INDUSTRIAL & SYSTEMS ENGINEERING











MESSAGE FROM THE CHAIR

In the Department of Industrial & Systems Engineering (ISE) at Mizzou, we're focused on preparing students to become leaders across a variety of industries while discovering new ways of optimizing systems, processes and performance. We're focused on emerging transportation logistics, data analytics for decision making, healthcare systems, human-computer interaction, quality and reliability, supply chain logistics, applied operations research and advanced manufacturing.

This past year, our faculty devised methods to predict trends in steel prices, monitor reactor coolant pumps, customized blood supply chain solutions and fabricated microprobes and nano electrodes. And our students have demonstrated excellence in research and leadership at regional and national conferences.

Thank you for taking a moment to explore ISE at Mizzou.

James Noble Chair, Professor Industrial & Systems Engineering



NEW LAB TO FUSE INDUSTRY TECHNOLOGIES

A new Industry 4.0 lab, scheduled to open in fall 2024, will create hands-on learning opportunities for industrial engineering students. Department Chair James Noble and Assistant Professor Yi Wang received a one-year, \$1 million grant from the Missouri Department of Higher Education and Workforce Development for the space and development of courses for an undergraduate student certificate.

"Industry 4.0 is multi-faceted, but at its core, it's a fusion of information cyber security, big data, cloud computing and blockchain—and cyber-physical manufacturing—sensors, internet of Things (IoT) additive manufacturing, robotics, collaborative robots, autonomous material flow and digital twins," Noble said. "Our Industry 4.0 lab will be a showcase for how all these aspects fit together seamlessly."

OPTIMIZING DELIVERY ROUTES

A Mizzou Engineering team is developing a tool that will allow delivery companies to best optimize routes using electric vehicles and drones in hopes of offsetting last-mile expenses.

"Getting a package from a depot to customers is the most expensive, time-consuming and polluting segment of the delivery process," Assistant Professor Sharan Srinivas said.

Srinivas and Arash Alizadeh, a Ph.D. student, are moving forward with plans to commercialize their system with help from the National Science Foundation's I-Corps, an immersive entrepreneurial program designed to help move research to the market.

The platform, called RoutePEARL, takes into consideration factors unique to emerging delivery fleets while also prioritizing safety. First, the platform considers whether a truck will drop an item off at its destination or if it would be more efficient to assign a drone to make the last-mile stop. Second, RoutePEARL considers the order in which trucks and drones should make stops. Third, it determines the sequence that drones should be deployed to avoid a potential collision. Finally, because drones must be able to communicate back to drivers, RoutePEARL optimizes routes that ensure network connectivity.

Srinivas is an assistant professor and director of graduate studies. His research interests include transportation/logistics, smart service systems and supply chains. This past year, he also devised a software model designed to make transport robots more efficient, developed an artificial intelligence-based tool to predict trends in steel prices and analyzed data from customer reviews to determine where airlines fall short of customer satisfaction.



electric last-mile tech Aeros

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CUSTOMIZING ELECTRODES FOR NEUROSCIENCE

Assistant Professor Yi Wang is working with collaborators from biomedical engineering, mechanical engineering and the MU School of Medicine to fabricate and provide neuro microelectrodes that can be used to further research around brain activity.

"I'm using hybrid manufacturing ways, including 3D printing and MEMS [micro-electro-mechanical systems] technology, to fabricate high-resolution neuro microelectrodes," Wang said. "By using 3D printing, we can save time and money, and we can customize electrodes for different neuroscience studies. In the coming years, my research focus will be on fabrication of multifunctional neuro microelectrodes to record neural activities and detect neural chemicals and transmitters."

Those findings can lead to improvements in medical treatments, as well as brain-machine interactions.

Wang came to Mizzou last fall. He earned a Ph.D. at North Carolina State University, where he presented a new flexible neural microbe and implementation strategy designed to record and stimulate neural activity under MRIs.

IMPROVING BLOOD SUPPLY CHAINS

Assistant Professor Suchi Rajendran has devised a system that could improve the efficiency of blood supply chains by optimizing multiple criteria. The method finds a balance between meeting medical demands and wasting donated platelets that expire.

"Typically people use single objective functions, but in this case, several conflicting factors have to be considered," she said. "If you have too much, platelets are perishable and are going to be wasted. But if you don't have enough, you're going to have a shortage and people will be denied service. The goal of the paper is to separate these into two components, taking conflicting factors into consideration to provide the best compromised solution."

Rajendran's analytics also take into consideration the cost of transporting blood units from blood banks to hospitals and other providers. She outlined her method in the journal Healthcare Analytics. It's believed to be one of the first papers to consider multiple objectives in the blood supply chain.



MONITORING REACTOR COOLANT PUMPS

Assistant Professor Kangwon Seo and his team devised a new technique to allow plants to monitor reactor coolant pumps more closely, allowing plant operators to flag abnormalities before they become problems.

He and Benjamin Oguejiofor, a Ph.D. student and first author, outlined their technique at the 2023 Annual Reliability and Maintainability Symposium, under the umbrella of the Institute of Electrical and Electronics Engineers. The work provides a blueprint that power plants can ultimately implement to better safeguard reactor pumps.

The novelty of the method is that it utilizes wavelet transforms to decompose vibration signals the reactor coolant pumps produce. Their technique separates and analyzes individual wavelets to flag abnormal vibration patterns or peaks.

"If an abnormal signal is locally concentrated, traditional methods won't capture that," Seo said. "One of the advantages of using the wavelets is that it captures local features."

NEW FACULTY



Hyeong Suk Na Assistant Professor Industrial and Systems Engineering

Hyeong Suk Na is an assistant professor in the University of Missouri Department of Industrial and Systems Engineering and leads the Smart, Sustainable and Resilient Systems (SSRS) Laboratory at the University of Missouri. Prior to joining Mizzou, he was an Ervin Pietz Assistant Professor in the Industrial Engineering Department at South Dakota School of Mines. His research interests include largescale stochastic optimization, stochastic networks and simulation modeling, artificial intelligence and machine learning. emergency management, and traffic operations and control. His research outcomes have been published in many leading journals such as Computers and Industrial Engineering, IISE Transactions, Transportation Research Part E: Logistics and Transportation Review, Safety Science, and Socio-Economic Planning Sciences. His work has been supported by various organizations including the National Science Foundation, the National Aeronautics and Space Administration, the South Dakota Board of Regents and the South Dakota Mines Foundation. He has a strong record of teaching various courses in Industrial Engineering and Operations Research.



Mike Klote

Associate Teaching Professor Joint Appointments: Engineering and Information Technology & Industrial and Systems Engineering

Mike Klote is an associate teaching professor for both Engineering and Information Technology and Industrial and Systems Engineering. Klote brings over 45 years of mechanical, electrical and mechatronics experience to both programs. He couples that industrial experience with over 35 years of experience teaching industrial technology. Klote previously worked for the College of Engineering for 28 years, with most of that time serving as the College's manager of technical labs and facilities manager. After early retirement in 2014, he started Moberly Area Community College's highly successful Mechatronics program. He has taught for the Columbia Area Career Center, Moberly Area Community College and MU. Klote has designed and implemented more than 30 state-of-the-art industrial technology labs, including a recent Columbia maker space. He specializes in designing and fabricating customized industrial training systems, instrumentation and tailored curriculum.

NSF REU FOCUSES ON AI-ENABLED OPERATIONS ENGINEERING

Ten students spent 10 weeks at Mizzou Engineering this summer learning about artificial intelligence (AI) models and how to best analyze large data sets.

The students were the first to participate in the Research Experiences for Undergraduates Site: Research on Perspective Analytics for AI-enabled Operations Engineering. The program is funded by the National Science Foundation and led by Principal Investigator Suchi Rajendran.

"It's been a great experience, connecting undergraduate students to our research areas so they can help develop models and gain new skills," Rajendran said.

Projects included predicting soybean yield utilizing aerial imagery; zero trust systems; AI-enabled operations in medical facilities and blood ordering policies; and determining the location of electric vehicle charging stations.

Rajendran was also awarded an NSF International Research Experiences for Students in AI-Enabled Decision Analytics for Advancing Air Taxi and Drone Operations. Participants gained research and industry experience in India, where they also pursued research with the Indian Institute of Technology, Madras.



ADVANCING AR CLASSROOMS

Senior Madeline Easley took first place in the ISE Undergraduate Research Competition this past year.

Easley presented work she's conducted with Associate Professor Jung Hyup Kim on using augmented reality (AR) classrooms. With funding from the National Science Foundation, the research team compared a current AR module, which uses an animated virtual instructor, against a protype built in 2020. In an ISE Ergonomics class, a unit of biomechanics was taught using AR, after which students were asked to evaluate their levels of physical and mental demand, effort, frustration and performance. Students this year reported a significant decrease in workloads from 2020.

"With the help of a virtual instructor guiding participants through the lecture, students rated their workload much lower, indicating that the instructor aided them through the process," Easley said. "I think this is because the new setup mirrors the classroom that students are familiar with. And for participants who have never used AR before — which was a vast majority of students — having an instructor gave them an immediate target to focus on."

Easley presented the work at Undergraduate Research Day at the Missouri State Capitol and at the Institute of Industrial and Systems Engineers (IISE) annual conference in New Orleans.



MIZZOU HOSTS IISE STUDENT CONFERENCE

Industrial engineering students from around the region had the opportunity to showcase projects, network with peers and tour campus and local manufacturing plants at the 2023 Institute of Industrial and Systems Engineers (IISE) South Central Regional conference hosted at Mizzou.

The three-day conference included a paper competition. Mizzou Engineering's team, Michael Stroud, Joshua Freeman and Madeline Easley, came in third place after sharing their simulation model used to analyze the state of operating rooms. Students also participated in a business competition during which they came up with ideas for new companies.

Keynote speakers at the IISE conference included ISE Hall of Fame members Mark Hense, B.S. IE '85, president and chief executive officer for TTG Inc.; Cynthia Bambini, B.S. IE '85, vice president, business development leader at CannonDesign; and V. Allan Samson, B.S. IE '92, senior vice president of marketing at T-Mobile.



MIZZOU STUDENTS TAKE HONORS AT CELDI RESEARCH SYMPOSIUM

ISE students took top honors for work around intelligent decision-making systems and optimizing manufacturing processes at the annual Center for Excellence in Logistics and Distribution (CELDi) Research Symposium.

Pyam Oveys, a Ph.D. student, received the Outstanding Graduate Student Award. Ray Wood, a senior industrial engineering major, received honorable mention in the Outstanding Undergraduate Student Award category. Both were on teams that tied for second place in the CELDi Research Symposium poster competition.

ISE HALL OF FAME INDUCTS 12

Twelve alumni were inducted into the Industrial and Systems Engineering Hall of Fame in October.

The Hall of Fame was established to honor distinguished industrial engineering graduates whose careers have made a significant impact within their fields.

"The ISE Hall of Fame is comprised of some of our most distinguished alumni," department Chair James Noble said. "They exemplify the best of industrial engineering and serve as tremendous role models to our students."

Also at the induction banquet, the department recognized three with Career Achievement Awards.

Nichole Alfonsi, B.S. IE '08, M.B.A. '09, received the junior career award. Alfonsi is a managing director at Deloitte.

Associate Professor Jung Hyup Kim received the Outstanding Faculty Award and Associate Teaching Professor Mike Klote received the Outstanding Instructor Award.



David Blackburn Vice President of Sealy and Stearns & Foster Assembly



Bart Fesperman Chief Commercial Officer Universal Technical Institute



Sean Heskett President of Fire Supression Potter Electric Signal Co.



Steve Jarboe Director of Shipping, Commerce, USPS



Steven J. Kunkel Vice President, Global Enterprises, Regal Rexnord



Chris Mowery Sr. Director, Northrop Grumman Propulsion



Adam Ruebsam President Tri Tech Automotive



Carol Shumate Chief of Staff Rockwell Automation



Mark Siebert Managing Director Performance Packaging Solutions



Deborah Thornburg President P&D Electric



Liz Trimble Director of Strategic Initiatives, Centene Corporation



Ryan Triplett Director of Product Development, Payment Networks, Mastercard

MIZZOU ENGINEERING ALUMNI AWARDS



KAREN HAMILTON

Karen Hamilton, B.S. IE '87, was honored with the James E. "Bud" Moulder Distinguished Alumni Award for her contributions to Mizzou, the College and the Department of Industrial and Systems Engineering (ISE).

"It's quite an honor to be among the people who have received this award in the past," she said. "It's a nice recognition for the different things I've been involved in."

Hamilton is semi-retired following a long career at Schneider Electric, Invensys and Motorola. When she left Schneider Electric, she was senior vice president of supply chain, quality and customer satisfaction. She has served as president of the ISE Hall of Fame and president of the Rocky Mountain Tigers alumni organization in Colorado.

ANDRE LOGAN

Andre Logan, B.S. IE '01, was honored with the Citation of Merit Award from the Mizzou Engineering Alumni Organization in recognition of his leadership and service to the College.

"I'm absolutely honored," he said. "I was definitely not expecting it. Looking back at some of the other recipients of the award, this is a big deal."

Logan is the Director of Strategic Initiatives at the University of Missouri-Kansas City. He has held a number of leadership roles in industry and academia, is a member of the Industrial and Systems Engineering Hall of Fame and a member of Mizzou Engineering's Inclusion, Diversity and Equity Alumni Advisory Council.





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Mizzou ISE Research Focus Areas

Advanced Manufacturing Applied Operations Research Data Analytics for Decision Making Emerging Transportation Logistics Healthcare Systems Human-Computer Interaction Quality and Reliability Engineering Supply Chain, Logistics, Material Flow

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Using data from here to predict 12 weeks forward