ANNUAL REPORT

2023-2024

THE UNIVERSITY OF MEMPHIS®
Herff College of Engineering

BY THE NUMBERS...

Research Expenditures

FY23	FY24
$21,474,189	$22,636,816

5.4% ↑

Graduate Student Facts

Total Headcount

FY23	226
FY24	245

8.4% ↑

Total Degrees Awarded

FY23	55
FY24	69

25.5% ↑

U.S. News & World Report

moved up 11 spots to

#141

Graduate Engineering

A year in review...

We have had a tremendous year at the University of Memphis Herff College of Engineering! We experienced remarkable growth in a variety of areas, including research funding and expenditures, that has set us up for a successful future. We have the opening of nearby Blue Oval City on the horizon, partnerships with industry leaders, as well as other opportunities for students and faculty to be involved in collaborative initiatives and projects.

Take a few moments to read about some of the exciting things going on in Memphis and our community through our amazing faculty and students. If you would like to work with us or discuss anything, please feel free to email me, *O.Okoli@memphis.edu*.

Sincerely,
Okenwa Okoli, Ph.D, CEng, CSci
Dean, Herff College of Engineering

Contents

PLANET-SAVING RESEARCH

Research focuses on the impact of plastic pollution on soil health

Increased plastic usage and waste management concerns have driven research by Dr. Farhad Jazaei, assistant professor in the Department of Civil Engineering in the Herff College of Engineering at the University of Memphis. Recognizing the potential impact of this type of research, the National Science Foundation awarded him a CAREER Award in the amount of $537,625 for his project entitled, “CAREER: Determining the mechanism and significance of microplastic pollution impacts on soil hydrology.”

This substantial funding boost will help Dr. Jazaei enhance his Microplastic Research Laboratory, enabling it to delve deeper into the study of emerging microplastic pollution in the soil environment and its potential impacts on soil-water-plant dynamics.

As part of the grant, his laboratory will conduct impactful research, provide hands-on learning experiences, and improve outreach efforts related to microplastic pollution. The project will provide valuable training and experiences for many undergraduate and graduate students to tackle growing microplastic pollution issues.

“I am absolutely thrilled and grateful for the awarded grant,” said Dr. Jazaei. “This is a game-changer for my Microplastic Research Laboratory. I am genuinely excited about the possibilities this funding opens up. It’s not just a project; it’s an opportunity to make significant breakthroughs in understanding microplastic pollution and uncovering its impact on the environment we live in and rely on. I am so hopeful that, with the support and engagement of students, my lab can make a real impact on understanding and addressing this new environmental challenge.”

“Reducing plastic pollution has been one of my priorities in Congress. Research into the impact of plastic pollution on our soils is a smart investment. I commend Dr. Jazaei and the University for receiving this prestigious National Science Foundation grant,” Cohen said in a statement about the funding.

- Congressman Steve Cohen (D-TN)

Herff hones engineering excellence with ERIC building

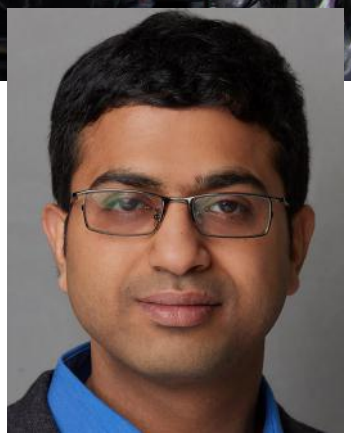
In early summer 2024, construction completed on the The Herff College of Engineering's new Edwards Research & Innovation Center(ERIC). A 65,000-square-foot facility, ERIC will serve as a new home for engineering research and instruction, as well as a competition, exhibition and seminar space. The new building serves as a signal to our students, faculty and the community that we are deeply dedicated to engineering excellence now and for decades to come.

ERIC will be home to innovative research for cyber security, workforce development, advanced manufacturing, hydrology, transportation, unmanned aerial systems, artificial intelligence, biomaterials, and more. Herff's research, projects and partnerships demonstrate UofM's ability to imagine possibilities, engage with partners, and create measurable impact.

"Our students, faculty, staff and community have something tangible to point to that proves our commitment to improving engineering education and research in the Mid-South. We are moving into a new era at Herff, and ERIC represents that progress and our ambitions for the future."

Dr. Okenwa Okoli, Dean

Research for the ages

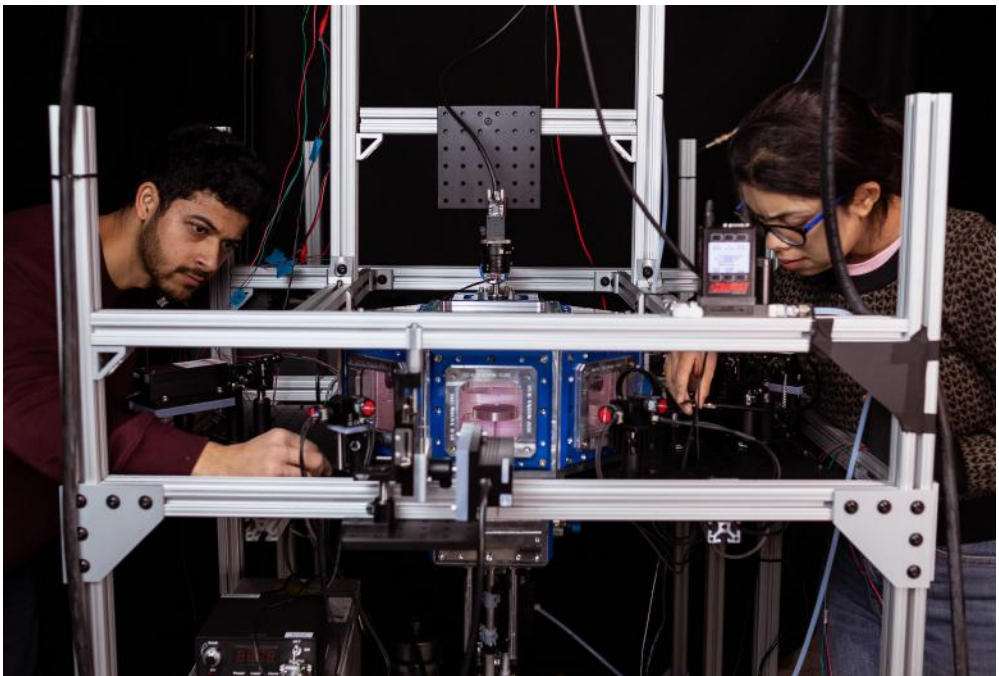


Conducting innovative research, breaking boundaries with high school students

Dr. Ranganathan Gopalakrishnan, associate professor in the departments of Mechanical Engineering and Biomedical Engineering and Graduate Program coordinator for Mechanical Engineering, is conducting ongoing research on the theoretical and experimental investigation of grain charging, coagulation, and heating in dense non-thermal dusty plasmas for large scale materials synthesis.

Thanks to a grant from the United States Army Research Office, a high school and undergraduate intern joined him in his lab over the summer to work on two specific projects tailored to their levels that will expose them to engineering research.

The high school student helped design a method to measure the temperature of small objects and possibly microparticles using Infrared imaging. The undergraduate worked on developing methods to introduce ceramic powders into a plasma in a controlled manner for materials processing applications. Interns received two months of paid research internship experience.



"This project aims to produce novel materials for specialized applications in bulk scale. We intend to hack plasmas to maximize materials production that can be taken further for commercial production," said Dr. Ranga, as he is known by his students. "Involving high school and undergraduate students in this project gives them exposure to real-time engineering and also tap their raw talent and eagerness to further our research."

FLYING HIGH:
MILITARY AWARDS MILLIONS FOR DRONE RESEARCH

Contracts from two military agencies are driving research being conducted by Dr. Eddie Jacobs and his team.

Dr. Jacobs has more than 20 years of experience in the modeling, analysis and development of military sensing systems in the private industry, government and academic perspective, as well as the unmanned aerial systems or drones.

Dr. Jacobs is a professor in the Department of Electrical and Computer Engineering and serves as the director of the Drones, Robotics, and Navigation Enabled Systems Research Cluster in the FedEx Institute of Technology at the UofM. He is also a senior researcher at the Center for Applied Earth Science and Engineering Research (CAESER).

Jacobs first began working on drones in 2016 with a project that involved building a drone that could take water samples, which encountered mixed results.

"We spent around $8K building that drone and it was very difficult to fly; flights were short and it crashed more often than I would have preferred," Jacobs recounted.

Since then, autopilots and other sensors have improved to the point where flights are routine and crashes are rare. He now uses a mix of custom made and commercial UAS platforms that are very reliable, which allows scientists to concentrate on the sensing and networking aspects of their research.

The Office of Naval Research and the Office of Naval Surface Warfare Center -Carderock Division (NSWC-CD) awarded Dr. Jacobs a contract worth $9.2 million to develop and test drones in adverse weather conditions. It is the hope that the research will help improve the odds for drones to successfully fly in heavy rains or on extremely windy days. As part of this, a state-of-the-art facility will be constructed for this research. In its early stages of planning, it will be located on President's Island at the William Morgan Large Cavitation Channel.

"The William Morgan Large Cavitation Channel is already a unique facility for testing ship and submarine components," said Jacobs. "We have the incredible opportunity to help build another unique facility for testing unmanned aerial systems (drones) in this space, greatly expanding the Navy's ability to develop and test these systems. When flying drones, we are often restricted to days that have calm winds and no rain. We will be able to accurately control the wind and generate rain in this new facility. This will help us design and test drones that can operate under more challenging conditions."

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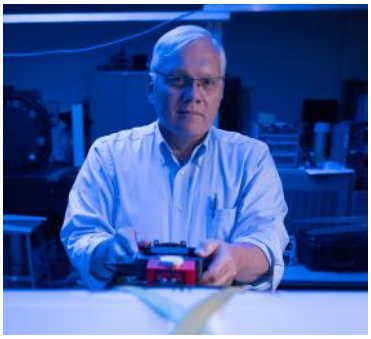
Dr. Jacobs is collaborating with researchers at the University of Arizona, the University of Central Florida and the University of Missouri-Kansas City, as well as others at the UofM.

Dr. Jacobs has also received a two-year $3.4 million grant from the Army Research Office. The grant will support the ongoing development of multiple drones for intelligence, surveillance, and reconnaissance. By combining various sensor technologies with multiple drones, the Army aims to enhance its situational awareness. This technology also has broad applications in agriculture and environmental assessment.

This project was secured with the assistance of the Memphis Institute for National Defense and Security (MINDS), which enables the pursuit and management of federal defense contracts procured through the National Defense Authorization Act.



According to Jacobs, in this latest research each drone-based sensor provides a different view of an area so that when the drones are combined, they give a clearer picture of what might be happening. The drone technology has applications for the military but also in agriculture and environmental assessment, he said.

> *"We will be able to accurately control the wind and generate rain in this new facility, This will help us design and test drones that can operate under more challenging conditions."*
>
> *- Dr. Eddie Jacobs*

"This grant provides opportunities for the University of Memphis to grow its research infrastructure while contributing to the advancement of drone-based sensor networks," Jacobs said. "It is also allowing me to provide terrific research opportunities to both graduate and undergraduate students."

NSF Award establishes EV/automated trucking center

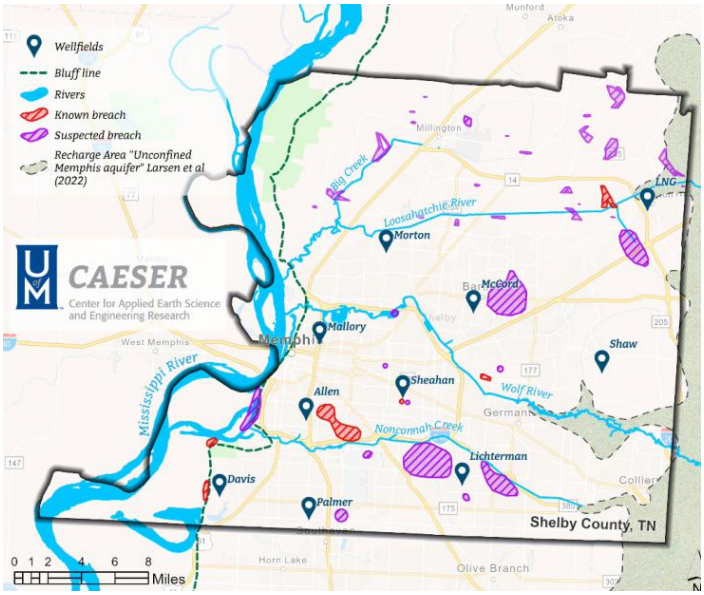
Civil Engineering Professor Dr. Sabya Mishra received the National Science Foundation's Industry University Cooperative Research Center (IUCRC) award to establish the Center for Electrified and Automated Trucking (CEAT). In collaboration with Purdue University in Indianapolis, CEAT will be a designated NSF IUCRC site at the University of Memphis from 2024-2029.

The combined support of NSF and industry members will be $1.5 million which will be used to focus on the future of automation, electrification, and next generation workforce of trucking and transit industry.

Dr. Mishra is lead principal investigator for this multi-disciplinary project, working with co-principal investigators Dr. Hasan Ali, Electrical Engineering; Dr. Myounggyu Won, Computer Science; and Dr. Mehdi Amini, Supply Chain and Business Management.

Commercial vehicles play a pivotal role in our society in moving people and goods. This project aims to converge and apply knowledge in emerging technologies in connected, electrified, and automated commercial vehicles and logistics networks for efficient, safe, agile, and sustainable mobility for the benefit of society.

CAESER receives 5-year, $9.75 Million to study aquifer



The Center for Applied Earth Sciences and Engineering Research (CAESER) at the University of Memphis was awarded a five-year, $9.75 million contract to continue research on water quality for the Memphis aquifer from the City of Memphis and Memphis Light, Gas and Water (MLGW).

In 2018, MLGW awarded CAESER a five-year $5 million contract amid concerns about water quality for the Memphis aquifer and the condition of the clay confining layer, or aquitard, protecting it. The results of this study showed their concern to be valid.

The study increased the knowledge of known and suspected breaches from two to six and from six to 36, respectively. Though research is showing that the clay layer is not as continuous as previously thought, CAESER Director Dr. Brian Waldron said that the water is safe for now but the city needs to be proactive. To this end, the City of Memphis, through the Tennessee Department of Environment and Conservation, and MLGW awarded the contract to continue the research.

Some of the focus for the next five years will be developing innovative technology for remote sensing aquitard breaches in urban areas, developing more advanced computer models to better understand the movement of water and contaminants and provide actionable conservation measures.

SCAN ME

CAESER earns governor's award

The University of Memphis' Center for Applied Earth Science and Engineering Research (CAESER) received the 2024 Governor's Environmental Stewardship Award for its outstanding work in water quality. Tennessee Governor Bill Lee and Tennessee Department of Environment and Conservation (TDEC) Commissioner David Salyers announced this prestigious recognition.

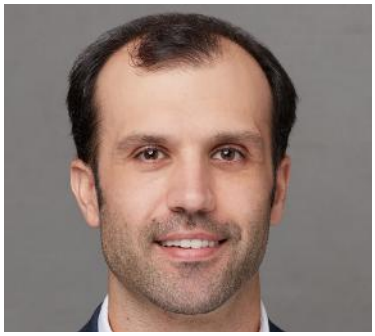
RESEARCH HIGHLIGHTS

Dr. Ali gets two patents for research

Dr. Hasan Ali, Electrical & Computer Engineering professor, received two patents. One was for the "System and Method for Improving Transient Stability of Grid-Connected Wind Generator System" (US Patent no. 11,990,752) and the other was for the "Triple-Function Battery Energy Storage System for Hybrid Microgrid System" (US Patent no. 11862979) with Morteza Daviran Keshavarzi. Dr. Ali heads the Electric Power and Energy Systems Laboratory at the University of Memphis. His main field of interest includes advanced power systems, smart-grid and micro-grid systems, cyber security issues and solutions to modern power grids, electric vehicle charging system and station, renewable energy systems, energy storage systems, grid resiliency, grid modernization, and workforce development.

Dr. Curry receives grant for bridge program

Dr. Amy de Jongh Curry, Biomedical Engineering, has been awarded a 5-year, $973,767 grant entitled "Bridges to Baccalaureate Research Training Program at The University of Memphis," from the National Institutes of Health (National Institute of General Medical Sciences). The overall goal of the program is to prepare a diverse group of highly trained biomedical scientists to enhance the diversity of individuals entering the biomedical research workforce. Dr. Curry is also the associate dean of Academic Affairs & Administration.



Dr. Foti conducts Naval Research

Dr. Daniel Foti was awarded $1M from the Office of Naval Research (ONR) for his project "Cavitation Erosion: Model to Full Scale." The overall goal of the project is to improve the Navy's understanding of cavitation erosion and associated performance loss of naval propulsors, control devices, and surfaces, as well as establish the capabilities in the William B. Morgan Large Cavitation Channel (LCC) to undertake full-scale experiments of cavitation erosion. Dr. Daniel Foti is the overall principal investigator with Dr. Amir Hadadzadeh and Dr. Yuan Gao, all in the Department of Mechanical Engineering, funded on the project.

Dr. Jennings receives research patent

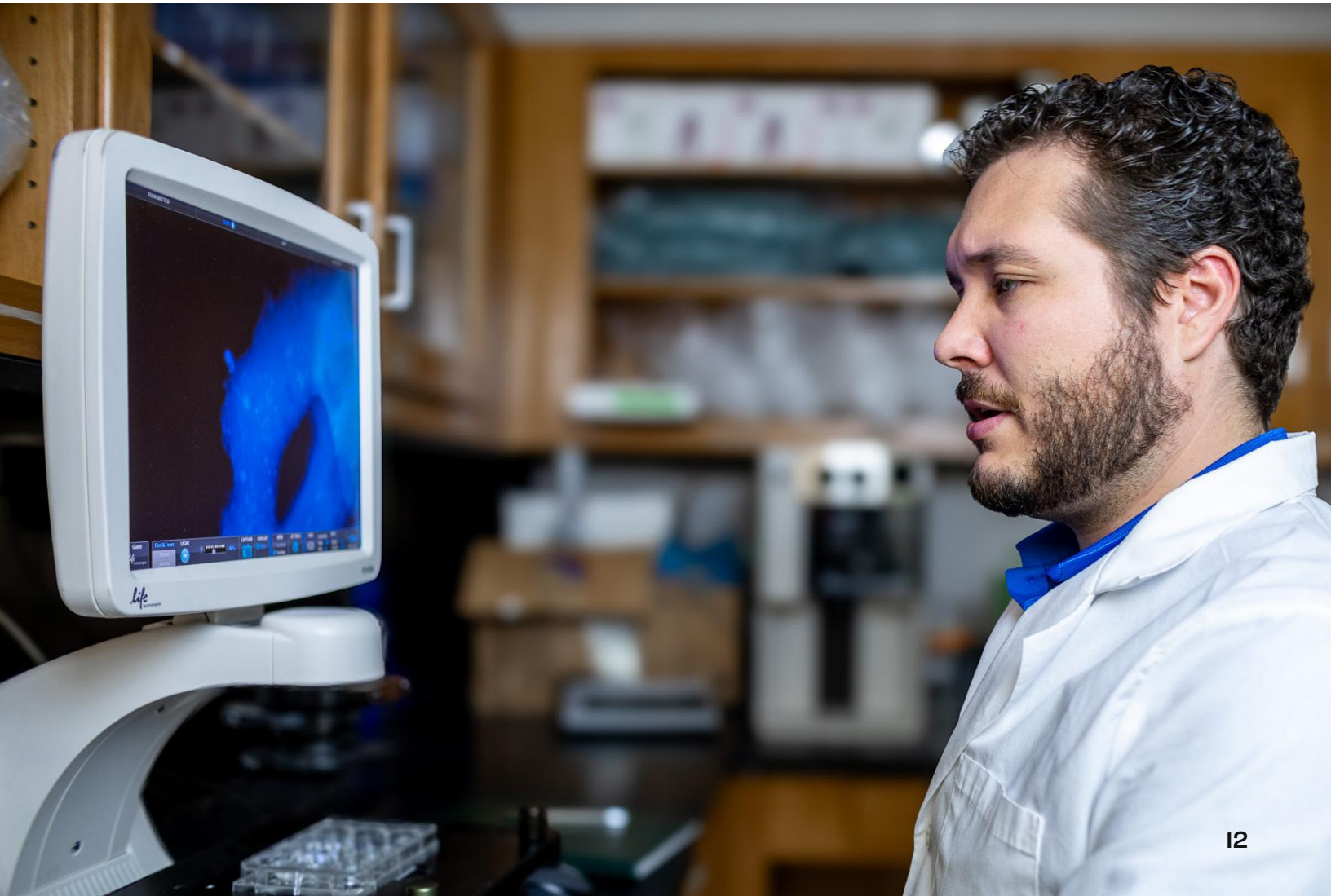
Dr. Jessica Amber Jennings, associate professor in Biomedical Engineering, is the lead inventor of the patent "Controlling Biofilms with Cyclopropanated Fatty Acids." Jennings's research focuses on the composition and methods for using cyclopropanated structural analogs of fatty acid biofilm dispersal agents which are characterized by superior biofilm dispersion. When these agents are used in combination with antimicrobials, these analogs decrease the minimum inhibitory concentration of antimicrobial agents required for eradication of the biofilm and/or treatment of infection. Applications for this technology include wound dressings that decrease infection rates and provide better healing.

Dr. Pezeshk establishes new center

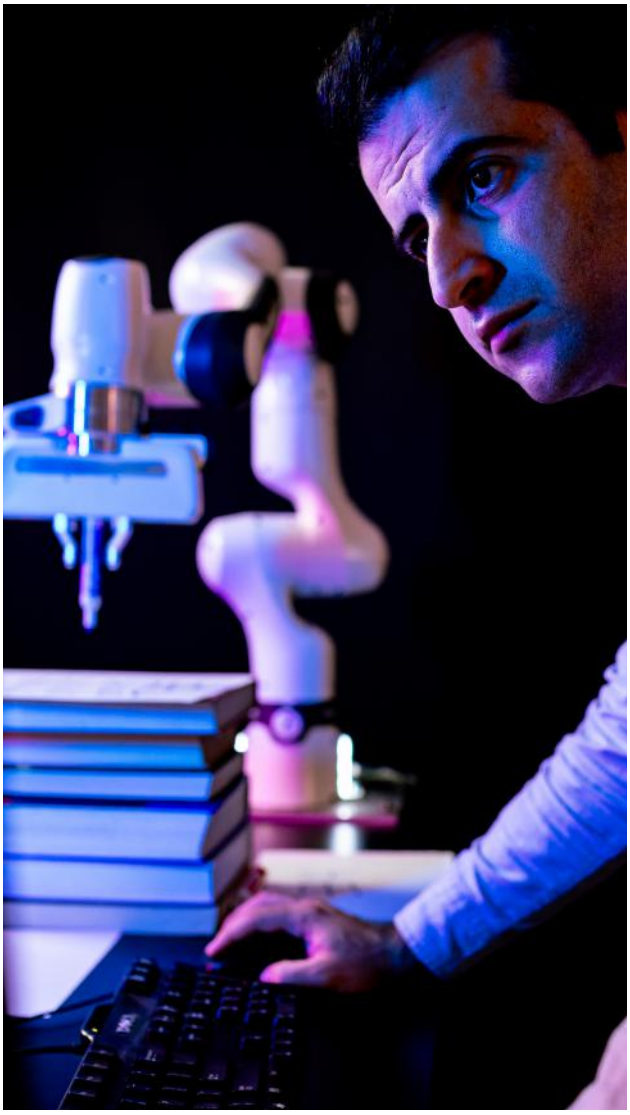
Dr. Shahram Pezeshk, professor and former chair of the Civil Engineering Department, launched a new center in partnership with the Shelby County Government to increase disaster resiliency across the Mid-South. The Center for Disaster Recovery and Resiliency (CDRR) will address this critical need by developing multidisciplinary research products and community programs to understand the potential impacts of natural hazards and support the development of appropriate emergency plans for extreme weather events and earthquakes.

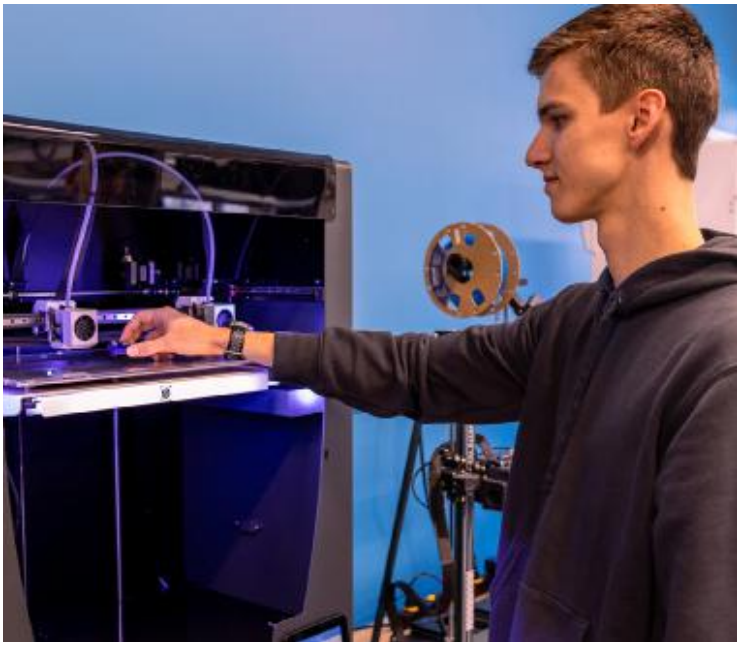
Dr. Ranga receives dry powder patent

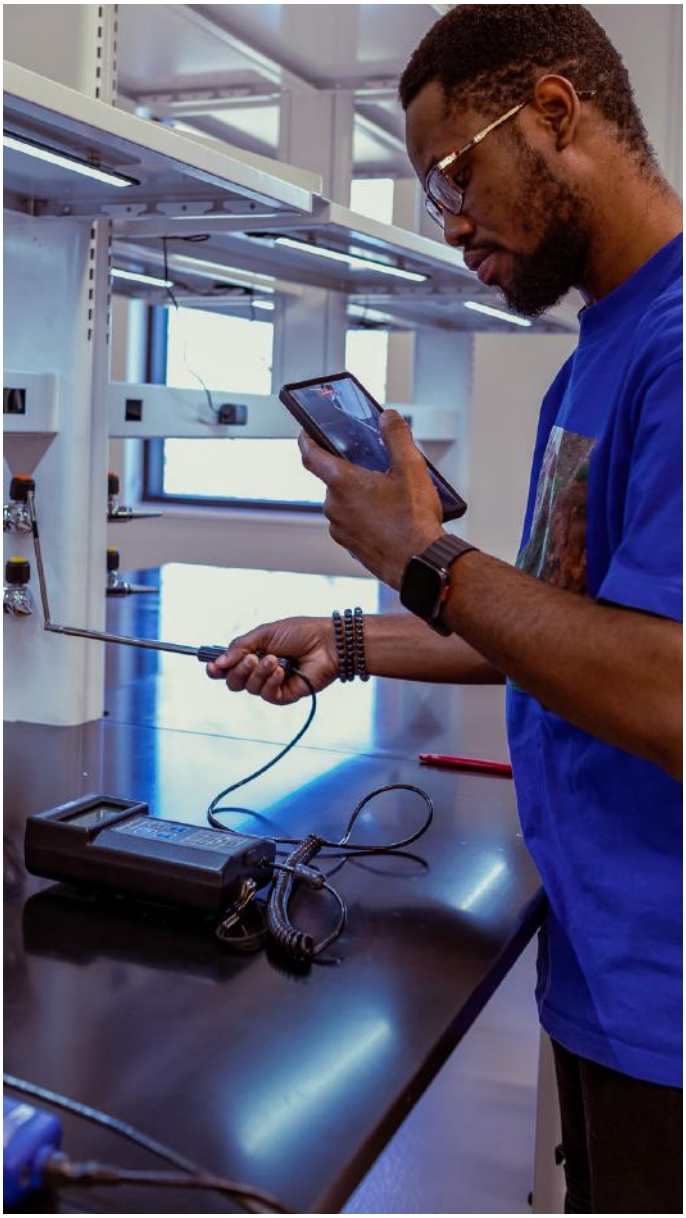
Dr. Ranganathan Gopalakrishnan, R. Eugene Smith associate professor and Graduate Program coordinator of Mechanical Engineering, is the lead inventor of the patent “Systems and Methods for the Dispersion of Dry Powder.” According to Dr. Gopalakrishnan, this patent describes systems and methods for preparing and dispersing dry powders at high concentratiaon for long periods of time. Potential applications of this invention are in the areas of aerosol drug delivery, surface cleaning, reaction engineering and powder manufacturing.




HEIDELBERG INSTRUMENTS







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