Center comes as TRC is experiencing a record year in terms of the number of clients who use the facility. TRC President and CEO **Brett Roubinek** expects the trend to continue.

"The SMART Center will accelerate that growth and continue to create further jobs," he said.

The SMART Center will also connect to the U.S. Route 33 Smart Mobility Corridor, a 35-mile stretch that will be one of the "smartest" highways in the country. The Ohio Department of Transportation is equipping the four-lane, divided highway with fiber-optic cable and wireless roadside sensors to allow open-road testing of autonomous and connected vehicles. ■

NEW HORIZONS WAKES UP FOR ITS NEXT HISTORIC JOURNEY

By Ryan Horns

WHEN NASA'S NEW HORIZONS SPACECRAFT PHOTOGRAPHED THE CLOSEST PHOTOS OF PLUTO IN HISTORY, TECHNOLOGY FROM THE OHIO STATE UNIVERSITY WAS ON BOARD MAKING IT POSSIBLE.

After this stunning performance of science in July 2015, New Horizons then went into communication hibernation, as it traveled thousands of miles per hour in radio silence.

Word from NASA this year, however, reported New Horizons awoke to prepare for its historic New Year's Day flyby at the edge of the Milky Way.

Over a decade ago, Ohio State ElectroScience Lab engineers began assisting Johns Hopkins University/ Applied Physics Laboratory (APL) engineer and alumnus **Ron Schulze**. Together, they worked to test and calibrate his high gain dish antenna design for the New Horizons probe. It remains one of seven instruments currently collecting data from space.

Antennas provide focused and narrow radio wave beam widths, allowing for more precise targeting of radio signals.

From 1989 to 1991 Schulze earned his master's degree at Ohio State, studying under the academic guidance of former ESL director Dr. **Walter Dennis Burnside**. Still employed with APL today, Schulze said the project remains a highlight of his career.

"I was introduced to the art of antenna measurements and design," Schulze said.

After graduation, he became lead engineer at APL for the New Horizons antenna system in support of NASA's mission to Pluto. The project pointed him right back to Ohio State.

At ESL, Schulze worked for months with Ohio State staff, primarily Dr. **Willie Theunissen**, now employed by Facebook.

For the scientific community, the New Horizons probe remains an achievement in engineering that has already graced the cover of countless tech magazines, as well as National Geographic. For those involved in the creation of the probe, it's been a time of long-anticipated celebrations.

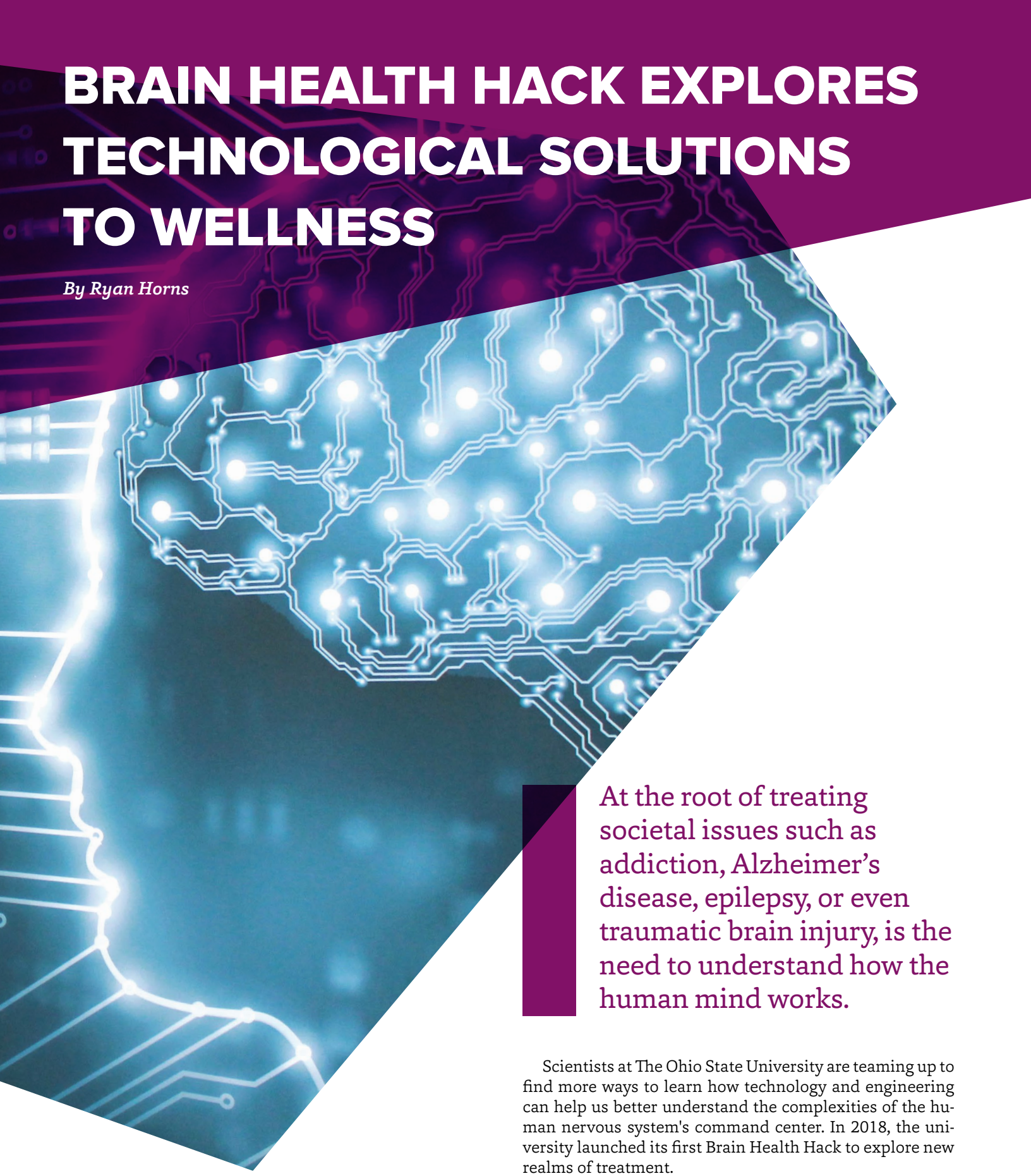
The New Horizons probe has been in hibernation mode since Dec. 21 to preserve resources. On June 5, however, the mission operations team at Johns Hopkins Applied Physics Laboratory received confirmation, through NASA's Deep Space Network, that the spacecraft had exited hibernation, as it was programmed to do.

The spacecraft will now begin preparations for an encounter with the farthest planetary boundaries in history.

The spacecraft is currently traveling more than 3.7 billion miles (6 billion kilometers) away from Earth through the icy band of debris surrounding the solar system beyond Neptune called the Kuiper Belt. It will spend the upcoming months preparing for its encounter with a small Kuiper Belt object, nicknamed Ultima Thule on Jan. 1, 2019. New Horizons is just the fifth spacecraft to speed beyond the outer planets, toward a close encounter. one billion miles beyond the Pluto system – which New Horizons famously explored in July 2015. ■

BRAIN HEALTH HACK EXPLORES TECHNOLOGICAL SOLUTIONS TO WELLNESS

By Ryan Horns



At the root of treating societal issues such as addiction, Alzheimer's disease, epilepsy, or even traumatic brain injury, is the need to understand how the human mind works.

Scientists at The Ohio State University are teaming up to find more ways to learn how technology and engineering can help us better understand the complexities of the human nervous system's command center. In 2018, the university launched its first Brain Health Hack to explore new realms of treatment.

On board as mentors were electrical and computer engineering faculty members **Liang Guo**, **Kevin Passino** and **Emre Ertin**.

Hackathons typically team up students and/or facul-

Watch a video of the 2018 Brain Health Hack recap:
https://go.osu.edu/brainhack18

ty of multi-disciplinary scientific minds, with the goal of solving societal issues and creating new technology to address them – typically, in one or two manic days of sleepless work.

In this case, however, participants are encouraged to go home and sleep at the end of each day. As co-organizer **Jessica Buskirk** lightheartedly pointed out, "Manic days of sleepless work does not equal brain health."

Buskirk is the director of operations at the Stanley D. and Joan H. Ross Center for Brain Health and Performance, which collaborated on the concept launched by the Chronic Brain Injury (CBI) program. CBI is one arm of the ongoing Discovery Themes Initiative at Ohio State, bringing together funding, faculty and strategy to solve worldwide issues. Members further cooperated with faculty at the university's Neuroscience Research Institute.

Kedar Hiremath, program director for CBI, said there are multiple innovation models on campus he drew inspiration from, like the MakeOHI/O student hackathons or the student-industry INNOVATE-O-thons led by the Institute for Materials Research.

Having a hackathon geared toward addressing brain health posed a unique opportunity, he said.

"It allowed us to take students from different backgrounds and have them work together," Hiremath said. "Especially in neurotechnology development."

In the end, a total of 35 students took part in nine teams, guided by 13 judges and two mentors. Their goal was to focus on solving three sponsored challenges within Ohio State programs. The three winning teams had their projects recognized at the 2018 Brain Health and Performance Summit.

In another bonus, Hiremath said, some students even joined university research groups to further their knowledge and continue to support faculty.

Marcie Bockbrader, Physical Medicine and Rehabilitation assistant professor and physician in the College of Medicine, got involved in the hackathon discussions early.

"We were thinking about different ways to use technology to improve our interventions with patients for health and wellness," she said.

One emerging form of research in this realm, she said, is virtual and augmented reality.

"Ways to help patients improve their stress, to decrease the need for opioids for pain reduction. Ways that we can transition care from the hospital setting into the home setting," Bockbrader said. "Just using technology to improve the patient's mindset. That led us to think: Hey wouldn't it be great if we got some of our young, bright minds at Ohio State to help us put together some novel apps that we could maybe try out?"

Smit Patel, an Ohio State College of Pharmacy Professions student who took part in the hack, said the traditional focus is on prescription drugs. His group was trying to

emphasize patient emotional care.

"Does the patient feel good? Does the patient feel alive? We wanted to bring that empowerment feeling, and that happy feeling, into the patient," he said.

Hiremath said the student response from the hackathon was overwhelmingly positive.

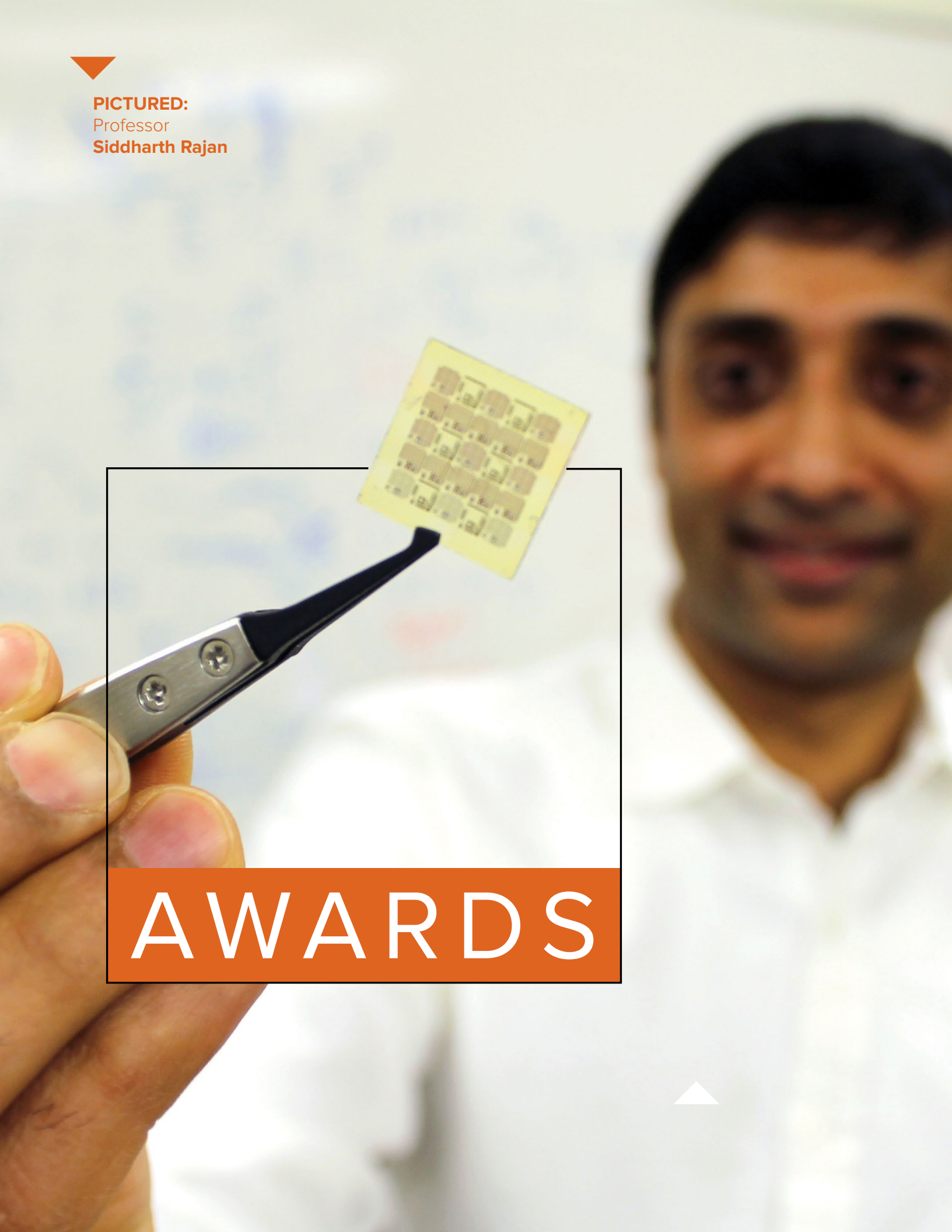
"Our next step is to help the students learn about commercialization of their work," Hiremath said. "Next year, we hope to have more industry sponsors, and perhaps to do this semiannually instead of annually."

The 2019 Brain Health and Performance Summit is scheduled for June 5 to 7. ■

“BREAKING BARRIERS IS VALUABLE. OHIO STATE IS A PERFECT GROUND TO START.”

ECE Ph.D. student

Hugo Gonzalez Villasanti



PICTURED:
Professor
Siddharth Rajan

AWARDS

OHIO STATE SWEEPS NATIONAL ECOCAR 3 COMPETITION

Showcasing the high caliber of Buckeye student research, EcoCAR 3 at The Ohio State University took first place in the final year of the Advanced Vehicle Technology Competition, sponsored by the U.S. Department of Energy and General Motors Co. This is the fourth consecutive win for the Buckeyes.

Although the team is populated primarily by Ohio State Mechanical Engineering (ME) students, many of its leadership roles are filled by Electrical and Computer Engineering (ECE) majors as well.

Each student involved said the experience has already helped catapult their career goals toward graduation.

EcoCAR 3 is a four-year collegiate automotive engineering competition that challenges 16 North American universities to redesign a 2016 Chevrolet Camaro to further reduce its environmental impact while maintaining the iconic Camaro performance and safety.

In addition to the coveted first place trophy and bragging rights, the team also took home $33,000 to further support the university's advanced vehicle technology program.

ECE student **Evan Stoddart** served as EcoCAR 3 Advanced Driver Assistance System (ADAS) team leader this year. A Graduate Research Assistant at the Center for Automotive Research at Ohio State, he said being on the team inspired his confidence and leadership skills toward completing long-term engineering projects. He

"EcoCAR3 is a great program that fosters future generations of automotive engineers and business people, encouraging them to become true innovators,"

knows it will help his job hunt going forward.

"EcoCAR will have a tremendous impact on my future career," he said. "I learned how to manage a large multidisciplinary project before graduating from school, which is a great talking point in interviews. EcoCAR has given me years of experience before I even accept my first job."

Stoddart initially joined the team because he was interested in learning more about cars and working with his hands. It turned into a whole new path for him, educationally.

"This project has advanced my skill set with computers and sensors and helped me realize what I want to do in industry," he said.

Ohio State's crew won 18 awards, including the NSF Diversity, Inclusion and Equity Award, the NSF Outstanding Advisor Award (team faculty advisor **Shawn Midlam-Mohler**) and the first place NSF Innovation Award.

Individual team members also earned awards, including electrical team lead **Kerri Loyd**, an ECE student, who received the General Motors Women in Engineering "Rookie Award." Given out every year to an undergraduate student in the competition showing exceptional potential in engineering leadership, Lloyd said she was very proud of the win.

In addition to sweeping all four years of EcoCAR 3, in 2014 the Buckeyes also captured top honors in the final year of the EcoCAR 2: Plugging In To The Future competition.

"EcoCAR3 is a great program that fosters future generations of automotive engineers and business people, encouraging them to become true innovators," **Ken Morris** said, General Motors vice president of Global Product Programs. "This year's winners—and all the teams—are proof of that. It's a competition that GM is proud to support."

West Virginia University and the University of Alabama took second and third place in the competition, respectively.

The Ohio State EcoCAR sponsors include Parker-Hannifin, Cooper Tires, Clean Fuels Ohio, Transportation Research Center, TE Connectivity, Johnson Controls, Parker, Tremec, Ford, Honda, 3dparts.com and Modern Driveline.

The EcoCAR 3 competition is sponsored by the U.S. Department of Energy and General Motors.

Additional sponsors include MathWorks; National Science Foundation; California Air Resources Board; NXP; AVL Powertrain Engineering; the Bosch Group; ETAS; PACCAR; dSpace, Inc.; Snap-on Tools; Siemens PLM Software; GKN Driveline; Transportation Research Center; HORIBA; DENSO; Champlain Cable; Woodward; Proterra; Ricardo; Mentor Automotive; New Eagle; Gage Products; Tesa Tape; Vector CANtech, Inc.; Delphi Foundation; EcoMotors; Electric Power Research Institute, Inc.; A123 Systems; Flextronics; and Samsung, SDI.

Story contributions by Allison Mellor, Ohio State EcoCAR team co-communications manager and Ryan Horns, ECE/IMR Communications Specialist ■

STEVE RINGEL

Steve Ringel is rarely at a loss for words.

An Electrical and Computer Engineering (ECE) faculty member for the past 27 years, Ringel found himself uncharacteristically taken aback, while surrounded by his colleagues and family in a Dreese Laboratories lecture room on a Monday morning. He was named a 2018 Distinguished University Professor in recognition of his exceptional record in teaching, research, and scholarly work at The Ohio State University.

Ringel serves as ECE's Neal A. Smith Professor, Associate Vice President for Research in the Office of Research, and is the Executive Director of the Institute for Materials Research (IMR). The Office of Academic Affairs announced the award during a surprise presentation.

"It is a tremendous honor for the college to have the Distinguished University Professor award within the college and, again, joining a very small and elite group of faculty," said **David Williams**, dean of the College of Engineering. "What you do for the college and the university is just extraordinary, and in the various leadership roles that you play in IMR and within the Discovery Themes, so it really has been — despite all I ever say about you — a tremendous pleasure to work with Steve and to build on the great things that he is doing. The college is truly proud."

Joining Williams in the recognition — as well as the occasional, light-hearted ribbing — were several colleagues including **Randy Moses**, interim senior vice president for research and ECE professor; **Joel Johnson**, chair of the ECE department; and award presenter **Bruce McPheron**, who serves as the Ohio State executive vice president and provost.

"The Distinguished University Professor is the highest honor we award to faculty members, here," McPheron said. "It is a reflection of sustained and excellent contribution to teaching, to the scholarship of research and creative expression, to service of the university, and a very rigorous analysis of dossiers of accomplishment before these decisions are made."

Ringel joins a small group of only 57 awardees in receiving the honor throughout Ohio State history. He was accompanied at the surprise announcement in Dreese Lab lecture room by colleagues, current and former undergraduate and postdoctoral students, his brother Matt, son Brett, and wife Geneva.

"In no way does this happen with one person," Ringel said. "This is really quite a shared honor."

Faculty nominations are typically submitted by department chairs to college deans. Ringel was nominated for this year's honor by Johnson, ECE chair.

"I'm very happy to see Steve recognized by Ohio State as Distinguished University Professor," Johnson said. "His contributions to the Department, College, and University have been outstanding, and his leadership of the Institute for Materials Research and the Material and Manufacturing for Sustainability Discovery Theme have had a transformative impact on materials research at Ohio State."

Ringel's research interests include electronic materials and devices based on compound semiconductors with applications in photovoltaics, integrated electronic-optoelectronics, RF and power devices, and energy harvesting. He also investigates epitaxial growth strategies for compound semiconductor-Si integration, as well as wide-bandgap semiconductors and devices, and advanced defect characterization methods. Ringel also studies global innovation, and translational research between academia and industry.

Ringel is the author or co-author of more than 150 journal articles. He has participated in more than 260 conference proceedings and presentations, and was invited to speak at about 150 lectures and colloquia at international conferences and professional organization throughout North America, Europe and Asia. He served as an editor of three books, was invited to contribute to four book chapters, and has filed three patents, with two issued. ■

Article by Mike Huson

Watch a short video of the award presentation in Dreese: http://go.osu.edu/ringel-vid

KEVIN PASSINO

In a surprise ceremony in front of his students and colleagues, Electrical and Computer Engineering Professor **Kevin Passino** became one of The Ohio State University's newest 2018 Distinguished Scholars.

Passino is a world leader in the field of intelligent control, and is respected at the university for his work as director of the Humanitarian Engineering Center.

Behind every great scientist, of course, is a person. As Passino's wife and son walked in, fresh from the airport, his surprise was evident.

"I want to thank everyone for coming. I'm not good at public speaking, although I do it every day. Especially if it has to come from the heart," he said, then laughed "I could do the math. If you want me to write the math down about how I feel, I can do that. I get emotional, is my problem. I love you all. I love this place. Go Bucks."

Only six professors at the university are chosen each year for the award, said **Bruce McPheron**, executive vice president and provost at Ohio State.

"We have thousands of faculty eligible for this recognition. This is a senior professor who has a sustained accomplishment in the scholarship of their research. This is truly a big deal," he said.

Jan Weisenberger, senior asso-ciate vice president of the Office of Research, said Passino's talent rose to the top this year.

"Kevin is one of our truly creative, truly interdisciplinary and multi-dis-ciplinary scientists," she said. "Your work in biomimicry and the way you can apply the principles of biological systems to engineering problems is really fascinating – especially swarm cognition. What are bees really thinking about when they are out there swarming?"

Weisenberger said Passino has a unique way of collaborating.

"Kevin came on my radar when I saw a proposal for another grant competition we had in the university, that emphasizes the intersection of technology and human affairs. This one caught my eye because it was a collaboration with a faculty member in social work," she said. "He's not in some tiny, little, focused area. He's really looking for the connections between fields. We knew there was something special there and I am so delighted everyone in your field similarly thinks there is something special here." ■

Article by Ryan Horns

Watch a short video of Passino receiving the award and his comments: http://go.osu.edu/passino-vid

NSF AWARDS $675,000 TO ADVANCE OHIO STATE TERAHERTZ RESEARCH

By Ryan Horns

Between the infrared and microwave sections of the electromagnetic spectrum lies the terahertz window, a largely untapped portion of energy, with the potential to reveal a huge variety of unknowns – from people carrying hidden weapons, to the thickness of paint, and next-generation Alzheimer's disease diagnosis.

ElectroScience Laboratory faculty at The Ohio State University recently earned a total of $675,000 in research and commercialization support from the National Science Foundation (NSF) to further its terahertz sensor development.

Electrical and Computer Engineering (ECE) Professor **Kubilay Sertel** won a three-year $450,000 NSF grant with his related research proposal, "Compact Polarimetric THz Sensor for Reflectometric Imaging." The grant comes via the NSF Division of Electrical, Communication and Cyber Systems.

Sertel's commercialization efforts also received the NSF Small Business Innovation Research grant for $225,000, in order to develop automated and noninvasive testing of high frequency integrated circuits, spearheaded by his startup, TeraProbes, Inc.

Sertel said the NSF funding will help his team advance polarimetric Terahertz-frequency next-generation imaging by developing a compact and portable sensor for studying brain tissue, ultimately demonstrating an alternative imaging modality for the early detection of Alzheimer's disease.

Terahertz sensors could expose a vast number of hidden secrets in imaging.

Sertel's team previously worked to validate the need for such a polarimetric sensor through the work of ESL Graduate Research Associate **Nandhini Srinivasan**, whose proposal won third-place at the 2017 IEEE APS/URSI San Diego Symposium Student Paper Contest.

Joining Sertel on this team is Ohio State Research Assistant Professor **Niru Nahar** and former Ohio State Pathology Professor **Norman Lehman**, now at the University of Louisville, where he will continue his collaboration.

The research proposal further details the technological advancements planned for the NSF funding.

"The fully-polarimetric THz sensor and the associated THz-spectroscopic polarimetry tools proposed here will usher in new sensing and imaging applications in the much-needed areas of biomedical sensing, chemical spectroscopy and pharmaceutical evaluation, to name a few," the abstract explains.

Once it is fully developed, Sertel said, an entirely new modality for THz spectroscopy and imaging is possible, for the first time, by harnessing the polarization properties of THz waves. The proposed work creates a laboratory-scale spectroscopy tool, readily incorporated into the academic curriculum, providing a hands-on experimentation and training testbed to inspire students toward an education in STEM fields.

Meanwhile, the NSF Small Business Innovation Research grant is scheduled to assist Sertel's commercialization activity for TeraProbes, as it seeks to transform the current electronics chip testing industry,

opening up new research areas and offering an immediate benefit to the entire semiconductor industry.

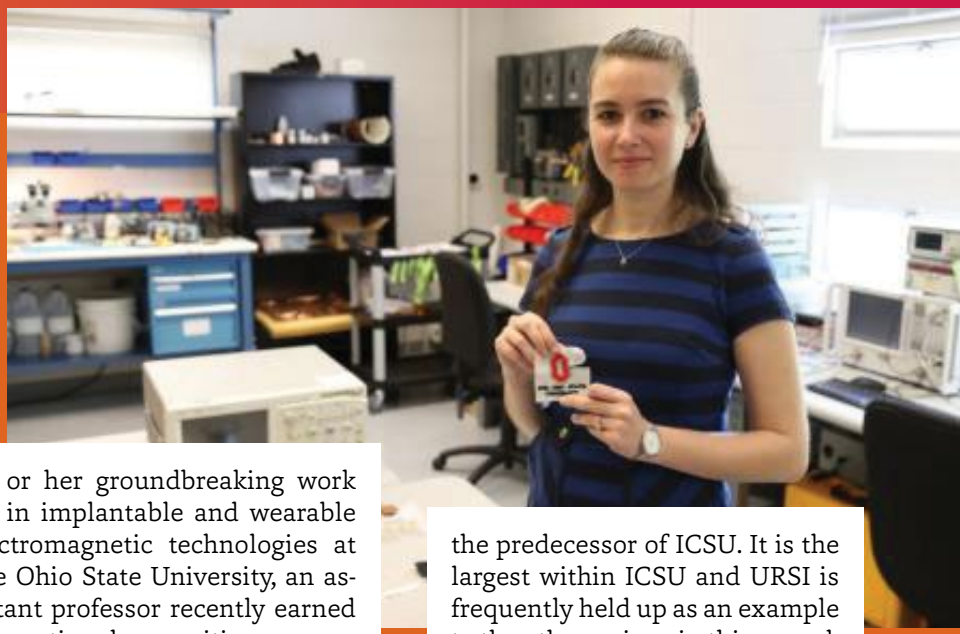
The first phase of NSF funding for TeraProbes, Sertel said, includes the creation of a Business Development Commercialization Strategy, as well as research to create the fully-automated version of the TeraProbes' non-contact probe station.

TeraProbes fabricated three probe stations through a seed grant from the State of Ohio Department of Development. These units were transferred to other universities, such as Arizona State University and are on loan to the National Institute of Standards and Technology, in Boulder, Colorado

The NSF SBIR funding also enables TeraProbes to hire two new team members, and work with processional design engineering teams at Ohio State's Center for Design and Manufacturing Excellence (CDME) – a manufacturing, engineering, and commercialization center at the Ohio State, led by former business leaders and entrepreneurs. ■

To learn more about the NSF SBIR/STTR program, visit: www.nsf.gov/SBIR

KIOURTI WINS URSI YOUNG SCIENTIST AWARD



For her groundbreaking work in implantable and wearable electromagnetic technologies at The Ohio State University, an assistant professor recently earned international recognition.

Asimina Kiourti, electrical and computer engineering (ECE), received the coveted International Union of Radio Science (URSI) Young Scientist Award at the 2018 Atlantic Radio Science Meeting held in Gran Canaria, Spain, May 28 to June 1.

"I am very excited about this award, particularly because it comes from URSI's Commission on 'Electromagnetics in Biology and Medicine,' an interdisciplinary area that my group is extensively working on," Kiourti said.

The Young Scientist Awards recognize an international group of individuals making innovative contributions and discoveries in multidiscipline research related to electromagnetic fields and waves. The award supports travel grants and gathers together some of the most promising scientists between the ages of 25 to 35.

Within the International Council for Science (ICSU), made up of 26 international singular-discipline scientific unions, URSI is one of the very few multidisciplinary unions. Formed in 1919, it was also one of the first four original scientific unions as part of the International Research Council, the predecessor of ICSU. It is the largest within ICSU and URSI is frequently held up as an example to the other unions in this regard.

Kiourti leads the Wearable Implantable Technologies group (WIT) at Ohio State's Electro-Science Lab. WIT conducts inter-disciplinary research at the intersection of electromagnetics, antennas, sensors and medicine. The work explores cutting-edge solutions for ubiquitous wearables and wireless implants to monitor a number of bodily functions and vitals. Among some of its research projects, are flexible E-textile electronics, batteryless and wireless brain implants, bio-magnetic detection of injuries and more.

Kiourti joined Ohio State as an ECE assistant professor in Fall 2016. From 2013 to 2016 she served as a post-doctoral researcher and then a senior research associate at ESL. Prior to that, she received her Ph.D. in Electrical and Computer Engineering from the National Technical University of Athens, Greece (2013) and her master's degree from University College London, UK (2009). Her research interests include wearable and implantable sensors, antennas and electromagnetics for body area applications, and flexible textile-based electronics. ■

ECE DUO WINS HARRISON FACULTY AWARD FOR EXCELLENCE

For the first time, two faculty in the College of Engineering at The Ohio State University received the Harrison Faculty Award for Excellence in Engineering Education.

The winners, Associate Professor **Siddharth Rajan** and Professor **Roberto Myers**, are both faculty in electrical and computer engineering (ECE) and materials science and engineering (MSE) within the Institute for Materials Research at Ohio State.

Established in 1982, this is the first time the annual Harrison Award was presented to two recipients. Winners are faculty members in engineering or architecture, making a positive impact on society, and showing excellence in aspects of teaching, fundamental or applied research.

Research by Myers and Rajan is becoming increasingly acknowledged for their focus on finding next-generation energy sources at the nanoscale level.

Rajan is principal investigator for the Rajan Group at the Electron Device Laboratory at Ohio State. He works with students in the creation of new devices with improved performance and functionality. The team produces several publications a year, often winning awards for research into tunnel-injected UV's LEDs, delta-doped transistors and more.

Ph.D. candidate **Yuewei Zhang** said, as a mentor, Rajan is open-minded and always interested in discussing and discovering new methods within ECE.

Aside from making strides in semiconductor technology, Rajan recently earned funding from the Department of Defense (DoD) to accelerate important research and training of graduate students as part of a Multidisciplinary University Research Initiative (MURI) award.

Rajan earned his Ph.D. in 2006 from the University of California – Santa Barbara. His areas of interest include nanoscale semiconductor devices, molecular beam epitaxy, and III-nitride semiconductors.

Myers created and leads The Myers Group at Ohio State, which focuses on molecular beam epitaxy of wide band gap semiconductors, particularly polarization-engineered nanowire LEDs, as well as materials for thermal spintronics.

The professor is the principal investigator of a five-year $6 million Department of Defense funded MURI aimed at understanding the mechanisms behind spin caloritronic effects, or electrical currents in which heat flow causes a flow of spins. His group also conducts research through the Center for Emergent Materials focused on engineering non-linear spin fluxes in magnetic materials. ■

SAHIN WINS IEEE AP-S DOCTORAL RESEARCH GRANT

A graduate student at The Ohio State University won grant funding to continue her research into electromagnetics and next-generation wireless communications.

Research Associate **Seckin Sahin**, who works primarily out of the ElectroScience Laboratory (ESL) at Ohio State, won an IEEE Antennas and Propagation Society Doctoral Research Grant.

The IEEE Antennas and Propagation Society (AP-S) awards up to six $1,500 pre-doctoral grants and up to 10 $2,500 doctoral grants each year to encourage students to pursue careers in electromagnetics.

Sahin came to Ohio State from Izmir, Turkey. She received her undergraduate degree in electrical and electronics engineering from Bilkent University, Ankara, Turkey in 2013 and went on to earn her master's degree in electrical and computer engineering (ECE) at Ohio State this year. She stayed on and is now pursuing her Ph.D. in ECE.

IEEE officials said Sahin earned the funding for her high-quality research proposal.

Sahin's research focuses on the areas of micro-fabrication, ultra wideband low-profile phased arrays for mobile applications, mmW antenna measurement techniques, and THz spectroscopy systems for material characterization. ■

AEP OHIO GIFTS $250,000 IN SUPPORT OF JK WANG'S CYBERSECURITY POWER GRID RESEARCH

American Electric Power offered a gift of support to The Ohio State University toward its research protecting power grids from cyber-attacks.

On May 17, the Ohio branch of the utility company presented the gift of $250,000 to **Dr. JK Wang**, assistant professor of electrical and computer engineering (ECE) at Ohio State, in support of her power grid cyber security research.

Wang joined the university in January 2014 with a joint appointment in ECE and Integrated Systems Engineering. Her research focuses on emerging technologies of modern power system operation and planning, electricity markets, reconfiguration, demand side management, distributed generation and renewable energy.

AEP Ohio is responsible for delivering electricity to 1.4 million Ohioans through a network of thousands of miles of power lines that crisscross the state. American Electric Power, AEP Ohio's parent company, has 224,000 miles of electric lines across 11 states, providing the physical and cyber security for these lines and the systems that support them. The company is acutely aware of these emerging threats and security risks. By way of a grant to Ohio State, the company hopes to convert awareness into action.

The Electric Power Grid Research Group Wang leads at Ohio State systematically investigates cyber, physical and economic issues relevant to the grid-level integration of energy and power delivery. In particular, its research focuses on electric power distribution networks, which are the last stage in delivering electricity to consumers, to make power supply more reliable, cyber-secure, energy efficient and environment friendly. ■

FIRST OHIO STATE STUDENT TO WIN PRESTIGIOUS ISSCC AWARD

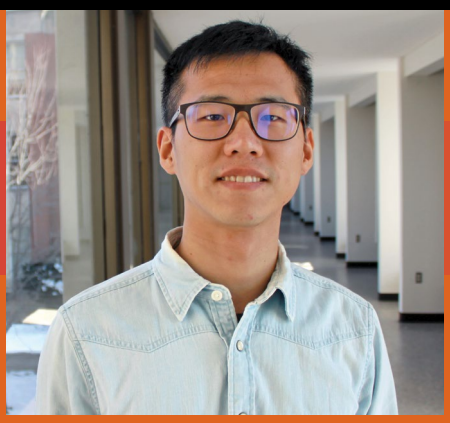
For the first time, an electrical and computer engineering (ECE) student at The Ohio State University won a prestigious award for his research in solid-state circuits technology.

ECE student **Jack Hsueh** received the Analog Devices (ADI) Outstanding Student Designer Award at the 2018 International Solid-State Circuits Conference (ISSCC) starting Feb. 11.

The event is the flagship gathering of scientists presenting cutting-edge research in circuit design.

Solid-state electronic devices are part of every day technology, from radios and amplifiers, to LED computer monitors and TV remote controls. Solid-state devices, such as a transistor, use conductors to control the flow of signals through a circuit. In digital circuits, an integrated circuit chip is a collection of transistors and wires that hook them together.

Hsueh's faculty advisor, ECE Assistant Professor **Vanessa Chen**, said the award is prestigious and marks the first time Ohio State research was highlighted among the winners. ■



GUPTA WINS 2017 GEORGE SINCLAIR AWARD

The highest honor bestowed on ElectroScience Laboratory faculty at The Ohio State University was presented this week to **Inder "Jiti" Gupta** for his respected work as both mentor and scientist.

ESL interim director, **Robert Burkholder**, said the George Sinclair Award recognizes faculty technical contributions and service to ESL. It honors its namesake, **George Sinclair**, who exhibited a career of exemplary standards in his own technical research and administrative leadership at the Antenna Laboratory (later to become ESL), which he founded in 1942.

Burkholder said Gupta was recognized in 2017 for his "research excellence, mentoring of researchers and students, as well as his leadership in establishing the international-recognized program in Global Navigation Satellite Systems (GNSS), and spearheading the formation of the ESL Consortium on EM and Radio Frequencies (CERF) and the Consortium of Ohio Universities on Navigation and Timekeeping (COUNT)."

Gupta is Retiree-Faculty Emeritus in Electrical and Computer Engineering (ECE) at Ohio State, and remains active in research. ■

The ElectroScience Laboratory (ESL) is a major center of excellence in the Ohio State College of Engineering and one of the largest radio frequency and optics research laboratories in the world.

ECE GRAD STUDENTS WIN DAGSI FELLOWSHIPS FOR THEIR FUTURES IN AEROSPACE TECH

Two graduate students at The Ohio State University won fellowships for their plans to support the Air Force Research Laboratory (AFRL) and pursue careers in aerospace technologies.

Trevor Dean and **Roman Fragasse** won the AFRL/Dayton Area Graduate Studies Institute (DAGSI) Ohio Student-Faculty Research Fellowship, which supports graduate science and engineering students and faculty conducting research in areas essential to AFRL at Wright-Patterson Air Force Base.

All DAGSI projects involve basic studies into aerospace technologies and originate from research topics provided by the four AFRL Directorates headquartered at Wright-Patterson: Human Effectiveness; Aerospace Systems; Materials and Manufacturing; and Sensors. ■

RAJAN WINS YOUNG INVESTIGATOR AWARD AT NAMBE 2017

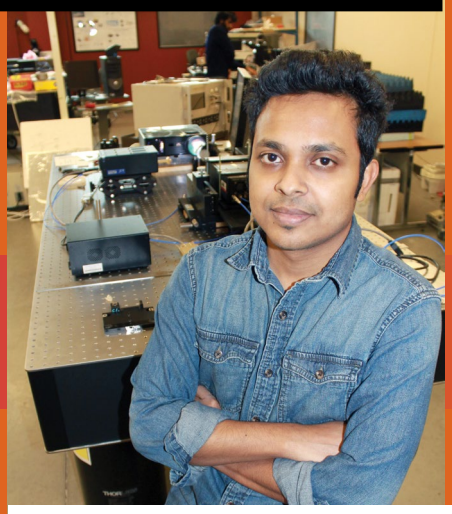
An associate professor at The Ohio State University won the prestigious Young Investigator Award at the 33rd North American Conference on Molecular Beam Epitaxy (NAMBE 2017).

Winner, **Siddharth Rajan**, is a member of both the Department of Electrical and Computer Engineering as well as Materials Science and Engineering faculty at Ohio State. His work is in the realm of nano-scale semiconductor devices, molecular beam epitaxy, and III-nitride semiconductors.

According to the NAMBE award selection committee, Rajan won for his "contributions to the development of molecular beam epitaxy based wide band gap materials and devices."

This year, not only did Rajan win the award, two Ohio State students won NAMBE Best Paper Awards, and ECE professor **Sanjay Krishna** was the keynote speaker. ■

PRESIDENTIAL FELLOWSHIP: SYED AN NAZMUS SAQUEB



An electrical and computer engineering (ECE) doctoral student at The Ohio State University was among the recent winners of a prestigious Presidential Fellowship for his work advancing the efficiency of terahertz (THz) imaging.

Student winner, **Syed An Nazmus Saqueb**, studies under the supervision of ECE associate professor **Kubilay Sertel.** Their research is focused on compressive imaging techniques for millimeter-wave and THz bands.

THz energy is a topic increasingly earning attention at Ohio State, as new grants and funding support increase each year. Much like microwave frequencies in the electromagnetic spectrum provide energy to cook food, the race is on to find a more affordable and efficient way to utilize the more untouched terahertz energy realm.

Saqueb is developing novel imaging techniques that enable a single-pixel camera to view invisible wavelengths of the electromagnetic spectrum and synthesize new information previously unachievable using low-cost sensors. ■

GRADUATE STUDENT WINS NSF IREDEFINE AWARD

The National Science Foundation (NSF) highlighted a graduate student at The Ohio State University for her role as an exemplary woman in the field of electrical and computer engineering (ECE).

Isabel Fernandez Puentes, an ECE student and Engineering Education graduate teaching associate, was chosen by NSF to participate in its Workshop on Improving the Diversity of Faculty in Electrical and Computer Engineering (iREDEFINE ECE) and receive a Professional Development Award.

iREDEFINE ECE is a two-year NSF project to help "motivate and prepare graduate women and underrepresented minority students to pursue faculty positions in American universities." ■

ECE: THE FUTURE IS WHAT WE DO

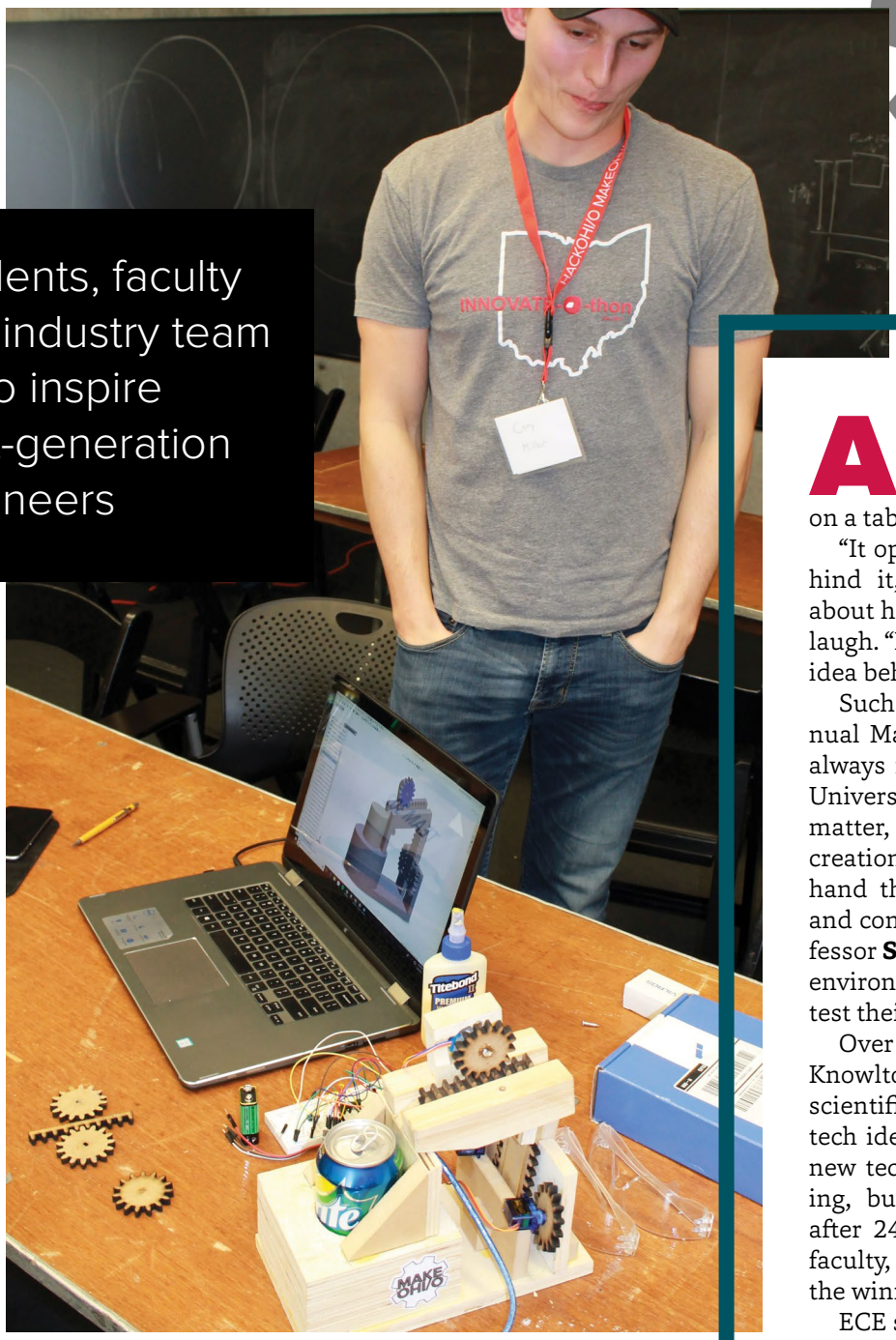
Electrical and Computer Engineering

SUPPORT

PICTURED: From left to right, ECE students **Wesley Thio** and **Raman Vilkhu** showcase their award-winning fabric battery proposal.

A LOOK INTO THE MAKEOHI/O 2018

Students, faculty and industry team up to inspire next-generation engineers



A wooden mechanical project, constructed of cranks, wires and a can of Sprite is set up on a table.

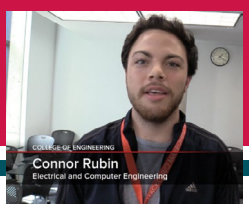
"It opens a can. That's the idea behind it," student **Cory Miller** said about his creation, then added with a laugh. "It doesn't work … but that's the idea behind it."

Such a jovial attitude is why the annual MakeOHI/O hackathon event is always interesting at The Ohio State University. Success or failure doesn't matter, it's all about the passion for creation. With faculty mentors on hand throughout, such as electrical and computer engineering (ECE) Professor **Steven Bibyk**, students find an environment to both experiment and test their skills.

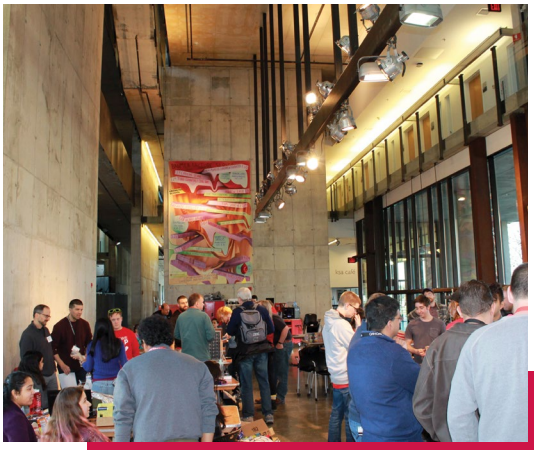
Over the first weekend in March at Knowlton Hall, students from many scientific disciplines brought their tech ideas to life. Not only inventing new technologies, but also engineering, building, and marketing them after 24 sleepless hours. Ohio State faculty, alumni and volunteers picked the winners.

ECE student **Connor Rubin** knows now how much work it takes to plan the event – let alone participate in it. As the president of the Electronics Club at Ohio State, he took on the lead organizing role this year.

The MakeOHI/O event focuses more on hardware development, he said, so it draws in a lot of ECE, as well



Watch a short video recap of the event: **http://go.osu.edu/makeohio18**



as Computer Science and Engineering (CSE) participants – although any student is welcome.

"They come together to build robots, light displays and things like that," Rubin said.

This year, MakeOHI/O proposed two tech challenges for participants. The first came via the Toy Adaptation Program at Ohio State, in collaboration with sponsor American Electric Power (AEP).

"The project was to adapt a dog treat shooter for a girl with cerebral palsy. It had to connect to her wheelchair, have variable distances, and she had to be able to operate it. They had to modify that for her needs," Rubin said.

The Center for Design and Manufacturing Excellence (CDME) at Ohio State presented the second challenge to participants, a $3,000 prize for the most entrepreneurial project.

"That's $3,000 to continue developing the idea, and to use their maker space," he said. "The idea is to pitch how you would sell it; how you would market it. It's a 24-hour event, so you can only really prototype it."

Rubin's own team created a resident check-in device utilizing radio frequency identification (RFID) technology.

"So basically, with RFID tags, you scan it and it notifies who is home or not home," he said. "And one of our CSE kids developed a web app. Maybe you want to make sure your kid got off the bus safely and they are checked in."

Ideally, if a team wins, members can use the CDME funding to continue prototyping their device.

Another team based a project off the Lunar Landing video game, utilizing a rotating mechanic landing pad.

"The rack goes up and down. That's your vertical access," team member **Matt Charleston** said. "And then your spaceship pivots to the left and to the right. On your control panel over there, you have a throttle, and your goal is to try and land it on a certain spot."

Another student created a laser projector in a shoebox, projecting dynamic images capable of being manipulated in size and shape.

"Just a huge range of projects," Rubin said. "I was really impressed, actually."

CSE student **Anjali Kapoor** was in charge of managing sponsors this year for MakeOHI/O. She got involved after participating in 2017.

"I was really kind of new to computer science, and applying those skills outside of the classroom. MakeOHI/O gave me a space to grow, both technically and in terms of working on a team," she said. "After doing that, it really made me want to get involved in putting the event together."

Working at the sponsorship level, Kapoor said, was a good chance to connect with industry leaders and learn what makes them tick.

"It was a really cool experience. It was a really great chance getting to communicate with different sponsors and see what they were interested in, and why they were passionate about events like this," she said.

Tom Bergman, Program Manager at Battelle, sponsored as a judge this year.

"There is a group working as interns at Battelle that have a birdhouse that tweets when it detects a purple martin show up, which was pretty cool," he said.

Bergman said the company gets involved with MakeOHI/O with the future in mind.

"We're trying to support, recruit, identify and help with that next generation of students that can come to places like Battelle and make a difference in the world," he said.

While primarily an event for the Electronics Club, Rubin said in future years MakeOHI/O will fall under Ohio State's hackathon program, OHI/O, which hosts a growing number of events on campus to foster the tech culture at the university.

OHI/O is led by CSE program director, **Julia Armstrong**, as well as CSE Faculty Director **Arnab Nandi**, and University Libraries Faculty Director **Meris Longmeier**. Events include MakeOHI/O the High School I/O, HackOHI/O, and ShowOHI/O. ■

OHIO STATE HOSTS GREAT LAKES ECE LEADERS

The Ohio State University recently hosted distinguished members of the Electrical and Computer Engineering Department Heads Association (ECEDHA) for the annual Great Lakes Regional meeting. With so many emerging engineering technologies, participants said the time is ripe to help guide younger generations into a greater understanding of electrical and computer engineering (ECE).

The overall takeaway message: **The future is what we do.**

"The electrical engineering components in today's high tech gadgets are almost invisible to the average person or incoming engineering student," University of Minnesota ECE Professor **Emad Ebbini** said. "We're essentially victims of our own success."

At the meeting in Dreese Labs July 14, the group expressed a desire to help advance the field of ECE, while providing a much clearer understanding to young students about what it is professionals do in both industry and academia.

The ECEDHA organization is made up of university department heads in ECE fields nationwide. Members meet at an annual national conference to help advance their programs, exchange ideas and improve ECE communication efforts with government, industry and the public at large. Regional meetings are also held to follow up on detailed topics of interest. The Great Lakes Region includes leaders from universities spanning Indiana, Illinois, Michigan, Minnesota, Ohio and Wisconsin.

Ohio State ECE Chair **Joel Johnson**, Associate Chair **Betty Lise Anderson**, and Chair-elect **Hesham El Gamal** took attendees on a tour of Dreese facilities, including the Clean Room and the High Voltage Lab, as well as Undergraduate Instructional Laboratories in Caldwell Lab. The group also discussed student exchange programs and curriculum reorganization.

University of Michigan ECE Chair **Khalil Najafi** said many high school students look at robotics and cell phones and immediately think Mechanical Engineering or Computer Science. Or, he said, they enter into biomedical fields, not considering how many devices used to treat patients are, in fact, designed and built by electrical engineers.

"We enable a lot of smart things," he said. "This is how our field changes society."

Attendees also discussed how just 15 years ago many of today's technological advancements were unheard of. A consensus was reached that perhaps the best way to convey what ECE does is to reveal how much modern life has changed because of electrical engineering.

Chair of the Ohio University ECE Program, **David Juedes**, said electrical and computer engineers arguably enabled some of the greatest scientific achievements of the 20th Century. Companies which employ electrical engineers are also some of the largest in the world – IBM, Toyota, Apple, Samsung, GM, AT&T, Ford, Amazon, Honda and many more.

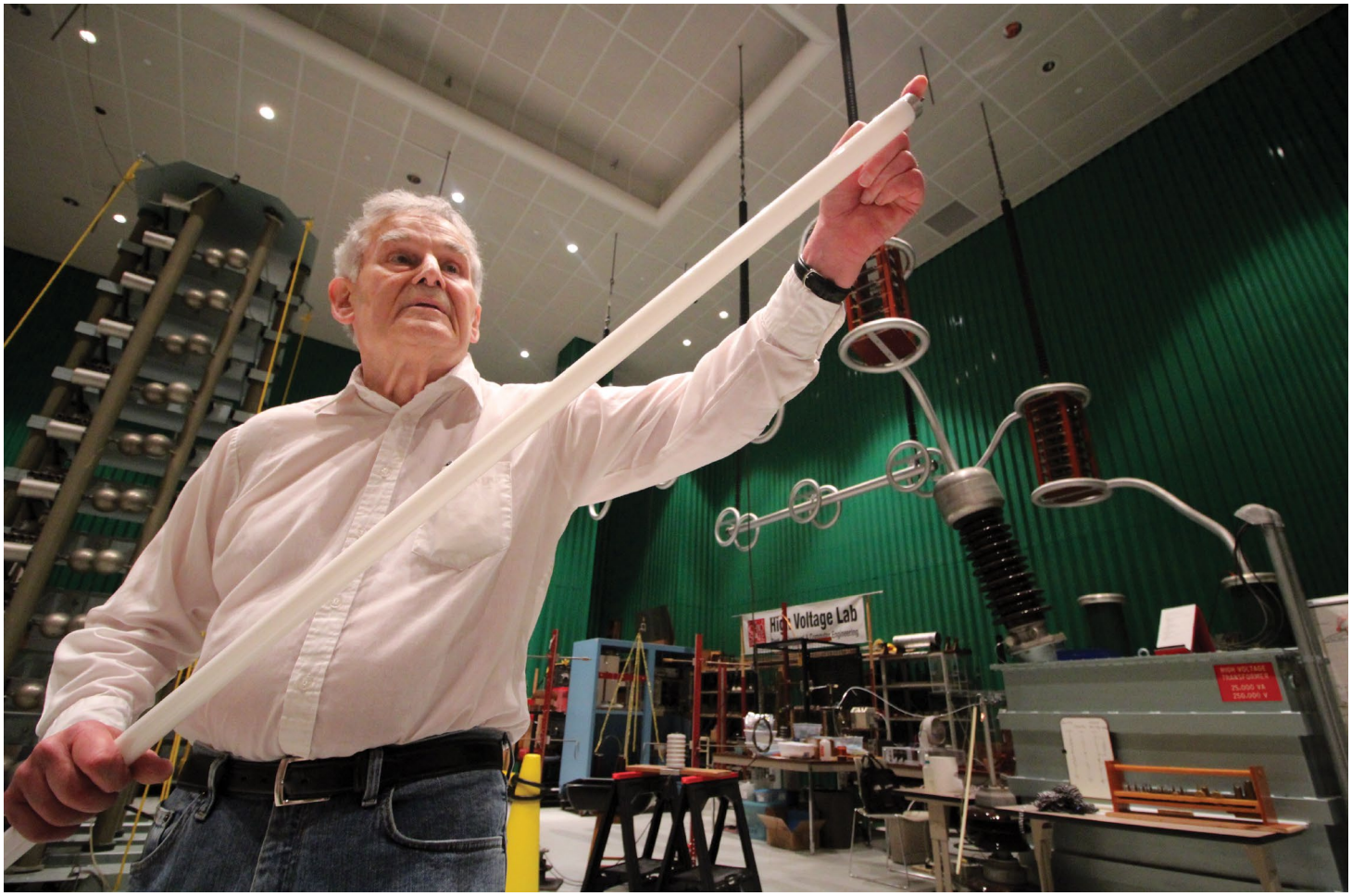
Juedes said ECE degrees allow for a broad education applying to so many of these industries. Getting the word out about this to young students early is essential.

Members represented at the Ohio State gathering also included chairs **Rashid Ansari** of the University of Illinois at Chicago, **Daniel Fuhrmann** of Michigan Technological University, **Brian King** from Indiana University /Purdue University of Indianapolis, **John Papapolymerou** from Michigan State University, **Guru Subramanyam** at the University of Dayton, **Randall Victora** from the University of Minnesota, **Jiann-Shiou Yang** from the University of Minnesota Duluth and **Chansu Yu** of Cleveland State University. ■

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Spring Graduate & Undergraduate

Class of 2018!



ECE Faculty Emeritus **Steve Sebo** has dedicated many years toward the advancement of the High Voltage and Power Electronics Lab at Ohio State. Even after retirement, Sebo continues mentoring graduate students and leading tours for Professor and Lab Director **Jin Wang,** as well as current graduate students. *(Photo: Mike Huson)*

EE CLASS OF 1968 REUNION: FRIDAY, OCT. 5

Attention EE class of 1968! You're invited to join the EE/ECE Alumni Society for a special celebration during OSU's homecoming weekend. We will gather in Dreese Labs for a reception and social time, tour Dreese and Caldwell Labs, then have dinner at a local restaurant with fellowship, food, drinks and door prizes. To RSVP for the tour and dinner, call **Carol Duhigg** at 614-292-7392 or email **duhigg.2@osu.edu.** Spaces are going quickly!

HOMECOMING FOOTBALL AND PRE-GAME TAILGATE TICKET PACKAGES: SATURDAY, OCT. 6

The EE/ECE Alumni society has a limited allotment of homecoming game football tickets to offer our eligible alums.* Each package costs $118 ($98 for class of 1968 and prior) and includes one OSU vs Indiana football ticket and one entry to the College of Engineering pre-game tailgate. Alums may purchase up to two ticket packages (while they last), by calling 800-762-5646 or 614-292-2281. Packages will be distributed at the tailgate entrance on game day.*Eligible alums must be a life or sustaining member of The Ohio State University Alumni Association.

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.

THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

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