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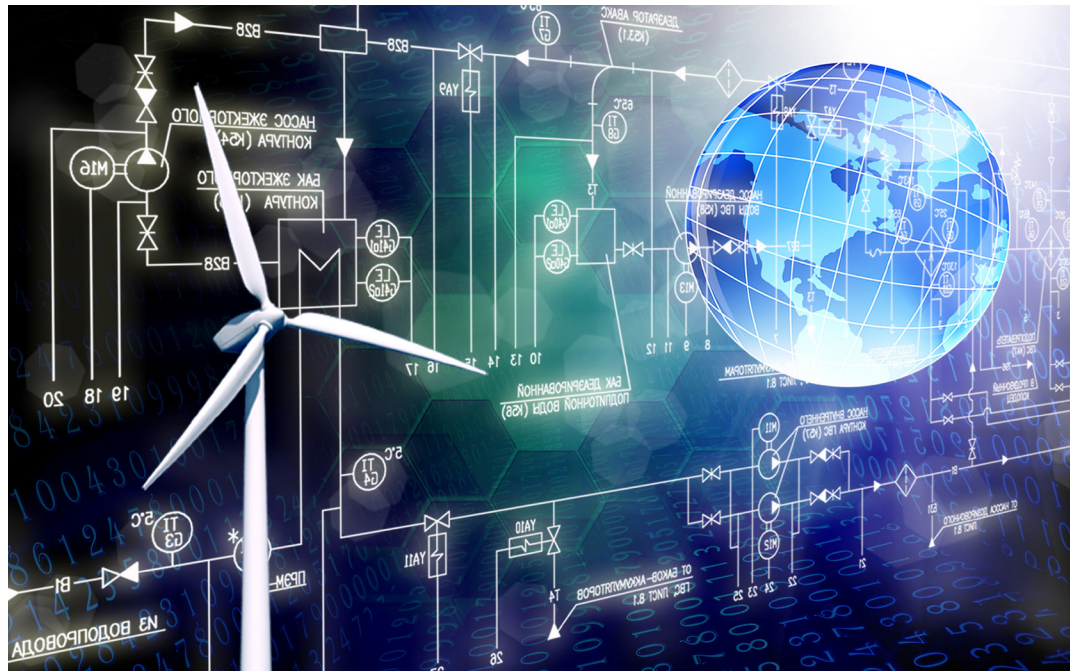
### Redefining Collaborative Research

Prof. Weihong "Grace" Guo undaunted by  
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## Industrial & Systems Engineering at Rutgers

Industrial and systems engineers devise ways to make products and services better, safer, easier to use, less expensive, and more energy efficient—dramatically transforming industry and society with advances in computing, communication, and automation sciences in the process. Rutgers' leading-edge ISE program emphasizes core competencies in reliability engineering, advanced manufacturing, smart systems, and energy systems, while keeping at the forefront of emerging technical areas to give the next generation of engineers and technology leaders a richly relevant educational experience.

[ise.rutgers.edu](http://ise.rutgers.edu)



## Bridging Data and Wind Energy Sciences

Revolutionary advances in data science have transformed everything from supply chains to social media. Yet, according to assistant professor Aziz Ezzat, its full potential is yet to be unleashed for wind energy. Ezzat is also the director of the Renewables and Industrial Analytics (RIA) research group, which was founded in 2019 to address the needs of the wind energy sector while establishing collaborations with industry partners.

To bring wind energy analytics up to speed, Ezzat insists on a need for "physically motivated data science solutions, wherein the construction of key parameters in machine learning models is driven by the underlying physical features of wind dynamics. This contrasts with the black-box, physics-agnostic machine learning paradigm."

For Ezzat, such an amalgam of data science, meteorology, and engineering is critical if New Jersey is to meet the ambitious goals it has set for cost-efficient offshore energy production by 2035.

To help address this challenge, Ezzat's RIA research is focusing on two core areas: wind energy forecasting at various spatial and temporal scales, and reliability and maintenance engineering for offshore wind farms.

Wind energy's intermittent, unpredictable nature makes it especially difficult to predict. According to Ezzat, when equipped with accurate forecasts of the amount of energy a wind farm might produce at a given time of

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## department news

From supply chain network design to smart urban development, ISE faculty researchers have received funding to tackle some of today's most pressing challenges:

ISE department chair **Mohsen Jafari** has received a three-year, \$205,000 grant from Qatar National Research Foundation as PI on his project, "Smart Urban Development Using Connected Buildings and Communities."

Professor **Wiehong "Grace" Guo** is a co-PI on a \$316,000 National Science Foundation Excellence in Research award for a three-year project that will benefit the nation's economy by studying the operations of mobile manufacturing facilities to develop a framework for supply chain network design and assembly planning.

A three-year, \$325,000 National Science Foundation grant for her project "Protecting Soft Targets Against Lone Actor Attacks Using Game Theory and Immersive Simulations," supports a Rutgers team's investigation led by Professor **Melike Baykal-Gürsoy** of lone actor attacks targeting public spaces. By developing new game theory models and immersive simulations, they hope to provide analytical and practical benefits to emergency management agencies, transportation safety personnel, and police that will reduce the risk of attack—and ultimately save lives.

In May, Professor **Aziz Ezzat** was elected as a board member of the Energy Systems Division of the Institute of Industrial & Systems Engineers (IISE). He plans to use his 2020-2021 Rutgers Open and Affordable Textbooks (OAT) Teaching Award for a series of case studies where students will solve real-world engineering problems by applying the fundamentals of engineering data science.

U.S. Army Signal Officer and Princeton University Army War College Fellow



## Message from the chair

Industrial and systems engineers are well-known innovators, whether they are finding new ways to produce consumer goods or reduce energy costs. Today's global coronavirus pandemic has prompted us to reconsider how we can best continue to educate and train tomorrow's engineers for success in a complex, diverse, and global workplace.

Even as we have pivoted to embrace a primarily remote learning experience in this year's spring and fall semesters, our outstanding faculty and staff remain committed to our mission of drawing on up-to-the-minute education and technology techniques in order to deliver high quality, relevant education programs to our undergraduate and graduate students. Our talented students have risen to the challenge in many ways—including by virtually preparing their Senior Design projects.

Our approach has long fostered success for ISE alumni such as retired Corning Incorporated executive John Sharkey, BS'79, MS'90. In appreciation, he and his wife Christine have created the Elsayed A. Elsayed Endowed Scholarship with a \$520,000 gift honoring distinguished professor Elsayed while also supporting underrepresented ISE students with financial need.

Class of 2020 ISE majors Mazie Ayers and Priti Kantesaria are embarking on careers with Crane Aerospace and Deloitte, while newly minted doctoral candidate Stamatis Tsiannikas benefited from our new fellowship program with American Express. We profile them—and master's degree alumnus and Schlumberger reliability métier manager Varun Sharma—in these pages.

Faculty like Professor Wiehong "Grace" Guo seized an opportunity to redefine collaborative research during the pandemic by supervising post-doctoral student Shenghan Guo's off-site internship with Oak Ridge National Laboratory.

At the same time, faculty including Aziz Ezzat continue to conduct cutting-edge research. His vital work in his Renewables and Industrial Analytics (RIA) research group bridges data and wind energy sciences.

I'm immensely proud of the dedication, innovation, and successes of our talented students, faculty, and staff in these challenging times. And I am delighted to share news of their achievements with you in the pages of this newsletter.

Sincerely,

**Mohsen A. Jafari, Ph.D.**

*Chair, Department of Industrial and Systems Engineering*

**Ron Iammartino** will be teaching Advanced Engineering Economics this semester. He previously served as commander for the 50th Signal Battalion at Fort Bragg, N.C., as well as an action officer on the Joint Chiefs of Staff and Department of Army Staff in Washington, D.C. His published work focuses on agent-based and statistical modeling.

Lecturer **Ali Ghofrani**, who earned his doctoral degree in ISE in 2019, is teaching a fully online course on energy systems models this semester. He has spearheaded several projects for the State of New Jersey and private companies involving feasibility studies for and life-cycle assessment of power and energy infrastructure. His research interests include the data-driven

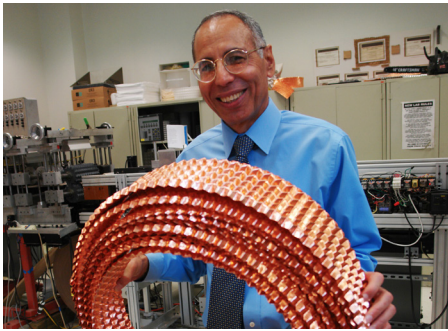
modeling and optimization of energy systems as well as the application of deep learning in energy systems modeling.

Johnson & Johnson vice president for global manufacturing technology **Arun Kumar Bhaskara-Baba** is responsible for technology at more than 100 global manufacturing locations spanning the manufacture of everything from pharmaceuticals and medical devices to consumer goods and vision care products. He is excited to teach his asynchronous, online course on supply chain engineering, which is informed by his deep educational, industry, and management experience.

# Alumnus' Gift Creates Elsayed A. Elsayed Endowed Scholarship

John Sharkey (BS '79, MS '90) describes himself as “a pay it forward kind of guy”—which is why he and his wife Chris have established the Elsayed A. Elsayed Endowed Scholarship with a \$520,000 gift.

“I was able to enjoy an unbelievable career because of my experience at Rutgers, which taught me a structured way to approach problem solving,” says Sharkey, who retired in 2018 as Vice President-Chief of Staff to the CEO of Corning Incorporated. “At Rutgers, I was able to grow into adulthood while getting a great education—a perfect combination that helped make me who I am today. And one that industrial and systems engineering distinguished professor Elsayed A. Elsayed played a large part in.”



For Elsayed, news of the scholarship came as a total surprise. “I thought it was wrongly named and should be named for the Sharkeys, not for me,” he says. “This is an honor, a humbling experience, and a highlight in my life.”

Elsayed played an outsized role in Sharkey's academic and personal success. After receiving his bachelor's degree, Sharkey completed everything for his master's degree except for his thesis. Eventually, Elsayed called Sharkey's wife Chris urging her to push him to finish his degree.

Elsayed explains, “The problem was, his thesis got lost on the back shelf. He only needed six more credits for his degree, but his work at Corning had become his priority. I encouraged him to take a course at Cornell to help finish things up.”

“I took the course,” recalls Sharkey. “I came down to Rutgers, presented my thesis and got my degree—all because he pushed me.”

Because of Elsayed's lasting impact, when Sharkey and his wife decided to make a gift, he naturally wanted to recognize his friend and former professor. “I couldn't think of a more fitting way to honor someone I respect im-

mensely and who is passionate about teaching young people.”

According to Elsayed, who joined the ISE faculty in 1977, teaching comes first and research comes second. “My first job in academia, is the students. I want them to be the best and succeed,” he says. “If we can't bring the best out in students, we fail. I'm extremely satisfied and the happiest person when I see my students succeed as stars. That's what drives me.”

He clearly succeeded with Sharkey, with whom he has maintained contact for more than 40 years. “John was a special student, very good, and very committed. He's the most honest student I've ever seen and is a very kind man.”

Sharkey's kindness and commitment is reflected in the Elsayed A. Elsayed Endowed Scholarship, which supports underrepresented minority ISE students who exhibit financial need.

“Naming this scholarship in honor of Professor Elsayed was important to me, but equally important was the opportunity to support both current and future deserving students,” notes Sharkey. “The pandemic brought into sharp focus for my wife and me that the barriers to high quality education are even more significant for underrepresented and in-need students. There's a strong correlation between income and academic performance; it can be hard to focus in the classroom when you're worried about how to pay for school. We are

hopeful this scholarship will help reduce some of this stress and financial hardship.”

Sharkey adds, “The power of the gift dwarfs its monetary cost. It can put young people on a path that allows them to achieve their dreams—and potentially change the arc of their life. And maybe one day, it will come full circle.”

*Rutgers School of Engineering is a national leader in diversity and inclusion both within the school and by serving as a pipeline for workforce diversity. Its programs have been recognized by the American Society of Engineering Education, the National Academy of Engineering, and the National Action Council for Minorities in Engineering. SoE additionally nurtures undergraduate diversity through its Engineers of the Future program—an extension of its Educational Opportunity Fund (EOF) program that gives economically and educationally disadvantaged students access to higher education. ■*

## LinkedIn™

Join the ISE LinkedIn group. Search **Rutgers Industrial and Systems Engineering Friends & Alumni** and click “Ask to Join.”



John and Chris Sharkey celebrate son Connor's graduation with older son Matt at right.

## Senior Design Projects: December 2019



## Reconceiving ISE Senior Design During a Pandemic

During the spring semester of junior year and fall semester of senior year four-person teams of ISE majors incorporate all they have learned into culminating Senior Design projects.

When the campus moved to virtual instruction last March, students quickly pivoted. This semester, they continue remote preparation for December's virtual Senior Design presentation.

Amanda Lescano and her "Seafeed" team are designing an indoor system for growing macroalgae, or seaweed, year-round. "This is beneficial because seaweed can serve as a food and/or energy source that doesn't depend on freshwater—a quickly depleting resource," she explains.

The team radically revised their original plan to build and test a vertical indoor tank structure in a campus lab by giving virtual direction to

the department for building the tank in the lab—and then moving it to her home garage for testing, monitoring, and data analysis. Their virtual presentation will highlight these steps and include a brief "proof-of-concept" video.

Lescano admits that despite obstacles that at times outweighed project benefits, "this opportunity has forced us to be creative and structured in our approach to handling new problems that come our way. I'm proud of what we've accomplished."

Classmate Kevin Stern says that his team's "Slime Mold Network Optimization" project, which takes a new, bio-inspired design approach to "transportation, distribution, and various networks that are sustainable, efficient, and non-partisan" has actively benefited from working remotely. "It forced us to use technology in ways we hadn't in the past. We had to pivot to Zoom calls for conferences and

meetings. We now use Google calendars to stay on track and schedule meetings, as well as share screens with advisors and teammates."

The project requires sterile environments that are sensitive to light, temperature, and moisture fluctuations. "Creating this environment in our own homes was a challenge. With support from our advisors and the department, we were guided to at-home DIY setups that will work on a par—if not more efficiently—than making trips to the campus lab," he says.

Stern values his remote Senior Design experience. "I think industrial engineers have a unique opportunity in that we have two semesters and a summer to complete our projects. This gives each of us the opportunity to fully flesh out ideas that dive into critical solutions to problems currently facing our society," he says. ■

day, wind farm operators can plan where and when to expect a dip in energy supply from a given wind farm—and then draw on other sources or locations across the grid to make up for the shortfall.

“Wind forecasting is a challenging data science problem because it involves fusing data from different sources, resolutions, and types,” Ezzat explains. “The goal is to build models that are neither purely data driven nor solely dictated by physics, but that are a hybrid of both. This builds on a branch of statistics known as ‘spatio-temporal data science,’ which is a major methodological thrust at the RIA group.”

He notes that limited accessibility, high crew dispatch costs, and the unprecedented scale and height of offshore turbines pose a unique set of challenges to cost-effectively maintaining offshore wind farms. “These factors motivate us to focus on formulating

maintenance scheduling strategies tailored to offshore wind farm maintenance operations and their offshore-specific operational and environmental conditions,” he says. “We rely on a combination of data science and mathematical programming to seek decisions that minimize operational costs.”

Ezzat has received support from the Rutgers Research Council for his project “The Promise and Peril of Offshore Wind Energy: Powering Up with Machine Learning and Operations Research,” which focuses on bridging forecasting models with mathematical programming to optimally schedule maintenance in offshore wind farms. His Rutgers Energy Institute-funded joint project, “Offshore Wind Energy: The Data Science Relevance,” with Rutgers’ director of atmospheric research Joseph Brodie, seeks to combine meteorological physics-based predictions with turbine-level data for

accurate wind resource and energy forecasting. Funding from each grant will support student stipends.

As a co-director of the SoE Energy Lab, Ezzat oversees measurement facilities that collect real-time local measurements and image data about wind velocity, solar irradiance, cloud motion, and more. The lab stores and processes these measurements for use in renewable energy forecasting and analytics by RIA researchers.

For Ezzat, the benefits accrued by applying data science to wind energy forecasting and optimal maintenance scheduling for offshore wind farms are considerable. “Solutions to these problems lower wind’s cost of energy, making it economically attractive and market-competitive relative to fossil-fuel energy sources,” he notes. “In short, data science can have a direct—and positive—impact on the value and profitability of wind farms.” ■

## On the Ground at Amazon: A Fulfilling Visit

In September 2018, Amazon opened a state-of-the-art robotic fulfillment center in Staten Island. The vast 855,000-square-foot warehouse employs more than 2,000 people and hundreds of robots to fulfill a constant stream of orders.

In February, a group of ISE students toured the facility to see how the center’s layout, operations, and material handling depend on industrial systems engineering.

The 62-person group—most of whom were seniors in the ISE “Facilities Layout and Materials Handling” course—enjoyed a two-hour walking

tour, followed by a luncheon Q&A session with senior-level Amazon managers.

The students came away with a first-hand understanding of how a technologically

advanced fulfillment center applies classroom theory to successfully handle high-volume materials transport, shipping and receiving, and more. ■



## Susan Albin Named 2020 Faculty of the Year



Professor **Susan Albin** was selected by her peers as SoE 2020 Faculty of the Year in recognition of her commitment and achievements that contribute to the university, the engineering profession, the scientific community, and society at large.

Dean Thomas Farris says that her “outstanding record as one of the top researchers in quality and reliability engineering and the role she played in advancing instructional technology . . . has brought much to the school and to Rutgers.” Albin has played a leading role in establishing the ISE graduate education and research program in the area of quality and

reliability engineering as one of the leading programs in the field.

She has also recently been named a fellow of her professional society, the International Institute for Operations Research and the Management Sciences (INFORMS).

“I am delighted to have received these two wonderful awards as we begin the school year,” says Albin. “I want to thank my colleagues for their support and, most of all, I want to thank my students for keeping me on my toes.” ■

## ISE Alumni Spotlight: Mazie Ayers

B.S. '20

Quality Engineer, Crane  
Aerospace



I'd spent time in jobs that didn't fulfill me or make me happy and realized I wanted something more, which is why I went back to school. I didn't even know the field of industrial engineering existed until I saw the Rutgers curriculum—and I immediately fell in love with it. There are so many directions to go in. The possibilities are limitless.

### During My Time at Rutgers. . .

It was rewarding to learn something in class and realize it applies to so many parts of my life. ISE is a small department—a real hidden gem. I was able to have good, close-knit relationships not only with my classmates, but also with faculty and staff.

### Where I am Today

I'm excited to use what I learned at Rutgers and as head of the quality assurance team at Gemco Valve Company, where I worked while in school, to further the quality system at Crane Aerospace. ■

## ISE Alumni Spotlight: Priti Kantesaria

B.S. '20

Federal Technology and  
Consulting Analyst, Deloitte



Rutgers gives you the chance to become the person you want to be—as long as you're willing to pursue it—and there were countless opportunities to do that. My research project with Dr. Luxhøj on the flight risk of drones let me focus on post-natural disaster relief efforts. Through this project, I presented at research symposiums and shared my achievements with the systems engineering community.

### During My Time at Rutgers. . .

My perspective on what successful advocacy and change really are changed. As Rutgers University Student Assembly (RUSA) treasurer/Sexual Violence Education (SVE) chair, and president of Rutgers NO MORE, I championed efforts to support survivors of sexual violence at the university. I'm proud to say that my focus on sexual violence advocacy created safer spaces for survivors around campus.

### Where I am Today

I started in August at Deloitte in Washington, D.C. as a full-time federal technology consulting analyst. ■

## ISE Alumni Spotlight: Stamatis Tsianikas

Ph.D. '20

American Express Company,  
Machine Learning Engineer



I'm from Athens, Greece and chose Rutgers because of the ISE department's high ranking and its proximity to New York City. I thought that it would open opportunities for me in the huge city market—which turned out to be true.

### During My Time at Rutgers. . .

Rutgers and the ISE department prepared me for my current role. First, there was the technical part. I took classes that sparked my interest in machine learning. The networking part was maybe even more important. I met people from American Express who later hired me through a seminar organized by ISE, which established an official relationship between Rutgers ISE and AmEx. I believe this is one of the most important things a department can do to help its students find professional success.

### Where I am Today

During the summer of 2019, I worked as a machine learning intern in AmEx's New York City office. My full-time position role is similar to the one I held during my internship. ■

## ISE Alumni Spotlight: Varun Sharma, M.S. '06

Drilling Group Reliability Métier Manager, Schlumberger



Varun Sharma, a native of Chandigarh, the capital city of Punjab, India, is currently the drilling group reliability métier manager at Schlumberger. After receiving his B.S. from India's Thapar Institute of Engineering & Technology, he worked as an engineer with Tata Motors before earning his M.S. in Industrial and Systems Engineering at the Rutgers School of Engineering. Through various positions at Schlumberger—from sourcing engineer and field engineer to his current role—he has gained expertise in all aspects of the value chain.

### What led you to Rutgers?

This was the first time I was leaving India. At that time, the internet wasn't what it is now. It was hard to look up information and you were limited to what you could find.

My freshman year college roommate got his degree in ISE at Rutgers and gave me highly positive feedback—plus my first cousin was living in New Jersey and I liked the idea of being close to New York City—which convinced me to come to Rutgers.

### You studied mechanical engineering in college. What attracted you to industrial and systems engineering?

After college, I went on to work for automotive company Tata Motors—one of the largest industrial groups in India—for two years. While working for them as an engineer, what I observed was that while a B.S. in mechanical engineering gave me the technical skills

required for the job, I had to relearn things specific to their cars.

At the same time, since I was in operations, process thinking became more central to me, so I decided to pursue a master's degree in ISE. I wanted to learn something with practical applications to the industry, which would add value to me in terms of higher education and help in furthering my career.

### When did you join Schlumberger?

In 2007, I joined Schlumberger in Princeton. I then spent a couple of years with them in India, before moving to Aberdeen, Scotland. I spent 5 years in a small town in England called Stonehouse. Since 2015, I've been back in the U.S. in Houston with them.

### What do you most enjoy about working at Schlumberger?

The one thing I most enjoy is the borderless career that Schlumberger offers by providing opportunities to work in different profiles across the globe.

I started out in supply chain, moved to manufacturing and hard core operations. In Scotland, I worked on oil rigs. This was not the calmest of scenes given the 20- to 30-foot waves in the North Sea. I'd go to the rig by helicopter and stay on it for 3 weeks at a time. That was the most exhilarating job I've ever done. It was an actual hands-on job, and gave me the satisfaction of knowing I'd delivered what I was sent out there for.

After that, I worked in manufacturing and product support before getting back into reliability and my current role in operations reliability.

### What does this involve?

In my current role as métier manager, I am directly involved in the strategy development and implementation for the improvement of product reliability within my technology portfolio. I own the internal processes and standards related to reliability and ensure their implementation through design reviews and audits.

### What do you most enjoy about your job?

I enjoy working in a technical leadership role where I can leverage the knowledge I have

gained over the years while collaborating with highly motivated project teams that are spread across the globe.

### Has the pandemic impacted your work?

I've been working remotely. By meeting online we can collaborate so quickly—sharing designs online and giving technical feedback to people on three different continents. This is quite exciting.

Technology has come a long way since I was growing up. I remember the time when I was the remote—and would have to get up from where I was sitting—when my family wanted to change the TV channel when I was young.

### What do you most value about your Rutgers education?

The diverse culture that was there in the ISE department. Before coming to Rutgers, my only experience was living and working in India. I still remember the day I first walked into the International Students and Scholars Services office so clearly. On the lawn outside the office there were students from all over—from India, China, the Middle East, Africa, Europe.

This was my first exposure to being in such a diverse environment, with people from all around the world. I feel like Rutgers prepared me well for working in a diverse, multinational company.

### Do you have any advice for new students?

One piece of advice I have for new students is to make sure to reach out to the professors and students at the university. They are the best resources to provide you with information about the work that is going on and to help you understand if Rutgers is the right fit for you. From my experience at Rutgers, the faculty is always ready to help and provide you with the right information. ■

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## Redefining Collaborative Research During the COVID-19 Pandemic

While the coronavirus pandemic has impacted virtually every facet of normal life, it has also prompted researchers to devise novel ways to continue progress on critical projects.

Professor Weihong “Grace” Guo, along with post-doctoral fellow Shenghan Guo, have formed an untraditional collaboration with the Oak Ridge National Laboratory’s project “Machine Learning for Autonomous Weld Quality Monitoring.”

“Usually, we’d reach out to someone at the lab, write a proposal together, and start our collaboration when we receive funding,” the professor explains. “This is different—my student, Shenghan, had been selected for a competitive 2020 summer internship program at Oak Ridge, which was cancelled because of the pandemic.”

Shortly after the cancellation, Oak Ridge PI Dali Wang contacted Guo, offering to sub-contract her as a project co-PI. In this collaborative role, she supervised her student on a remote 12-week internship focused on machine learning for smart welding. “Because this is a remote

internship, Dr. Wang wanted me to be heavily involved. Shenghan and I met once a week and I gave a lot of guidance to the project and paper writing.”

In a twist on pre-pandemic collaboration, Guo did not accept funding for herself. Instead, her student received the salary she would have earned as an onsite intern.

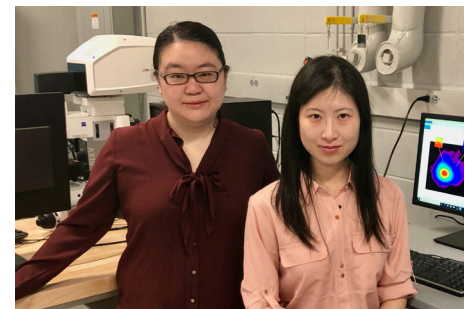
The two worked closely with Wang on the project’s data analytics and machine learning, which falls under Oak Ridge’s current collaboration with General Motors and the Pacific Northwest National Laboratory.

Welding, especially lightweight material welding, is increasingly used in industries such as automotive, aeronautics, and electronics. Traditional, off-line methods of assessing weld quality are expensive and time-consuming. The project is developing machine learning methods that can analyze in-line video inspection data and correlate it with weld quality.

Using deep image and graph learning technologies and applying GM metrics, the project is identifying spot welds as desirable or

undesirable across GM’s robust resistance spot weld (RSW) database. The aim is to develop a cost-efficient framework to predict and improve weld schedules for high-performing joints in order to advance the use of lightweight materials in automobiles.

“The internship’s main task was to design proper machine learning models and a prototype data system to analyze a small set of RSW data in 12 weeks,” explains Guo. “Our contract was recently renewed until the end of the year.” ■



Professor Weihong “Grace” Guo, at left, with post-doctoral fellow Shenghan Guo in the Advanced Manufacturing Laboratory.