Research at the forefront from the **UMKC School of Computing and Engineering**

VANGUARD

INTRODUCING UMKC'S NEWEST DISCOVERY HUB

/FROM THE DEAN

Dear friends,

I hope this magazine finds you well. It has been a difficult year for many of us, and as we begin to heal from the upheaval and loss of the past 18 months, I'm excited to share a moment of good news and joy. This year we watched as the Robert W. Plaster Free Enterprise and Research Center came alive with the ideas and passion of our research faculty and their students.

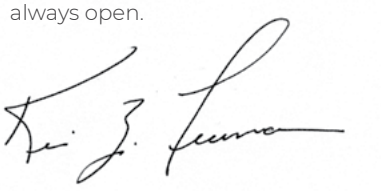
Seven years ago, the School of Computing and Engineering (SCE) embarked on a new journey. By more than doubling our student population in five years, we had outgrown our home in Flarsheim Hall. Beyond the restrictions of the physical space, the laboratories and equipment simply could not match the level of research being dreamed up by our faculty. We needed more, bigger, better.

Thanks to the strong support of our community, in September 2020, we got it. The Plaster Center is exactly what SCE needs to rise to the next level — to meet the challenges of next-generation research and prepare our students for a 21st century workforce.

In this new facility, we have the only clean room on UMKC's campus. The building is home to more than $3 million in 3D printing equipment. We have a flight simulator, an AR/VR showroom and developer's workspace, a machine shop, solar panels , wind turbines and so, so much more.

In the pages of this issue of Vanguard, we hope to give you a glimpse of everything the Plaster Center has to offer. We wanted to tell you the stories already taking shape within these walls and challenge your own thinking.

This space is not just for our students, faculty and staff. This space belongs to all of us — our alumni, our industry partners, innovators and entrepreneurs across the Kansas City region. Reach out! Tell us your ideas and let us see how we can help. The Plaster Center is meant to inspire, and my door is always open.



KEVIN Z. TRUMAN, PH.D., F.ASCE
Vice Provost, UMKC
Dean, School of Computing and Engineering

VANGUARD

/'VAN,GÄRD/
A group of people leading the way in new developments or ideas

Research at the forefront from the **UMKC SCHOOL OF COMPUTING AND ENGINEERING**

PRODUCTION
UMKC Division of Strategic Marketing and Communications

MANAGING EDITORS
Sara Atchison
Lindsey Mayfield

ART DIRECTOR/DESIGNER
Michael Duah

CONTRIBUTING WRITERS
Sara Atchison, Kelly Edwards, Greg Hack, Kelsey Haynes, John Martellaro, Lindsey Mayfield, Patricia O'Dell

PHOTOGRAPHER
Brandon Parigo

Cover photo by Randy Braley, image courtesy of HOK Architects

Contact us
Flarsheim Hall, Room 534
5110 Rockhill Road
Kansas City, MO 64110
816-235-2399
sce@umkc.edu

sce.umkc.edu

Relay Missouri: 800-735-2966 (TTY)
SCE 20094981

UMKC
School of Computing and Engineering

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Above, a 3D bioprinter in the Plaster Center's new Clean Room prints "UMKC" using biocompatible self-assembling materials. The machine uses UV curing emissions, which emit blue light while working and green light when complete.

BRANDON PARIGO

Located on the east side of campus at the corner of East 51st Street and Rockhill Road, the Plaster Center represents the limitless imaginations of UMKC faculty and students.

BRANDON PARIGO

How to use this e-magazine
Whenever you see this icon, bold text or a button, click through to read more or share the story on social media. The magnifying glass tool can be used to zoom in or out.

INTRODUCING UMKC'S NEWEST DISCOVERY HUB

Welcome to the Robert W. Plaster Free Enterprise and Research Center

The Plaster Center isn't just an addition to the university's skyline — it's an expansion of what's possible for our outstanding students and faculty at the School of Computing and Engineering.

In this issue, we'll introduce you to some of the groundbreaking research already taking place inside and what you can expect in the years to come.

In his new lab within the Plaster Center, Dianxiang Xu, Ph.D., takes on cybersecurity threats using deep learning models, a specialized area of artificial intelligence.

BRANDON PARIGO

Read online or share on social media

REINING IN SOFTWARE TROJAN HORSES

Deep learning research identifies cybersecurity risks

BY JOHN MARTELLARO

What's the easiest way for hackers or spies to penetrate a secured computer network?

Have the network managers open the door and invite them in.

Almost all networks purchase basic software from third-party creators. The bad guys have figured out that the third parties present an opportunity for them to penetrate software-supplier systems and hide malware inside the software to be purchased. The software becomes a digital Trojan horse, carrying attackers inside the network's walls.

That was the strategy behind a huge espionage campaign, first revealed in December 2020, that compromised several major U.S. government agencies, including the Justice Department and the Treasury, as well as private companies including Google and Microsoft. It has been described as one of the largest and most successful digital espionage cases in history.

That's where Professor Dianxiang Xu comes in. In the SS&C Data Analytics, Cybersecurity and High Performance Computing Facility of the Robert W. Plaster Free Enterprise and Research Center, Xu is using deep learning models, a specialized area of artificial intelligence (AI), to help combat the emerging threat. The goal is to use static code analysis of computer programs to find potential defects and security vulnerabilities. The work is funded by a National Science Foundation grant.

"Software vulnerability is a major source of cybersecurity risks. It is very difficult to identify vulnerabilities in software code as software has significantly increased in both size and complexity," Xu says. "Finding software vulnerabilities is analogous to 'searching for a needle in a haystack.' Recent advances in deep learning can be promising for predicting software vulnerabilities."

Spies and hackers aren't the only bad guys Xu is working to combat. He is also studying ways to use AI to collect and process digital evidence for presentation to juries in court. Xu is basing his network security work on a deep learning model known as The Transformer.

"The Transformer is a deep learning model introduced in 2017, used primarily in the field of natural language processing, or NLP," he says. "It has enabled training on larger datasets than was possible before it was introduced. The pretrained transformer systems such as BERT (Bidirectional Encoder Representations from Transformers) have achieved state-of-the-art performance on a number of NLP tasks."

> *Finding software vulnerabilities is analogous to 'searching for a needle in a haystack.' Recent advances in deep learning can be promising for predicting software vulnerabilities.*
>
> — DIANXIANG XU, PH.D.

"Considering the similarity and difference between natural languages and programming languages, we expect the transformer systems can be pre-trained with a large amount of computer code so as to improve various program-understanding tasks, such as detection of vulnerabilities in source code."

So, how vital is the anti-spyware research underway by computer scientists such as Xu?

In an article for ***The New Yorker***, Sue Halpern wrote: "The simple truth is that cyber defense is hard, and in a country like the United States, where so much of our critical infrastructure is privately owned, it's even harder. Every router, every software program, every industrial controller may inadvertently offer a way for malicious actors to enter and compromise a network."

Inside the Plaster Center, Xu can be found chipping away at those many cyber threats, one model at a time.

IF IT PLEASES THE COURT

Using AI to train lawyers to present digital evidence

In the 21st century, evidence is often measured in bits and bytes. Emails. Browser histories. Images and documents buried deep in hidden files and folders.

The challenge for attorneys is to present such evidence in ways that both satisfy the rules of admissible evidence and are understandable and convincing to jurors.

Professor Dianxiang Xu is researching ways to use graph-based AI models to represent, store and visualize digital forensic evidence. Presentations would include timelines indicating when items were created, what types of software were used and correlate different pieces and types of evidence.

"My project focuses on the development of educational materials so that students can learn to collect and process digital evidence," Xu says. "The evidence should be presented in a way that is easy to follow and admissible in a court of law."

//DIANXIANG XU, PH.D.
Professor, Department of Computer Science Electrical Engineering

PLASTER CENTER SPACE
SS&C Data Analytics, Cybersecurity and High Performance Computing Facility

RESEARCH INTERESTS
Software security, access control, software engineering, data analytics, software-defined networking

JOINED UMKC
2019

In the Plaster Center's new Clean Room, Zahra Niroobakhsh, Ph.D., and her students have access to a 3D bioprinter and other technologies that assist in their bio- and nanomaterials research.

BRANDON PARIGO

NOW THAT'S CLEAN

Plaster Center's contamination-free area has specs that get rid of the specks

BY GREG HACK

Read online or share on social media

When working with bio- and nanomaterials, success can hinge on keeping dust and other impurities out of the process. So for Assistant Professor Zahra Niroobakhsh and her colleagues, it was good news that the Robert W. Plaster Free Enterprise and Research Center would include a top-notch clean room.

"In the past I've had to use facilities in Lawrence, Kansas, for some work or order materials from elsewhere to start experiments, which can be very expensive," says Niroobakhsh, an assistant professor in the Department of Civil and Mechanical Engineering. "But now we have the 3D bioprinters … and the Clean Room, to be able to make everything right here."

APPLICATIONS ACROSS CAMPUS

For Niroobakhsh, "everything" covers a wide range of research interests and applications. She frequently works with other departments and schools, including chemistry, dentistry, medicine and pharmacy.

Clean Room experiments often involve designing and printing soft nanomaterials, which exist in a state between solid and liquid, then studying how they react and interact in different situations. Because the materials can be designed molecule by molecule, Niroobakhsh and her team can produce the tiny building blocks for all sorts of collaborative research and applications.

In petroleum engineering, for example, the aim can be to improve emulsions used in oil spill cleanup, or to enhance the substances used to recover more oil from a well. In pharmaceuticals, experiments can seek more stable and effective ways to deliver drugs or coat a microchip with a material that can detect virus or disease. And in medicine, the building blocks for cells can be tweaked depending on what is being studied.

Niroobakhsh's team has worked with Peter Koulen, a professor in the UMKC School of Medicine who has led several groundbreaking research projects at the school's Vision Research Center.

"Tissues for different parts of the body have different mechanical properties," Niroobakhsh says. "We can 'tune' the biomaterials we are printing so they will produce cells with the properties needed in Dr. Koulen's work for different parts of the eye."

As versatile as Niroobakhsh's work has been already, she's looking forward to the much more advanced 3D printers available to her in the new Clean Room.

"One of my graduate students built a 3D printer we use," she says, reflecting the school's can-do approach. "But our new printer will allow us to inject six different liquids simultaneously and to switch materials during the print. It also has much higher resolution and other capabilities. We're very excited!"

EMBRACING NEW POSSIBILITIES

Niroobakhsh is used to change and progress. When she joined the faculty

Our new printer will allow us to inject six different liquids simultaneously and to switch materials during the print. It also has much higher resolution and other capabilities. We're very excited!"

— ZAHRA NIROOBAKSH, PH.D.

in 2018, she brought international experience to the school, having earned her doctorate in materials science and engineering at Penn State, her master's degree in Germany and her bachelor's degree in Iran.

She also set right to work establishing her lab, including procuring the right equipment for her work. Niroobakhsh says her rheometer, which measures the flow of most materials, is the only one in the area.

One of her closest collaborators, Stefan Lohfeld, also joined UMKC in 2018 as an assistant professor at the School of Dentistry. They teach the Introduction to Biomaterials course together, using a textbook co-written by UMKC Chancellor C. Mauli Agrawal. They both also utilize bioprinters in their research, and lean on each other for support and perspective. Their printers use different processes, and they often talk about which might be better for a particular task or experiment.

"My printer at SCE uses light to solidify liquid polymers layer by layer to build a device," Lohfeld says. That Continuous Digital Light Process, or cDLP, "is faster as it manufactures a full layer at a time. This is useful for larger constructs and could be important in mass production. But my printer can't use multiple materials at once, unlike Dr. Niroobakhsh's new high-end machine."

Lohfeld has a master's in production engineering with a focus on materials sciences and his doctorate in materials sciences. He is, essentially, an engineer that works in the School of Dentistry. That works out well, because Sarah Dallas and others at the dental school are leaders in bone-muscle tissue research, and Lohfeld is expert at printing scaffolds on which research cells can grow for tissue engineering.

Lohfeld says the Plaster Center "really gives us access to technologies we haven't had before, which allows us to expand our research on materials and their processing."

Besides the research possibilities, Niroobakhsh is eager to have her students see what's possible from a well-equipped clean room.

"I'm not sure yet how much access there would be for a whole class," she says. "But the Clean Room's walls are glass, so we will be able to show students what is being done and explain the processes. ... The new facilities will have so many benefits for us."

//ZAHRA NIROOBAKHSH, PH.D.
Assistant Professor, Department of Civil and Mechanical Engineering

PLASTER CENTER SPACE
Clean Room

RESEARCH INTERESTS
Microfluidics; 3D printing of bio- and nanomaterials; soft materials including surfactants, lipids, colloids and polymers; bulk and interfacial rheologies; and fluid dynamics of non-Newtonian flows

JOINED UMKC
2018

/TWO SIDES OF THE CLEAN ROOM

RATED ISO 7 AND CLASS 10,000

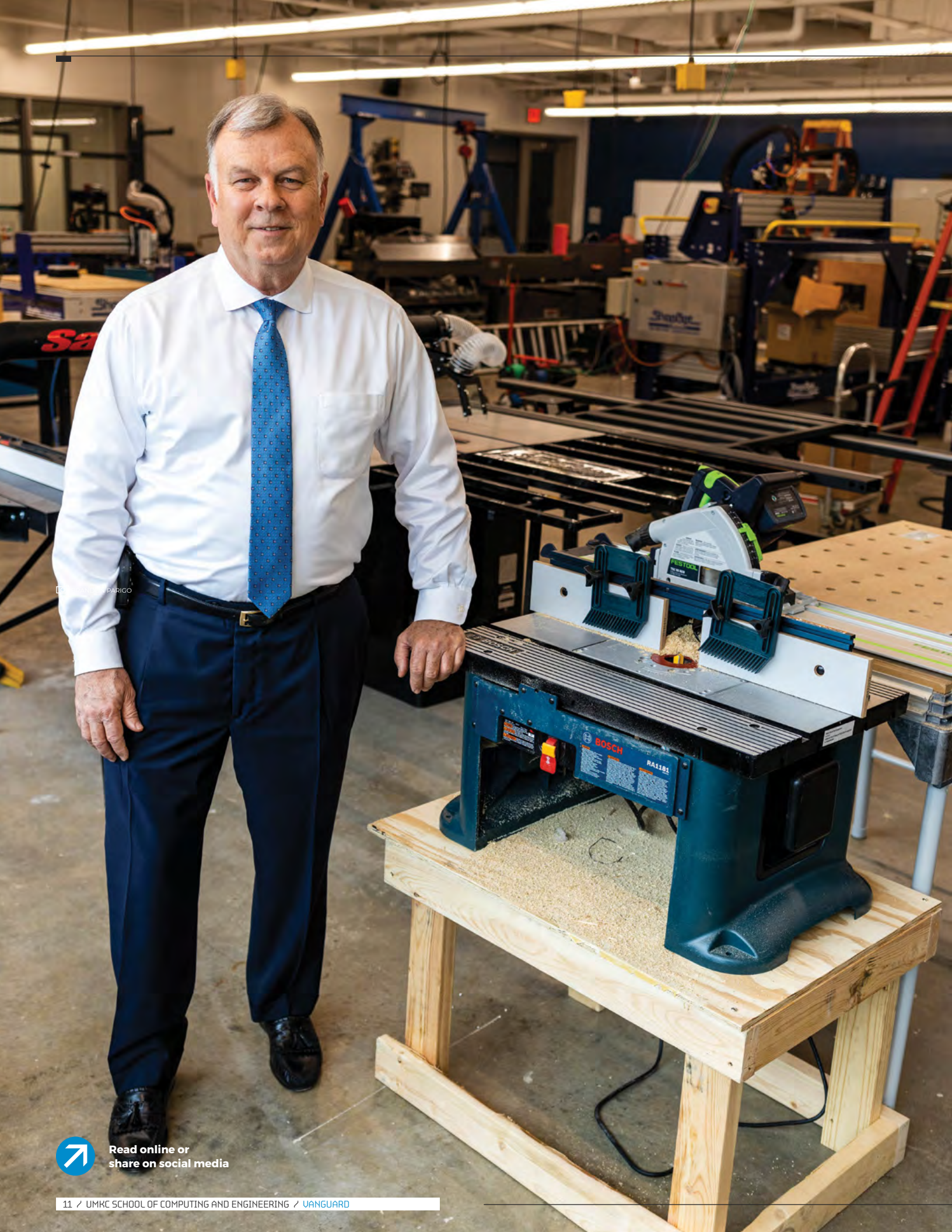
Participants can wear street clothes with shoe covers. The 10,000 refers to the maximum number of particles larger than half a micron per cubic foot of air.

The air in the ISO 7 side is changed out 60 times per hour; the ISO 6 air is changed 180 times an hour. An ultra-purification system also keeps the water pristine.

RATED ISO 6 AND CLASS 1,000

Occupants must wear gowns. It has no more than 1,000 half-micron or larger particles per cubic foot of air.

The ISO 6 side has a room isolated from vibrations fully shielded from electromagnetic and radio frequency interference. It houses a scanning electron microscope used to image nanocircuitry.



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COLLIDE AND CREATE

New Innovation Studio brings together UMKC and the community

BY PATRICIA O'DELL

Dean Kevin Truman has vision.

As he walks through the halls and labs of the UMKC Innovation Studio in the Robert W. Plaster Free Enterprise and Research Center, he sees progress, growth and untold opportunity.

"This is a place for entrepreneurs to come, collide and create," he says. "It's digital to physical."

While the machines are quiet and the few students in the building work independently and masked, Truman's eyes are alight with the certain creation of new products, new processes and new collaborations that will not only build UMKC and the school, but also the community.

"We hope to see art students from the Kansas City Art Institute, K-12 students interested in science, technology, engineering and math, or enthusiasts of the virtual reality world."

While providing some familiar components, the Innovation Studio is different than traditional makers' spaces. For example, the space provides access to new technologies for rapid prototyping using the 3D printing lab.

"The makers' spaces in town do a great job serving their market, but we are focused on entrepreneurship," Truman says. "We can provide services to companies, researchers and the community. It may be someone building one model, but if they need to make 20 prototypes to make sure they've gotten it right, we can also accommodate that."

The Ewing Marion Kauffman Foundation is a major partner and funder in the Innovation Studio. They consider the programs and spaces for students, faculty, staff and the community as critical to the regional entrepreneurial ecosystem.

"Our grant to UMKC helps build on the university's strong foundation of student- and community-facing entrepreneurship support programs," says Melissa Roberts Chapman, senior program officer at the Kauffman Foundation. "That includes the Innovation Studio. We are excited to work together to see how entrepreneurship can help remake our regional economy to become more equitable, more vibrant and more innovative."

Students will also have the opportunity to take advantage of the labs in the Innovation Studio and will be able to work at cost. In order to maintain state-of-the-art capabilities, community members will be charged reasonable fees. The center will maintain a staff for assistance, training and maintenance, and there will be a shop manager to help with 3D printing.

"Our 3D printing facility is one of the top five in the country," Truman says. "Someone could send a graphics package here and a technician can use the company's files to create what they need. The machine can create product composed of metals including titanium, machine grade steel or copper. We'd track the materials used, pack and ship it to them. It couldn't be easier."

The Augmented and Virtual Reality (AVR) lab will have the very latest technology. Professionals and enthusiasts can use the AVR Training Lab to experience the newest augmented and virtual reality technology. The AVR Showroom can accommodate meetings, product development and training. Visitors, whether they are enthusiasts or professionals, can experience the latest virtual reality technology as well as learn the latest 3D design and development software.

"We will be a hub of information," Truman says. "We have relationships with others and are excited to share resources. We are not an island. We are here to create community."

PLASTER CENTER SPACE
UMKC Innovation Studio

INVESTING IN FUTURE TALENT

Two-story Structural Lab helps prepare Kansas City's next generation of civil engineers

BY SARA ATCHISON

There's no denying Kansas City is a hub for civil engineers.

With international industry leaders such as Burns and McDonnell and Black and Veatch headquartered locally, Kansas City maintains a uniquely high demand for new recruits trained in the field. So even before the plans for the new Plaster Center began to take shape, SCE leadership knew it was critical to provide students with a state-of-the-art structural lab.

Today, the UMKC Structural Lab occupies the west wing of the Robert W. Plaster Free Enterprise and Research Center. This two-story facility is designed to test full-size structural components like highway beams.

"It is always a benefit for structural engineers to see how their designs are constructed in reality," says John Kevern, Ph.D, chair of the Department of Civil and Mechanical Engineering. "This hands-on experience provides a level of practicality that we haven't been able to offer before and will improve the quality of all civil engineering students."

In addition to preparing graduates for competitive jobs here in Kansas City and beyond, the Structural Lab will allow faculty to propose projects using non-traditional materials and analysis techniques because they now have a testbed for validation and verification.

/BY THE NUMBERS

20T The two-story crane can support up to 20 tons.

52' Beams up to 53 feet can be unloaded and tested.

//JOHN KEVERN, PH.D., P.E.
Professor and Department Chair of Civil and Mechanical Engineering

PLASTER CENTER SPACE
Structural Lab

RESEARCH INTERESTS
Concrete mixture proportioning, development of sustainable construction materials related to concrete, pervious concrete mixture design, construction and testing, concrete material analysis, development of testing procedures and pavement performance, durability of concrete materials, beneficial material byproduct utilization

JOINED UMKC
2008

One of the most striking spaces in the Plaster Center, the Structural Lab provides new hands-on learning opportunities for students of John Kevern, Ph.D., and other faculty members.

BRANDON PARIGO

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A SPACE JUST FOR STUDENTS

New collaboration area allows for peer-to-peer prototyping and a superior student teams workshop

BY SARA ATCHISON

Students from SCE's Baja Buggy Team test their designs on campus near the Plaster Center.

BRANDON PARIGO

PLASTER CENTER SPACES
Black & Veatch Student Collaboration Studio and Burns & McDonnell Student Teams' Fabrication Shop

New collaboration and teams spaces in the Plaster Center give the SCE Baja Buggy Team a workspace worthy of their top-tier talent — UMKC regularly places among the top in the nation at Baja Racing competitions.

BRANDON PARIGO

Engineering is a collaborative process, and at the UMKC School of Computing and Engineering, collaboration is a cornerstone of the student experience.

In fact, in the undergraduate capstone course Senior Design, students are challenged with taking a real-world engineering problem through the entire design process alongside a group of their peers. Thanks to the School's close proximity to industry, faculty are able to partner with local businesses to actually "hire" these small groups.

For years, students from Senior Design have crouched in empty classrooms or gathered inside their garages to work — until now.

The Robert W. Plaster Free Enterprise and Research Center features a new space on the first floor just for students: the Black & Veatch Student Collaboration Studio. With large workspaces and access to state-of-the-art 3D printers, students will be able to collaborate much more effectively. For the first time ever, they can test their prototypes in a dedicated environment.

"These projects are really the first time the students get to work on a 'real-world' engineering problem, just like they will be doing in a few months after graduation," says Assistant Dean Katherine Bloemker. "They are required to take their ideas from the concept phase through to the detail design phase and, most importantly, to the prototyping and testing phase."

Classroom requirements aren't the only thing to draw students to the first floor. Adjacent to the collaboration space is the Burns & McDonnell Student Teams' Fabrication Shop, another hub for students to work together — designing and building for engineering competitions such as the concrete canoe, big beam challenge and, of course, our signature Baja Racing Team.

According to Baja Racing Vice President and Frame Lead Clayton Morgan, "Having access to this new space really changes the game in terms of our ability to compete."

The laser jet cutter, paint booth, drill press, horizontal band saw and other tools located in the student space have saved the team both time and money. Where they previously would have sent a frame to be fabricated by an external vendor, now they can manually bend, cut and notch the tubes together — allowing them to really experience bringing their designs to life.

Morgan, who is a junior in the mechanical engineering program, says he chose UMKC in part because the Baja Racing program was highlighted during his campus visit. He "saw the team was pretty prominent in the School and that year ranked 11th out of 116 teams nationwide, a sign that they're top tier."

In addition to Baja Racing, Morgan credits UMKC's close proximity to industry with his choice to study here — both aspects of the school only enhanced by these new collaboration hubs.

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share on social media

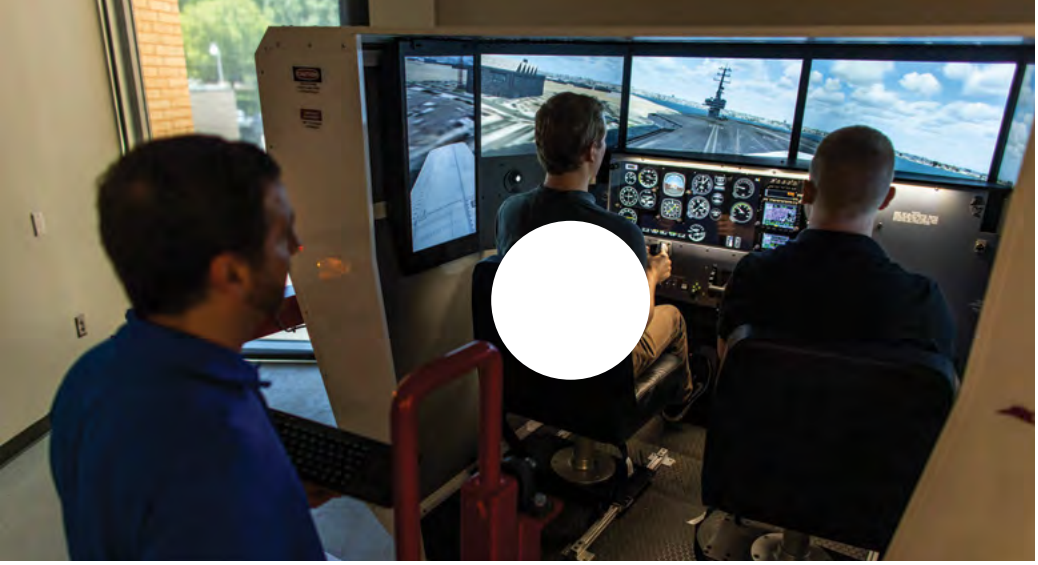
EXPANDING INTO AEROSPACE

New lab spaces give students hands-on training

BY KELSEY HAYNES

Mujahid Abdulrahim, Ph.D., and Travis Fields, Ph.D., demonstrate some of the capabilities of the Plaster Center's flight simulator.

BRANDON PARIGO



As excitement surrounding the opening of the Robert W. Plaster Free Enterprise and Research Center has ramped up, so has excitement surrounding the expanded education and research opportunities it provides.

Among the building's most eye-catching features is the three-story Motion Capture Lab and Flight Simulation Lab, reflecting the School of Computing and Engineering's expansion into aerospace engineering.

Through his work with unmanned aircraft technology, Associate Professor Travis Fields noticed that many high-level contracts, grants and research initiatives were leaning toward airspace. He also noticed that students required more hands-on experiences in rigorous, interdisciplinary fields like mechatronics, an intersection of electronic, electrical and mechanical engineering systems.

Together, Fields and Assistant Professor Mujahid Abdulrahim are partnering to charter the Master of Aerospace Engineering program at UMKC.

"The courses Travis pioneered are things we would love our students to know, like system modification and guidance laws for aircraft — classes that address the research needs and lay the foundation for aerospace curriculum," says Abdulrahim, who's been flight-testing aircraft for 21 years. "Anytime students are tasked with designing something new or have a specific desire to go into aerospace, we're teaching the philosophy behind it."

Whether students need to understand how to develop new things or have a specific desire to go into aerospace engineering, Fields and Abdulrahim agree that aircraft can be a great jumping-off point for other areas of engineering. And while both professors admit their obsession is with with aircraft, students will also learn to integrate cars for those who want to go into automotive testing and performance assessment.

"There is a responsibility on you as an engineer to do good work. It's not just optimizing the most efficient system possible, its also about the holistic design approach that aerospace engineering promotes," says Abdulrahim.

That's where the new Flight Simulation Lab comes in. The lab allows students to do complex and relevant tests in safe and accessible ways, teaching them all the things Abdulrahim says he wishes someone would've told him when he started out. The new space will help provide the workforce development training students really need.

//MUJAHID ABDULRAHIM, PH.D.
Assistant Professor, Department of Civil and Mechanical Engineerin

PLASTER CENTER SPACE
Flight Simulation Lab and Motion Capture Lab

RESEARCH INTERESTS
Air and ground vehicle autonomy, aircraft design and optimization, human-machine interaction, handling qualities for manned and unmanned vehicles, aeroservoelasticitym and dynamics and control of high-agility vehicles

JOINED UMKC
2019

LEADING THE DEVELOPMENT OF DEFENSE TECHNOLOGIES

By Stacy Downs

The Missouri Institute for Defense and Energy (MIDE) at UMKC aims to improve quality of life by bridging academia with industry. Lofty, to be sure, but MIDE is accomplishing its goals.

The institute, based at the Plaster Center, is funded by a variety of industry and federal contracts and grants from souces including the Office of Naval Research, National Science Foundation, Intel Corporation, Small Business Administration and Department of Defense. At any one time, MIDE is executing on an average of 13 awards, from $10,000 to $27 million.

The 60-person institute is comprised of undergraduate, graduate and post-doctoral students, professional staff and non-tenure-track and tenure-track faculty.

At its new prototyping space in the Plaster Center, MIDE is developing:

- Countermeasures for drones that threaten ships, bases, airports and other high-value targets
- Countermeasures for microwaves that may be used against service members or law enforcement, such as smart textiles that pass wanted radiofrequency signals and block unwanted signals
- New materials that allow electronics to shrink to half of their current size, specifically technology that prevents transistor crosstalk

"MIDE's work creates an impact at the university as well as local, state, federal and international levels," says Anthony Caruso, professor and assistant vice chancellor for research at UMKC, who leads MIDE. "From intellectual property development, licensure and small business startups to dissemination of intellectual matter to ultimately, improving quality of life.

//ANTHONY CARUSO, PH.D.
Curators' Professor of Physics and Electrical Engineering and Associate Vice Chancellor for Researchg

PLASTER CENTER SPACE
MIDE headquarters

RESEARCH INTERESTS
Developing countermeasure technologies

JOINED UMKC
2007

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In their Plaster Center lab, Ahmed Hassan, Ph.D., and his graduate research assistant Somen Baidya measure electrical pulses in picoseconds — one-trillionth of a second.

BRANDON PARIGO

ELECTROMAGNETIC MEDICINE

Using high-powered electric pulses to treat cancer in a 3D world

BY KELLY EDWARDS

Ahmed Hassan, Ph.D., has long been fascinated by electromagnetics and how electrical impulses can affect the smallest of particles, particularly those with complex shapes. Inside the Advanced Power, Electronics and Electromagnetics Lab at the Robert W. Plaster Free Enterprise and Research Center, the associate professor is focused on how to use high-powered electrical pulses to treat cancer cells.

Scientists have for some time explored the use of electrical pulses to deliver drugs and gene therapies into biological cells. But where most of those studies have looked at cells in a two-dimensional realm, Hassan is taking things a step further.

"At UMKC, we are one of the first groups to study how the three-dimensional shape of actual cells, grown in realistic 3D environments, affects their electrical response," Hassan says. "It's only by looking at the full 3D structure that you can predict how the cell will behave when it's excited by an electrical stimulus."

Through their research, Hassan and his graduate research assistant Somen Baidya have shown that the outer shape of a cell plays a significant role in how it will react to an electrical stimulus. With help from the National Institute of Standards and Technology (NIST), where their scientists have been able to determine and reconstruct the exact 3D shape of cells, Hassan and Baidya now have thousands of cells shapes to work with, including cancer cells.

PRECISION TO THE ONE-TRILLIONTH DEGREE

Armed with an array of computers to create computational models and simulations, Hassan is working with multiple computational techniques that can be used to calculate the response of those complex, three-dimensional cancer cells to electrical impulses.

Electroporation is a technique in which an electrical field is applied to a cell in order to increase the permeability of the cell membrane. This allows chemicals such as therapeutic drugs or even DNA to easily be inserted into the cell. The technique offers potential advantages over other therapeutic methods of cancer treatments because of its noninvasiveness and lack of toxicity for noncancerous cells, as well as the possibility of being used in combination with other therapies. The selectivity of the electroporation technique also makes it safer than other techniques that cannot differentiate between healthy and cancerous cells.

Variations in the rate of supra-electroporation used to pierce the cell membrane and penetrate the cell's internal organelles can guide the selective targeting of desired cells with specific shapes. The current goal, Hassan says, is to determine how to calculate — with a high degree of accuracy and efficiency — the necessary voltage and precise location of these electrical pulses on the cell's membrane to achieve the desired effect.

Electrical pulses are delivered at very high amplitudes for extremely short durations of time — from nanoseconds, which are one-

> *If you want to kill cancer cells, then you apply a strong enough electrical stimulus to break down the cell membrane completely. We're trying to figure out the optimum pulse that will give us the correct response.*
>
> — AHMED HASSAN, PH.D.

billionth of a second, to picoseconds, which are one-trillionth of a second. In some instances, the goal is to create a tiny hole in the cell membrane, just large enough to deliver the material inside the cell without harming it.

"If the holes become too large, the cells might die," Hassan says. "In some cases, that's desired. If you want to kill cancer cells, then you apply a strong enough electrical stimulus to break down the cell membrane completely. We're trying to figure out the optimum pulse that will give us the correct response."

Once the computational techniques are developed, the next step will be to develop a machine learning (ML) platform that uses cell information to predict the precise excitation characteristics necessary to achieve the correct effect on the cell.

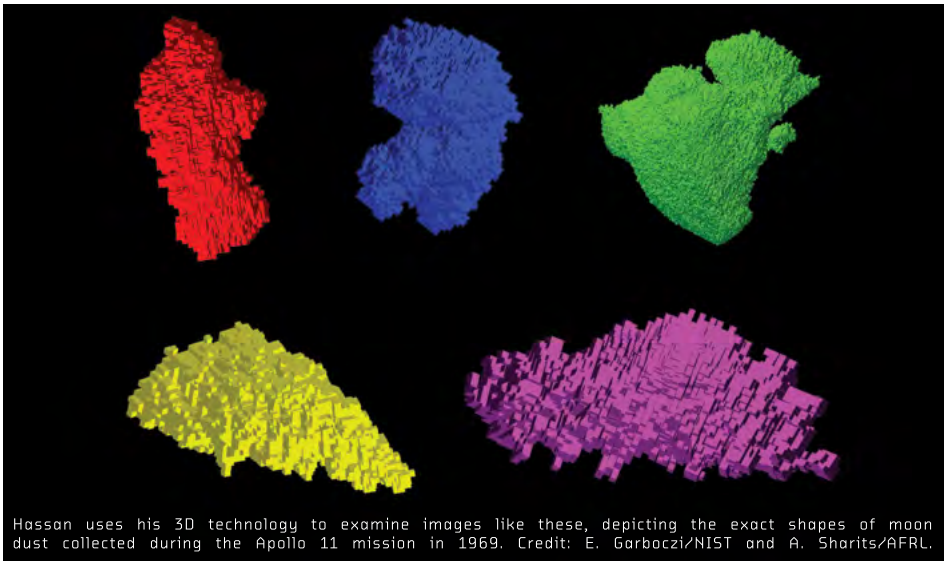
generate necessary short-time pulses of nanosecond or picosecond duration with high peak amplitude optimized for each cell shape.

FROM MEDICINE TO THE MOON

Once developed, this ML technology could be used to treat other types of cells, for instance, isolating and treating or modifying immune cells. Moreover, different electrical signals can be used to selectively move and isolate specific cells from a collection of cells.

"It's like applying a magnet to the cell. That will start attracting the cell differently based on its shape," he says.

Hassan is currently working on the first two aspects of the project to get preliminary data, then working on funding to start building the hardware.



Hassan uses his 3D technology to examine images like these, depicting the exact shapes of moon dust collected during the Apollo 11 mission in 1969. Credit: E. Garboczi/NIST and A. Sharits/AFRL.

Ultimately, Hassan says, the new Plaster Center Power Lab will give him the capability to develop a novel, tunable, high-voltage pulser that can generate the desired electric surge needed as predicted by the ML platform. It will be designed to

"We've been working on this for three years," he says. "An optimistic timeframe is that we're halfway there to finishing the engineering aspects before we can take it to the medical researchers and ask them to help us with the actual biological tests."

A member of the UMKC faculty since 2015, Hassan serves as director of the Multidisciplinary Multiscale Electromagnetics Lab. Before coming to UMKC, he began studying nanostructures with extremely complex shapes as a postdoctoral researcher at NIST. There he developed a large library of computational codes to study their response to electromagnetic stimulus.

"When I came to UMKC, I was using this library of computer codes that I had developed as an electrical engineer to study complex shapes with a wide range of applications," Hassan says. "One application was to study biological cells with complex shapes."

Another is looking at the electrical properties of sand and rock particles from the moon. Working with his collaborators at NIST, Hassan was able to obtain the three-dimensional shapes of sand particles obtained during the Apollo 11 mission to the moon.

"We're trying to calculate the electrical response of those sand particles as another exciting application of using electromagnetic radiation to understand the physics of complex shaped particles," he says.

//AHMED HASSAN, PH.D.
Associate Professor,
Department of Computer Science
Electrical Engineering

PLASTER CENTER SPACE
Advanced Power, Electronics and Electromagnetics Lab

RESEARCH INTERESTS
Nano-electromagnetics, bio-electromagnetics, computational electromagnetics

JOINED UMKC
2015

Sarvenaz Sobhansarbandi, Ph.D., works with her students on the roof of the Plaster Center, where they maintain and study several solar thermal collectors.

BRANDON PARIGO

SUNSCREEN RECOMMENDED

In the Plaster Center, even the roof is optimized for groundbreaking research

BY LINDSEY MAYFIELD

Read online or share on social media

> *My graduate and undergraduate students are very excited as the new lab gives them the opportunity to perform research in an even more well-equipped environment.*
>
> — SARVENAZ SOBHANSARBANDI, PH.D.

Most days, Assistant Professor Sarvenaz Sobhansarbandi, Ph.D., keeps her eyes on the sky.

Sobhansarbandi has spent her career studying solar energy. Her research focuses on a type of solar thermal collector called an evacuated tube collector (ETC). More specifically, she is interested in how this type of collector can make water heating systems more efficient.

The Robert W. Plaster Free Enterprise and Research Center includes two unique spaces for Sobhansarbandi and her students: the Evergy Advanced Renewable/Thermal Energy (ART-E) Lab and the accompanying Evergy Renewable Energy Roof Deck.

Since the completion of the Plaster Center, Sobhansarbandi and her students have spent much of their time on the roof and the lab, working to learn more about ETCs and how we can best utilize them.

How is the Plaster Center enhancing your research with ETCs and solar water heating?
The Evergy Renewable Energy Roof Deck was designed for maximum solar gain exposure. It uses local, easily configurable, leading-edge technology to test both small- and large-scale ETC solar water heating systems. The space will also allow us to get baseline results for Kansas City weather conditions and optimize the system's functionality to achieve higher efficiency.

A low-voltage conduit connects the roof to the lab below, allowing us to monitor the system and data connection devices. Outside of the Renewable Energy Research Lab, the new 3D printing lab and Innovation Studio will allow us to fabricate prototypes in-house and move them straight upstairs for testing.

Are you working with any new technologies in your new spaces?
The 5,000-square-foot roof deck gives us plenty of space for a new full-scale solar water heating system. In the future, we plan to integrate photovoltaic arrays and a weather station to track comprehensive, real-time conditions. Currently, we are able to monitor solar radiation intensity using Pyranometers on the roof, connected directly to the lab space.

How have your students responded to the new research lab?
My graduate and undergraduate students are very excited as the new lab gives them the opportunity to perform research in an even more well-equipped environment. Here are some of their individual reactions:

- "Moving into this new lab is great as we now have a more sophisticated facility to do hands-on experimental research."
- "It's wonderful to have more space to work on our research and collaborate comfortably."
- "The new lab is equipped with high-tech devices and a big glass window, which makes it a more visually and thermally comfortable place to monitor the technology."
- "The new facilities have given me the opportunity to pursue my research in avenues that I previously thought were impossible."

Does the new space enhance your teaching?
Absolutely! My mechanical engineering students get to see some real-world applications of heat transfer in action in our solar water heating system setup, as well as all of the instrumentation used to monitor the equipment and collect data for our research.

My colleagues are also able to show examples of material analysis using the Thermogravimetric Analyzer and Differential Scanning Calorimeter in our lab. On top of all that, it's a great excuse to take students outside for fresh air and sunshine to look at cool technology and the view of downtown KC!

How does your new lab compare to those of schools across the country?
Having 1,000-square-feet of interior space and direct access to the roof deck is a distinct feature. The dedicated space to perform field testing gives us the potential to cross-validate our simulation modeling results without the need for travel to other available research sites. In addition, the high-end video conferencing technology has been a huge benefit when collaborating with other researchers and staying connected.

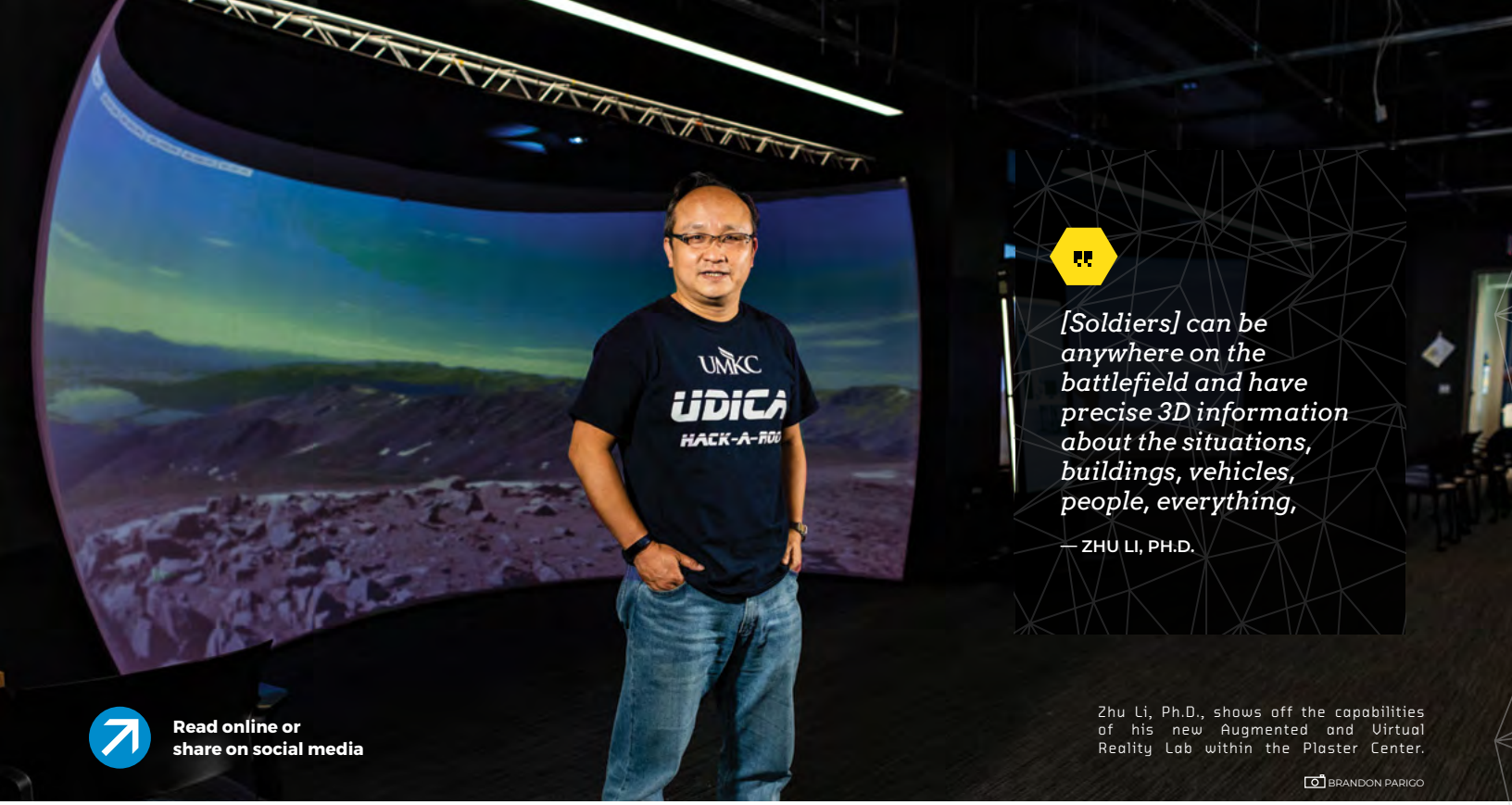
What is the next step in your research?
Next steps include experimental investigation of modified large scale ETCs by applying preliminary findings from small scale analysis with the goal of efficiency enhancement. Additionally, development of control systems to automate and optimize the system functionality are being studied.

//SARVENAZ SOBHANSARBANDI, PH.D.
Assistant Professor, Department of Civil and Mechanical Engineering

PLASTER CENTER SPACE
Evergy Advanced Renewable/Thermal Energy (ART-E) Lab and Evergy Renewable Energy Roof Deck

RESEARCH INTERESTS
Renewable energy, solar energy, computational fluid dynamics and fuel cell technology

JOINED UMKC
2017



[Soldiers] can be anywhere on the battlefield and have precise 3D information about the situations, buildings, vehicles, people, everything,

— ZHU LI, PH.D.

Read online or share on social media

Zhu Li, Ph.D., shows off the capabilities of his new Augmented and Virtual Reality Lab within the Plaster Center.

BRANDON PARIGO

KEEPING SOLDIERS SAFE

Video game technology reimagined for the real-life battlefield

BY KELSEY HAYNES

We've all seen the dangers of war, whether it be in the news, movies or in video games where we get to virtually immerse ourselves in simulated military operations. With various combinations of the A and B and X and O buttons, we strategize actions, move in on targets and eliminate opponents.

In our increasingly digital world, one UMKC professor is exploring how to maximize the virtual experience to serve real-life military operations. Associate Professor Zhu Li, a renowned artificial reality and virtual reality (AVR) research expert, is helping to bring virtual warfare into reality using the new AVR space located in the Robert W. Plaster Free Enterprise and Research Center.

It's only fitting that as a war history buff – he can identify nearly every WWII aircraft – Li would be working with the United States Department of Defense and the U.S. Air Force to develop a 3D technology to give soldiers a new set of eyes on the battlefield. Using point cloud compression and communication — a way of compressing and transmitting volumetric visual data to present the real world in 3D — soldiers will be able to literally see the enemy from a mile away.

"The idea is to virtualize special forces in warfare because soldiers get air dropped into hostile-raging situations," Li says. "Normally there's no way to tell what they're getting into, but with this new equipment soldiers don't have to risk their own life. They send an unmanned aerial vehicle, or drone, with 360 cameras and 3D sensors, and the soldier can navigate the cameras and find the target based on information transmitted back."

To enable this, the drones need 3D sensing, information capture and compressions and communication to present it back to a different device in real time. It's the same kind of technology used in military-themed video games — goggles included — but reconfigured for real-life scenarios.

"It's like they'll have virtual eyes and ears in the battlefield. … They can be anywhere on the battlefield and have precise 3D information about the situations, buildings, vehicles, people, everything," says Li, comparing it to Google Maps' street view with added 3D elements.

Having a 360-degree view gives soldiers the freedom to navigate the virtual world and be able to walk around and scope out what's ahead.

"Number one, it's safer and, two, it's more effective because human eyes and perceptions are limited. With this new technology, you can see much further and identify you targets much easier. You have more accurate positioning," Li says.

He's still doing the algorithm research, so it will be another three to five years before it's sent off to produce a prototype. But, Li says, the state-of-the-art 3D and AR/VR technology in the Plaster Free Center will enable him to take this research even further.

//ZHU LI, PH.D.
Associate Professor, Department of Computer Science Electrical Engineering

PLASTER CENTER SPACE
Augmented and Virtual Reality Lab

RESEARCH INTERESTS
Image and video processing, coding and communication, machine learning

JOINED UMKC
2015

VANGUARD AWARDS 2021

2021 VANGUARD AWARD WINNERS

Congratulations to our 2021 Vanguard Award winners, who have shown outstanding commitment and dedication to the School of Computing and Engineering at UMKC. Please join us in thanking them for their service.

Riddhiman Das

YOUNG ALUMNI AWARD

Riddhiman Das (B.S.C.S. '12, M.S.C.S. '19) is a standout young SCE alumnus. In 2019 he co-founded TripleBlind. TripleBlind's patented breakthroughs in advanced mathematics, cryptography and AI give organizations the ability to share, leverage and monetize regulated data, including PII and PHI, and mission-critical enterprise data, such as tax returns and banking transactions. TripleBlind unlocks new revenue opportunities while enforcing GDPR, HIPAA and other privacy regulations.

Sunderland Foundation

SUPPORTER AWARD

Since its inception, the Sunderland Foundation, which continues to be led by Lester T. Sunderland's descendants, has focused on supporting construction projects and awarding grants to nonprofits in the Kansas City region and other markets traditionally served by the Ash Grove Cement Company. The Sunderland Foundation's support of UMKC, SCE and the community has been exemplary.

Kauffman Foundation

STEM OUTREACH PARTNER OF THE YEAR

The Kauffman Foundation works with communities in education and entrepreneurship to increase opportunities that allow all people to learn, take risks and own their success. The Kauffman Foundation has been instrumental in STEM Outreach in the Kansas City region (and beyond). In addition to their support of K-12 education, the Kauffman Foundation has been a great supporter of UMKC, SCE and regional STEM programming.

Black & Veatch

ORGANIZATION OF THE YEAR

Black & Veatch is an employee-owned engineering, procurement, consulting and construction company with a 100-year legacy of innovations in sustainable infrastructure. Black & Veatch has supported SCE in many ways: scholarships, internships, jobs, adjunct faculty and so much more.

/MAJOR GRANTS AND AWARDS AT SCE

CONGRATULATIONS

to our many faculty members who received financial support for their work in 2021 through grants and other major awards.

MUJAHID ABDULRAHIM was awarded more than $275,000 from various sponsors for his projects:

- UAV and UAM Rapid Vehicle Charge Hybrid Cube (Rapid Vcc)
- Modeling and Simulation Architecture to Improve Research
- FLEXI-FLY: Field-Reconfigurable, Mission-Adaptive eVTOL
- UAV-UGV Cargo Drop

DEB CHATTERJEE was awarded more than $19,000 for his project, "Signal and Radiating Systems Design and Modeling for App."

ZHIQIANG CHEN was awarded $33,000 from Kalscott Engineering for his project, "Guidelines for Response Planning, Assessment, and Rapid Restoration of Service of Bridges in Extreme Events."

BAEK-YOUNG CHOI was awarded $18,000 from Oregon State University for her project,"REU Supplement: Technology Education for Women in Transition: Broadening Participation Through Innovations."

TRAVIS FIELDS was awarded more than $253,000 from various sponsors for his projects:

- Low-Cost Aerial Delivery of Medical Supplies
- Graduate Fellowships for Students Engaged in NASA-relevant Disciplines
- Material Processing and Automation – Partnership with IMP

THIAGARAJAN GANESH was awarded more than $129,000 from the Missouri Department of Transportation for his project, "Load and Resistance Factor Rating Methodology Recommendations for Missouri Bridges."

CEKI HALMEN was awarded $128,000 from the American Concrete Institute and Concrete Reinforcing Steel Institute for his projects:

- Justifying Corrosion Durability of Reinforced Concrete: Comparable Critical Chloride Threshold for Various Reinforcement Types
- Development of Instructor Resources for Contractor's Guide to Quality Concrete Construction, 4th Ed.
- Standard Critical Chloride Threshold Test Variability due to Material Sources

MEGAN HART was awarded more than $262,000 from the Department of Defense for her project, "Validation of a UV/TiO2 Activated Alkaline Media (CFM) for Destruction of PFAS in Concentrated Liquid Waste Streams."

JOHN KEVERN was awarded more than $1 million from the National Science Foundation, the University of Wisconsin–Platteville and the City of Kansas City, MO, for his projects:

- KC Urban Renewal Engineering (KCURE) Fellows
- Evaluating the Impact of Anti-Icing Solutions on Concrete Durability
- Evaluation of Non-Traditional Sidewalk Options for Reduced Long-Term Cost and Improved Public Accessibility

/MAJOR GRANTS AND AWARDS AT SCE

FAISAL KHAN was awarded more than $301,000 for his project, "Estimating Remaining Life and Availability of Power Semiconductor Devices using Sympathetic String Phenomena, Dynamic Safe Operating Area Theory and Ultrasound Resonators."

YUGYUNG LEE was awarded more than $648,000 from the National Science Foundation, Jackson County, MO, and other sponsors for her projects:

- CUE Ethics: Open Collaborate Experiential Learning (OCEL. AI): Bridging Digital Divides in Undergraduate Education of Data Science
- Smart and Connected Communities Planning Grant: Early Community Intervention for Neighborhood Revitalization Using Artificial Intelligence and Emerging Technologies
- Gamifying Cybersecurity to Eliminate Alert Fatigue
- Our Healthy KC Eastside: A Community-wide COVID-19 Vaccination and Health Services Project to Address Health Inequities

ZHU LI was awarded $50,000 from Qualcomm to conduct research in Learning Based Compression and $50,000 from InnoPeak Technology for research in video deduplication, as part of the NSF Center for Big Learning.

AMIRFARHANG MEHDIZADEH was awarded nearly $25,000 from Water Resources Solutions for his project, "Indian Creek Flood Assessment PAS."

ZAHRA NIROOBAKHSH was awarded $110,000 for her project, "Tuning Viscoelastic Properties of Enhanced Oil Recovery Relevant Bijels."

ANTONIS STYLIANOU received $13,500 from UMKC for his project, "Development of Computational Tools for pre-op Planning of Periacetabular Osteotomies."

DIANXIANG XU was awarded $163,000 from the National Science Foundation and the UM System NextGen Data Science and Analytics Innovation Center for his projects:

- EAGER: SaTC-EDU: Exploring Visualized and Explainable AI to Improve Students' Learning Experience in Digital Forensics Education at MSI and HBCUs
- Modeling Clinical Notes with Deep Learning Transformers

He also received more than $96,000 from the National Security Agency to fund GenCyber summer camps at UMKC.

ZAHRA NIROOBAKHSH and **KUN CHENG** received $22,500 from UMKC for their project, "3D Printing of Next Generation Therapeutic Microneedles Using Rapid Self-Association of surface Active Peptide Drugs."

WYUGYUNG LEE, BRENT NEVER and **WANG YE** received $22,500 from UMKC for their project, "Communities in Action: Sustainable Science in Cyberinfrastructure."

/SCE AWARDS AT A GLANCE

$3.6 MILLION
Total amount awarded to SCE faculty

40
Faculty members who received funding

$600,000
Largest single award (Awarded to John Kevern from the NSF)

Numbers reflect data for awards received since previous issue of Vanguard, *from Jan. 2020–July 2021.*

UNIVERSITY OF MISSOURI-KANSAS CITY
School of Computing and Engineering
5100 Rockhill Road
Kansas City, MO 64110

/GET INVOLVED

EVENTS

UMKC BLUE AND GOLD WEEK
Sept. 25 –Oct. 3, 2021

UMKC VIRTUAL 5K
Sept. 25–Oct. 3, 2021

VANGUARD AWARDS
Thursday, Sept. 30, 2021
The Rockhill Grille
Celebrating the classes of 2020 and 2021

ROBERT W. PLASTER FREE ENTERPRISE GAND RESEARCH CENTER GRAND OPENING
Friday, Oct. 1, 2021
UMKC Volker Campus

UMKC NIGHT AT SPORTING KC
Sunday, Oct. 3, 2021
Children's Mercy Park

FUNDRAISER FOR SCE STUDENT GROUP FUND
Friday, October 14, 2021 | 1–5 p.m.
Topgolf Overland Park

RISE AND SHINE: KC STREETCAR
Oct. 22, 2021
Zoom webinar event

SCHOLARSHIP RECOGNITION LUNCHEON
Spring 2021

Find more SCE events online at **sce.umkc.edu/events**

See all UMKC Alumni Events online at **umkcalumni.com/events**

CONTINUING ED

CIVIL P.E. REVIEW COURSE
Aug. 17–Sept. 28, 2021, with practice exam on Saturday, Oct. 2
This live, six-week course is designed to help engineers prepare for the Civil PE exam and covers six technical areas.
CLASS TIMES: Tuesdays and Thursdays from 6–9 p.m.
LOCATION: School of Computing and Engineering, UMKC Volker campus
REGISTER:
sce.umkc.edu/continuing-ed/civil-pe

PROJECT MANAGEMENT PROFESSIONAL (PMP) PREP COURSE – LIVE VIRTUAL CLASS
Sept. 9–30, 2021
Gain an understanding of the project management concepts, terms, processes and scenarios that are required content for the PMP Certification Exam in this 35-hour online course.
CLASS TIMES: Tuesdays and Thursdays from 4–7:30 p.m. and Saturdays from 8 a.m.–12 p.m.
REGISTER: sce.umkc.edu/continuing-ed/pmp-prep-class

WEB DEVELOPER FUNDAMENTALS
Fall 2021
This course introduces aspects of web development including HTML, CSS, JavaScript, jQuery, Bootstrap, Web servers, MySQL, PHP, Content Management Systems (WordPress) and SEO.
MORE DETAILS:
sce.umkc.edu/continuing-ed/web-developer

INSPIRED GIVING

Donors like you make it possible to provide student scholarships, update our facilities, attract nationally recognized faculty and recruit high-caliber students.

SCHOLARSHIPS
More than 100 students receive donor-supported scholarships every year.

STUDENT LIFE
Donors support student life so our students can grow and explore through SCE teams and organizations.

CAPITAL SUPPORT
From renovating existing labs and spaces to providing equipment for the new Robert W. Plaster Free Enterprise & Research Center, there are many opportunities to support exciting SCE capital projects.

TO DONATE
You can make difference in a student's life. Please give online at **sce.umkc.edu/giving** or contact Melissa Ford: 816-235-1277 or **mford@umkc.edu.**