2022 ANNUAL REPORT
MECHANICAL & AEROSPACE ENGINEERING

College of Engineering
University of Missouri
4 Mizzou Engineering Celebrates Opening of MU Materials Science & Engineering Institute

5 Rogers: MU Materials Science & Engineering Institute Will be Catalyst for Innovation

6 Research at Mizzou Engineering Could Help Reduce Cost to Build Particle Accelerators

7 Using AI to Work Harder and Smarter

8-9 New Method to Design Semiconductors

10 Mizzou Engineer Using Machine Learning to Solve Growing Space Debris Problem

10 Professor Designs New Landing Strategy

11 Chen Researching Condensation in Space

12 In Pursuit of Better Lithium-ion Batteries

13 Ma Awarded Patent for Second Generation Mug

14 Engineers Develop Robot to Automatically Inspect Heat Exchangers in Power Plants

15 Team Creating System to Monitor Vital Signs

16 MAE Welcomes Four New Faculty Members

17 UM Curators Name Hongbin ‘Bill’ Ma Curators’ Distinguished Professor

17 Midwest IAC Earns DOE 2022 Center of the Year

18 Mizzou Space Program is Reaching for the Stars, Looking to the Future

19 Mizzou Formula SAE Team Speeds Ahead of Competition at National Events

19 Torq’N Tigers Finish Second at ASABE Quarter Scale Tractor Competition

20 Heart of the Matter: Oliver Part of Team Devising New Way to Detect Heart Disease

20 MU Engineer Earns Award at Visual Art Showcase

21 Bond Awarded Department of Defense Scholarship

21 MAE Student Selected for Mizzou ‘39 Award

22 Merkel Prepared for Aerospace Engineering

22 Langenbeck Recognized with Mizzou Alumni Association Faculty Alumni Award

23 Departmental Statistic Highlights
Mechanical engineering at Mizzou continues to grow. In the past 20 years, we’ve increased faculty from 15 to 28 and undergraduate enrollment from about 230 in 2000 to nearly 700 this year. With newly updated lab spaces equipped with state-of-the-art facilities, MAE’s research expenditure has grown six times over the last 20 years. This past year, we added another milestone with the opening of the MU Materials Science & Engineering Institute (MUMSEI).

Our researchers continue to push boundaries and discover new possibilities. This past year, MAE faculty have developed a new method to design semiconductors, developed a machine learning model to predict vital signs and integrated artificial intelligence into material development. On the aerospace side, faculty continue to investigate condensation in zero-gravity environments and new ways to monitor space objects.

We also continue to build upon the undergraduate curriculum, adding an Introduction to Manufacturing Processes course to give students hands-on experiences with lathe and milling machines. We’ve also recently opened four labs around manufacturing processes, instruments, material and manufacturing and thermal/fluid dynamics.

Our students continue to excel in the College and across campus. As you’ll read later in this report, students received awards for their undergraduate research and service to Mizzou at large.

MAE has a more than 100-year history of engineering excellence at Mizzou, and our future looks brighter than ever!
A new institute at Mizzou will advance collaboration around materials research and education across campus. University and College leaders celebrated the grand opening of the MU Materials Science & Engineering Institute (MUMSEI) at a symposium and ribbon cutting event in May.

The institute is a partnership between Mizzou Engineering and the College of Arts & Science and includes faculty from 10 academic departments. Matt Maschmann, associate professor of mechanical and aerospace engineering, and Tommy Sewell, professor of chemistry, will co-direct MUMSEI.

“The study of materials intersects engineering, physics, chemistry, biology, and more,” Maschmann said. “We expect this institute to lead to numerous opportunities for joint projects and proposals as material development is of significant interest to government agencies and industries.”

Ultimately, the goal is to create smarter, safer and more efficient ways of living, said Sewell, who is also an adjunct instructor in mechanical and aerospace engineering.

“Material is in every aspect of our daily lives,” Sewell said. “We’re excited to explore ways in which we can analyze and develop materials that can be used to improve society.”

MUMSEI includes the new Materials Characterization and Fabrication facility—a clean room and lab space on the third floor of Lafferre Hall that houses cutting-edge equipment to fabricate and characterize the properties of diverse material systems. Adjacent to the MCF facility, materials researchers will share lab spaces to promote collaboration and build a cohesive materials community. Mizzou Engineering researchers will work with faculty from the chemistry, physics, biology and other sciences at Mizzou to investigate the design and application of high-performing materials through machine learning, atomistic simulations and other emerging technologies.
Rogers: MU Materials Science & Engineering Institute Will Be Catalyst for Innovation

The new MU Materials Science & Engineering Institute will be a catalyst for innovative research and discoveries that could lead to technologies to solve some of the world’s most pressing problems, Dr. John A. Rogers said.

And if anyone knows about connecting fundamental sciences to world-changing technologies it’s Rogers. A member of the National Academy of Science, National Academy of Medicine and National Academy of Engineering, Rogers is widely considered the father of the field of bio-integrated electronic technology. He has more than 80 patents and patent applications for devices and patches that interface with the human body to continuously monitor and measure physiological changes.

Rogers delivered the keynote address at the MUMSEI Symposium and Ribbon Cutting in May and joined university administrators to help celebrate the opening of the institute.

“The University of Missouri has a number of prominent faculty members in areas of materials science, but up until this point, it’s been a fairly distributed collection of programs and efforts driven by individual faculty,” said Rogers, who is director of the Querrey-Simpson Institute for Bioelectronics at Northwestern University. “This institute will serve as a really powerful vehicle for pulling those faculty together and establishing a mechanism to drive collaborative work.”

While at Mizzou, Rogers joined the next generation of engineers at the Spring 2022 Commencement ceremony, where he addressed graduates before receiving an honorary doctorate.

Rogers earned his undergraduate degrees from the University of Texas at Austin and a PhD from Massachusetts Institute of Technology (MIT). He also was a Junior Fellow in the Society of Fellows at Harvard University, a member of technical staff and director at Bell Laboratories and the highest chaired faculty member at the University of Illinois and the Beckman Institute for Advanced Science and Technology.
Research at Mizzou Engineering Could Help Reduce Cost to Build Particle Accelerators

If Mizzou Engineers are successful, that price tag of particle accelerators could drop dramatically and be more easily manufactured for medical and commercial applications.

Associate Professor Matt Maschmann and collaborator Scott Kovaleski, professor of electrical engineering and computer science, believe carbon nanotubes could provide an affordable alternative. Carbon nanotubes, or CNTs, are tiny tubes of rolled carbon.

“If we can make those carbon sources of electrons a viable, useful thing, it opens up this opportunity to proliferate that technology and make it more available and more capable,” Kovaleski said.

But first, researchers will need to figure out how to grow the perfect carbon nanotube configuration for the job. Scientists know how to make CNTs in the lab, but they’ve not yet figured out how to control their properties and behaviors when they grow in mass quantities.

In the MU Materials Science & Engineering Institute (MUMSEI), Maschmann is using both simulated and physical environments to determine what properties a CNT would need to have to best work for radiofrequency generators.

“The whole idea is that we want to generate devices that emit electrons,” Maschmann said. “In order to do that, you apply a high electric field, high enough to extract electrons from the materials. One of the benefits of CNTs in particular is there is a geometric effect to pulling electrons off of materials. CNTs are very narrow in diameter, and that actually causes a localized electric field enhancement, making it easier to draw electrons off of them.”

The team outlined the project at the IEEE International Conference on Plasma Science this spring.
Using AI to Work Harder and Smarter

Supported by a two-year, $4.875 million grant from the U.S. Army Engineer Research and Development Center (ERDC), Associate Professor Matt Maschmann and collaborators are developing a theoretical framework around “explainable AI” to describe how the next-generation of AI can be integrated into the innovation process for designing new and existing materials.

One of the team’s goals is finding a way to accelerate the discovery process by helping make better quality materials in a shorter period of time. To do this, Maschmann and Derek Anderson, associate professor of electrical engineering and computer science, are starting with how to integrate AI and machine learning into the process.

“One of the more pressing challenges in the development of new materials, or optimization of existing materials, is the time required by the processing and characterization steps,” Maschmann said. “Making discoveries takes quite a bit of time and money. If we can introduce machine learning algorithms and AI into the process, it could drastically reduce the time needed to obtain material properties of interest. My hope is this project will greatly increase the rate of discovery for developing materials while also increasing our fundamental understanding of these processes.”
Mizzou Engineers have come up with a novel new technique to design semiconductors, the chips that make your phones, laptops and other devices not only smart, but also compact.

Associate Professor Matt Maschmann and team outlined a proof of concept for their technique in a recent issue of Nano Select and worked with the Technology Advancement Office to file an application to patent the work. Now, they’re hoping to scale up and optimize the process to make it viable in industry.

“It’s not practical yet, but we want to take the underlying mechanism and make it scalable and something attractive to the semiconductor industry,” Maschmann said.

Semiconductors are made of layers of thin films, each of which are deposited or etched with specific patterns that impact their functions. Aligning patterns between processing steps makes the manufacturing process especially complex. The new process invented by Maschmann and Matthias Young is a different type of a technique known as area-selective atomic layer deposition (AS-ALD).
“To make these microchips, you need to control matter at the nanoscale; you need to control where atoms are positioned and where material is on a scale that's a thousand times smaller than a human hair,” said Young, an assistant professor in biomedical, biological and chemical engineering. “For faster computers, you need to control matter on a smaller scale, approaching the size of an atom.”

Right now, AS-ALD occurs using self-assembled monolayers to block deposition of material in areas where it is not desired. Essentially, a liquid is spread onto a silicon wafer shaped with the desired pattern. Similar to a stencil, that allows the liquid to cover specific spaces without covering undesired areas.

Young and Maschmann have taken the opposite approach. They’re using an electron beam as a “pencil” to write the patterns exactly where they want them. And they’re doing that work in a low-pressure water vapor, dissociating water molecules in collisions with the electron beam. One byproduct of the reaction is hydroxyl molecular groups, the initial layer of chemical functionalization needed for atomic layer deposition.

“It’s not a common environment to have: water vapor and focused electron beams,” Maschmann said.

The research is under the umbrella of the MU Materials Science & Engineering Institute.
Companies are launching satellites into orbit at a dizzying pace with no plans to clean them up once they’ve completed their missions. That means dead satellites are floating in space with no one controlling them, leaving them vulnerable to collisions.

“Space is becoming more and more crowded,” Professor Ming Xin said, “and solutions are becoming more and more urgent.”

While studies are underway on best practices to remove space debris, right now there’s no good method to know exactly what’s out there. That’s because once a satellite is no longer in use, it stops being controlled. Xin compared it to putting tens of thousands of vehicles on a highway system without any signage or traffic regulations.

Xin is working on a model that could not only track space objects but also predict their behaviors, including potential collisions that would send new debris and particles into orbit. He’s using machine learning to train a model with historic and current data and has plans to retrain the model when new data becomes available. In a paper published in the Journal of Aerospace Information Systems, Xin and a collaborator outlined their plans for a data-driven surrogate model and admissible-region-based orbital uncertainty propagation.

“In our paper, we are investigating the problem of how to predict space objects accurately without measurement and without observation,” Xin said. “Using available sensing data, we’re trying to build a machine learning model that can fairly accurately predict the future position and velocity of space objects. As new measurements come in, we can retrain the model to be more and more accurate.”

Landing a spacecraft on Mars isn’t an easy feat. According to NASA, only about 40 percent of all Mars missions have succeeded, because it requires a vehicle to go from 12,500 miles per hour to zero in a short amount of time while adjusting for heat, pressure and other constraints. Now, Professor Ming Xin is proposing a new landing strategy that could be more efficient and effective than current methods.

Xin designed a guidance law to be computationally more efficient and more precise. His design is based on the range of a spacecraft’s entry trajectory rather than on traditional variables such as time and energy.

“The mission is the same: to get the spacecraft to Mars safely and efficiently, but we use a very different approach,” Xin said. “Here, we are using range as the independent variable to propagate the dynamics more accurately and solve the trajectory optimization problem more easily.”

Xin and co-authors published this new guidance law in the Journal of Guidance, Control, and Dynamics, a premier journal in American Institute of Aeronautics and Astronautics (AIAA).
Professor Chung-Lung “C.L.” Chen received a continuation of grant funding from NASA to send his research team to G-FORCE ONE, a zero-gravity facility in Florida to continue research around water in space.

During previous trips, students conducted experiments around electrowetting, a technique that uses electric fields to improve condensation on surface areas.

With a device developed in Chen’s lab, the team was able to significantly enhance condensation, which could lead to effective ways to harvest water on spacecraft such as the International Space Station.

The electrowetting technology also allows better control of water droplet dynamics. Rather than falling downward as they do on earth, water droplets move in different directions via electrowetting without gravity.

“When we use electrowetting to make a specific spot of surface wet, we can become more strategic in time and space with patterned hybrid surface,” Chen said. “If we know more about fundamental mechanism of condensation dynamics, we can control it and change surface wettability adaptively.”

On board a space station, this would give astronauts control over limited moisture. For instance, they may want droplets close to computational devices or instrumentation to absorb the heat from those electronics.
From personal electronics to electric vehicles, lithium-ion batteries are used in many technologies today. Over the last 30 years, scientists have worked to improve the overall safety and performance of these batteries by converting a key component, called electrolytes, from liquid to solid — partly due to an issue of the liquid being flammable.

Yet, while solid-state lithium-ion batteries — using solid electrolytes — are considered by many to be the next big advancement in battery technology, these batteries continue to suffer from performance issues. That’s why a team of researchers at the University of Missouri are working to figure out why this is happening.

What the team discovers through their research could ultimately help advance the future of battery technology as scientists continue developing solutions for a safer lithium-ion battery that’s also better optimized for energy performance.

The team recently received a three-year, $500,000 grant from the National Science Foundation (NSF) to better understand the origin of this issue, which they believe may occur at a key connection point on the battery.

To help the team determine their findings, they will use a specialized electron microscope — a Thermo Fisher Scientific Spectra 300 Transmission Electron Microscope (TEM) — from the Electron Microscopy Core (EMC) located in the Roy Blunt NextGen Precision Health building. The microscope is capable of seeing and identifying atoms, according to Xiaoqing He, senior scientist in the EMC and adjunct assistant professor of MAE.

“Understanding interphase layer formation at the cathode/solid-electrolyte junction,” was awarded by the National Science Foundation.
A new coffee mug on the market instantly cools boiling liquids to the ideal drinking temperature. It’s the second generation of the Burnout Mug, designed by Mizzou Engineering’s Hongbin “Bill” Ma.

Ma was recently awarded a patent for the cooling technology, and the Burnout 2.0 mug is currently available through his company.

The first Burnout mug was revolutionary in that it cools hot coffee to the perfect drinking temperature in minutes and keeps this temperature for hours.

“In the first mug, it takes three to eight minutes to cool the coffee to the perfect drinking temperature,” said Ma, Curators’ Distinguished Professor and Chair of mechanical and aerospace engineering. “Last year, we launched the new coffee mug. You can pour coffee in and drink it immediately, so that’s a big difference.”

The liquid flows through an insulated container, then out of small holes along the bottom to a microchannel formed between the container and mug inner wall, where it becomes the drinkable temperature. In other words, the scalding hot coffee becomes drinkable instantly only when you take a drink. Consumers have the option of using a special container to add tea leaves or coffee flavoring, as well.

Ma’s quest for the perfect drinkware set continues this year as he and his team are putting the final touches on a mug that can be frozen to keep soda, water or beer cold for hours without ice. Another thermos, a two-temperature bottle, allows for beverages to be enjoyed either cold or at room temperature.

Mugs are just one of the products Ma has developed and commercialized through two companies he co-founded, ThermAvant Technologies and ThermAvant International. Researchers there are also developing other products based on phase-change heat transfer and oscillating heat pipes.

Also last year, Ma was awarded a patent for a dehumidifier that is quieter and more efficient than others on the market. While the noise is about the same level as a running laptop, his team is working to make it quieter still. The next iteration will also serve as both dehumidifier to remove moisture from the air and humidifier to add moisture during drier conditions.

MAE Professor Frank Feng is also named on the patent for the thermoelectric dehumidifier.
The demand for energy is expected to increase rapidly over the coming decades, and power plants need to run efficiently to keep up. That’s why a Mizzou Engineering team is designing a robot that can automatically inspect heat exchangers, devices that are critical to generating electricity.

Right now, power plants use a technique known as eddy-current testing (ECT) to detect and characterize flaws in some power plant components such as heat exchangers.

“To keep power plants at high efficiency, you need to maintain the heat exchangers regularly, and that requires human technicians with experience and steady manipulation to operate the ECT inspection device,” said Bujingda Zheng, a PhD student under the supervision of Associate Professor Jian Lin. “That process is time-consuming and labor-intensive. Our goal is to develop a robotic platform that autonomously do the operation, obtain the data, and then analyze it with a trained machine learning model.”

The robot is on a Mecanum-wheeled chassis, making it mobile, and it uses machine vision to locate tube bundles and inlets inside of the exchangers. The robot can operate the ECT probe to collect information from the exchangers, and the system analyzes the data in real time to alert power plant operators of any problems.

The machine learning component ensures that the robot will become smarter over time. As it collects information from a wider variety of heat exchangers, the computer will build upon its knowledge and learn all the unique ways the devices could be defective.

“We’re training the machine on what to look for in regard to what’s defective and what’s working,” Zheng said. “In order to make the machine more commercially viable in the future, we have to collect information from enough tubes to make our own comprehensive data set.”

In addition to building the data set, researchers are also looking for ways to make the prototype more agile and compact for industrial use.

This work was accepted for publication in Journal of Field Robotics. Authors are Bujingda Zheng, Dr. Jheng-Wun Su, Lin’s prior Ph.D. student, currently an assistant professor at Slipper Rock University (Pennsylvania), Yunchao Xie, Jonathan Miles who was a MAE undergraduate, Hong Wang, Wenxin Gao, MAE Professor Ming Xin, and Lin. Former MU Power Plant Director Gregg Coffin offered consulting information for this project. This project was funded by US Department of Energy (Award #: DE-FE0031645) under the management of Dr. Heather A. Hunter at National Energy Technology Laboratory (NETL).
A Mizzou Engineering team is developing a system that will monitor vital signs and may someday be able to alert people when they need to seek medical care.

The system includes a finger clip with two sensors that use optical light to penetrate blood vessels, said Jian Lin, associate professor and William R. Kimel Faculty Fellow in mechanical and aerospace engineering. It then measures how fast blood flows from one sensor to the other, providing information that can then be used to calculate blood pressure, heart rate, blood oxygen saturation, respiratory rate and temperature.

“These vital signs have strong correlations with certain diseases such as COVID-19, influenza and lung-related diseases,” Lin said. “Using machine learning algorithms, the system can monitor changes in vital signs as time goes by and provide an alert when people need to see a doctor.”

Lin and Richard Byfield, a PhD student, demonstrated its ability to predict blood pressure on 26 student participants. The system predicted systolic, or maximum, blood pressure with 88% accuracy.

They outlined their results in this month’s issue of IEEE Sensors Journal, under the umbrella of the Institute of Electrical and Electronics Engineers.

The paper is just the first step, Lin said. Now, Byfield is developing a database of diseases that can be diagnosed based on vital signs. When completed, the system will be able to compare a person’s measurements against the database to indicate the presence of disease.

“The input will be all five vital signs, and the output will be to tell you if you’re healthy or at risk of a specific disease,” Byfield said. “We’re using active learning, which means the system is learning what your ranges are in real time and will update the model as it receives new information.

The research team has filed a preliminary patent for the system, which they plan to commercialize for at-home monitoring.

Health care professionals have indicated the need for the device in clinical settings, as well, Byfield said.

“We interviewed 30 nurses and the number one problem they cite is the number of devices they have to use,” he said, adding that vital signs often spike when patients are uncomfortable in a doctor’s office. “Your breathing rate changes, your heart rate changes, your blood pressure changes.”
The Department of Mechanical and Aerospace Engineering welcomed four new faculty members this fall.

Yue Jin is an assistant professor. Before joining Mizzou, he worked as a postdoctoral research associate at MIT. His research interests span multiple areas of thermal-fluid sciences and nuclear engineering, including fluid flow mass and heat transfer, reactor thermal hydraulics, design, modeling and optimization of complex energy systems. He received his PhD from Pennsylvania State University.

Mushuang Liu is an assistant professor. Before joining Missouri, she worked as a postdoc at the University of Michigan, Ann Arbor, Michigan. She received her PhD from University of Texas at Arlington and a bachelor’s from University of Electronic Science and Technology of China. Her research interest lies in control and optimization for multi-agent systems using techniques from control theory, game theory and machine learning.

Christopher O’Bryan is an assistant professor. He received his PhD, master’s and bachelor’s from the University of Florida. His research focuses on exploring the instabilities that arise at the interface between soft materials, leveraging these instabilities to design new biomaterials, and developing new design principles for soft matter manufacturing.

Yao Zhai is an assistant professor. His research interest is in design, fabrication and characterization of optical materials and opto-electronic devices for energy, infrared imaging and biomedical engineering. He has a PhD from the University of Colorado-Boulder, a master’s from University of Massachusetts-Lowell and from Chinese Academy of Science and a bachelor’s from Tianjin University.
The Midwest IAC was honored with the 2022 Center of the Year Award by the U.S. Department of Energy (DOE). Professor and Midwest IAC Director Sanjeev Khanna accepted the award at the DOE Directors’ annual meeting in Denver this summer. The Office of Energy Efficiency and Renewable Energy chose the center from among 39 IACs in the United States.

“This recognition is a testimony to the impact the Midwest IAC is having on our region’s manufacturing sector by making it more energy efficient and reducing any adverse effects on the environment, while improving their financial bottom-line and training energy savvy engineers,” Khanna said. “The 2022 Best Center of the Year award is a great encouragement to the students and staff at the center, and we look forward to expanding our services.”

The Midwest IAC provides manufacturers with free energy assessments. The IAC aims to help companies cut down on energy consumption, carbon dioxide emissions and realize significant cost savings. To date, that work has resulted in more than $102 million in energy cost savings. More than 300 manufacturing companies in Missouri and Kansas have benefited from IAC energy assessments, and more than 80 students have graduated from the program.
Mizzou Space Program is Reaching for the Stars, Looking to the Future

The Mizzou Space Program’s performance has been out of this world, and the team is aiming even higher this academic year.

MSP recently attended two competitions, including the Argonia Cup in April, where they placed 6th. The result was an improvement from last year, when they could not recover their rocket during the competition, said Abigail Penfield, MSP president.

In June, there were more than 150 teams selected to compete at the Spaceport America Cup, the world’s largest intercollegiate rocketry competition, with 93 teams meeting the requirements to compete. MSP placed 14th in their category of 47 teams and 24th overall.
Mizzou Formula SAE Team Speeds Ahead of Competition at National Events

Mizzou Engineering’s formula car team has been speeding ahead of the competition, placing within the top 20 teams at two recent events, including at the Michigan International Speedway.

Mizzou’s formula team competes as a part of Formula SAE (FSAE), organized by SAE International. The car is quarter scale, meaning it’s about ¼ the size of a standard formula one vehicle. Students build on work from the previous year to build a more competitive vehicle.

“The 2021-2022 season saw a ton of improvement,” said Spencer Goldstein, a member of the team. “The team has been rebuilding from COVID and finally got into a position to be competitive again in 2022.”

Torq’N Tigers Finish Second at ASABE Quarter Scale Tractor Competition

The University of Missouri Torq’N Tigers team earned second place honors during the American Society of Agricultural and Biological Engineers (ASABE) International Quarter-Scale Tractor Student Design Competition. To go along with the second-place finish, the team also took top honors in the Overall Performance Event. This was the 25th anniversary of the event, which took place June 2-6 in Peoria, Ill.

Students are challenged to harness the power and torque of a specified stock engine during the competition, in order to maximize performance during a series of challenges.
Heart of the Matter: Oliver Part of Team Devising New Way to Detect Heart Disease

Heart disease remains the leading cause of death in the U.S., many times claiming its victims without warning. Maggie Oliver, a PhD student in mechanical engineering, hopes to help to change that. She’s working with Noah Manring, Dean of the College of Engineering and Ketcham Professor, and Dr. Senthil Kumar from University of Missouri Hospital on research that would make it easier to uncover signs of cardiovascular problems.

Oliver — who recently received a graduate fellowship from the College of Engineering Foundation — said her team is specifically trying to devise a way to determine someone’s cardiovascular age based on the thickness of the aorta. They are doing that by correlating information from echocardiograms, which provide information about how a heart beats and pumps blood, with data from pulse wave velocity machines and using basic values of hydraulic flow.

Together, those calculations could provide a clearer picture of whether a person’s cardiovascular system has aged more rapidly than the person’s chronological age.

“Once you know that information, you know if you’re at risk of a stroke or heart attack,” Oliver said. “Our long-term goal is to see whether weight loss or exercise programs can help reverse the aging or even just stop the aging — anything we can do to make it less likely you’ll die from cardiovascular disease. It could be life-changing if it works out.”

MU Engineer Earns Award at Visual Art Showcase

Emily Werner, a senior in mechanical engineering, won an Award of Merit in Applied Design at MU’s Visual Art and Design Showcase. Her pieces were displayed at the Columbia Art League, and she was recognized at a reception on Monday during Undergraduate Research Week.

The Visual Art and Design Showcase is a venue for undergraduate students to display and discuss scholarly work in an exhibition setting. Werner’s work, “Origami Hyperboloids,” was one of eight projects selected for an award by a jury panel of three Mizzou alumni who are professional artists.

For the event, Werner created a pair of origami sculptures defined by mathematics and inspired by hyperbolic surfaces. In both, the geometry and curvature of the sculptures are dependent on the two-dimensional folding pattern, creating features the material otherwise could not exhibit.

The work has a wide range of possible applications such as collapsible robotics that use biomaterials, aerospace deployable mechanisms and architecture in civil engineering design.
MAE Student Selected for Mizzou ‘39 Award

An MAE student was selected for the Mizzou ‘39 Award, a prestigious honor that recognizes outstanding academic achievement, leadership and service to the University of Missouri.

This past year, Ymbar Polanco Pino conducted undergraduate research through the Massachusetts Institute of Technology, where he studied plasma physics in the electric propulsion systems of spacecraft. He was also a part of Mizzou’s zero-gravity NASA Space Grant research team, where he studies microfluidics in a zero-gravity environment on-board the G-FORCE ONE aircraft in Florida. At Mizzou, he was a McNair Research Scholar who conducted research around energy harvesting and renewable energy. Polanco Pino has been a member of the National Society of Black Engineers (NSBE) all four years and led the reinstatement of the Society of Hispanic Professional Engineers (SHPE) chapter at Mizzou.

Bond Awarded Department of Defense Scholarship

Graham Bond — a junior mechanical engineering major — was awarded a full-tuition scholarship that guarantees him two years of civilian employment with the Department of Defense immediately after he graduates.

When he’s not working in Associate Professor Jian Lin’s advanced manufacturing lab, Bond is minoring in music, taking piano lessons from award-winning pianist Peter Miyamoto and oboe lessons from composer, arranger and performer Dan Willett, both of whom are professors in the School of Music.

“One of the reasons I chose Mizzou is because I can be a mechanical engineering major and do all of this undergraduate research while simultaneously taking music lessons from world-class faculty. You can’t do that at many universities,” he said.

“And through the Honors College Discovery Fellows Program, I was able to start in the lab right when I got to campus. You can’t do that at a lot of universities, either.”

Bond is one of just three Mizzou students in the University’s history — the first since 2010 — to receive the Department of Defense Science, Mathematics and Research for Transformation Scholarship.

The award provides students with full tuition for up to five years, guaranteed summer internships, a stipend and full-time employment with the Department of Defense after graduation. Bond interviewed and was selected to work with the U.S. Army Corps of Engineers in Omaha, Nebraska. Specifically, he’ll work in the fueling systems division.

“I am incredibly thankful for the generous support of the Department of Defense and the United States Army Corps of Engineer - Omaha District,” he said. “With the SMART Scholarship, I will be able to dramatically improve my academic and professional development and tangibly impact the crucial strategic research performed by the DOD.”
Merkel Prepared for Aerospace Engineering

Anna Merkel

University of Missouri graduate Anna Merkel landed a job at SpaceX following graduation in May. But even though she’s shooting for the stars, Merkel stressed her feet will remain firmly grounded on planet Earth.

“I’ve always been interested in how sending satellites to space or humans to the moon relates back to improving life here,” she said. “Space exploration has led to so many improvements on Earth, and that’s the really cool part.”

At Mizzou, Merkel conducted undergraduate research around drones, helped start the MU Student Astronomical Society and was a Stamps Scholar in the Honors College. She also got involved in the Society of Women Engineers, Mizzou Space Program and Alpha Omega Epsilon, the engineering sorority.

Among her most impactful experiences as a Tiger were an internship at NASA’s Jet Propulsion Lab and an eight-month co-op at Sierra Nevada Corporation.

“Thanks to the organizations I was a part of at Mizzou, I was able to get great professional and networking experience,” she said. “Attending the Society of Women Engineers national conference several times has allowed me to get internships and jobs in my field, connections I would not have made otherwise.”

Langenbeck Recognized with Mizzou Alumni Association Faculty Alumni Award

Sharon Langenbeck

Sharon Langenbeck, BS ME ’74, MS ’76, PhD ’79, who retired from NASA’s Jet Propulsion Laboratory, received a Faculty Alumni Award from the Mizzou Alumni Association this fall.

In 1979, Langenbeck became the first woman at Mizzou to graduate with a doctorate in mechanical and aerospace engineering. This would be the first of many “firsts” during her long career in a historically male-dominated profession; she was the first woman with an engineering PhD employed by Lockheed-California Company. Later, after joining NASA’s Jet Propulsion Laboratory (JPL), she was selected as the first woman to manage one of the engineering sections, which included over 200 mechanical engineers. She also served as the mechanical engineering project manager for developing a replacement instrument to correct a defect in the Hubble Space Telescope’s mirror following its launch in 1990. For this work, she was awarded the NASA Exceptional Service Medal in 1993.

As a Mizzou PhD student, Langenbeck won the Amelia Earhart Fellowship awarded by Zonta International, a leading global organization dedicated to empowering women through service and advocacy. She remained involved with the organization throughout her career, and, after holding various leadership positions, she was named President and CEO in 2020.
TOTAL

674
MAE STUDENTS

UNDERGRADUATE
619
STUDENTS

GRADUATE
55
STUDENTS

28
Mechanical & Aerospace
Engineering Faculty

29
Average ACT Score
For First Year
Students

Areas of Focus within MAE
Aerospace Vehicle Flight Mechanics and Control
Fluid Power Systems
Metamaterials - Elasticity
Nanomaterials, Nanotechnology
Topology Insulators
Thermal Management
Materials
Machine Learning

Campus Initiatives
MU Materials Science and
Engineering Institute (MUMSEI)

Centers and Signature Programs
Midwest Industrial Assessment Center (IAC)
Multiphysics Energy Research Center (MERC)