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

VANGUARD

OPERATION: AIR SUPPLY

Covert and cost-effective parachute drops

/FROM THE DEAN

Dear colleagues:

It is with great joy that I introduce to you our second issue of the School of Computing and Engineering's annual research publication, *Vanguard*. With the launch of this new magazine last year, we were able to deliver some of our most promising and forward-thinking research stories to your front door.

As SCE continues to grow, welcoming our largest freshman class ever in 2017, it is invaluable that we strengthen and deepen our relationships with you — alumni, community leaders, partners, and friends. The Kansas City region has a hunger for a workforce trained in 21st century computing and engineering, and it is these relationships that make SCE best prepared to fill that need.

Due to the generosity of this network of supporters, this year SCE was able to announce that we will begin construction of a new education and research center directly adjacent to our current home in the Robert H. Flarsheim Science and Technology Hall. This $32 million project, unanimously approved by the Missouri Board of Curators on Dec. 7, will add 44,000 square feet of laboratory space for faculty to conduct cutting-edge research and students to engage in real-world learning.

The new facility will be equipped with state-of-the-art technology. These new amenities will include a clean room for the development of nanotechnology, a high-bay structural lab for the training of our future construction engineers, and a motion capture facility which can be utilized in every kind of research from drone technology to biomedical engineering to animated film. The center will also feature a community space with industry-grade 3-D printing, and a metal shop for fabrication, rapid prototyping, and artificial learning. Finally, we are excited to receive $3 million in virtual reality and augmented reality equipment for advancements in entertainment and synthesized training.

As you explore the pages of *Vanguard*, I encourage you to imagine what will be next for SCE. With the spaces and resources to inspire greatness, what might our faculty and students do for our school, our community and our world? We'll continue to keep you apprised of the construction of our new space and you can visit us anytime online at **sce.umkc.edu/educationresearchcenter.**

We look forward to working with you to bring even more innovation to our community and beyond.

Sincerely,

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

VANGUARD

/ˈvanˌgärd/
A group of people leading the way in new developments or ideas

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

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UMKC
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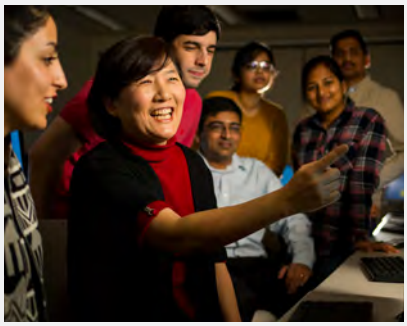


/UPCOMING

On the cover: Travis Fields
Photo: Brandon Parigo
Photo illustration: Mike Duah

▼ Associate Professor Zhu Li, Ph.D., immerses himself into an underwater world through VR goggles.

BRANDON PARIGO
ILLUSTRATION: MIKE DUAH

PUTTING MORE REAL IN VIRTUAL REALITY

BY JOHN MARTELLARO

The big hurdle for virtual reality has always been that it doesn't seem all that ... real.

ZHU LI, PH.D., associate professor of computer science and electrical engineering at UMKC, is hard at work in the lab in an effort to put more "real" in your virtual reality experience. Major industry players such as Samsung, Qualcomm and Snapchat are helping fund the research.

Li's challenge: The human eye can collect and transmit — and the human brain can process — more data at a faster rate than any technology currently in use. Passive video, in which a camera operator decides what the viewer will see, has the capability to be extremely lifelike. But true virtual reality allows the user to interact with the content — to walk through a scene, change directions, look up or down — and real-time video transmission can't keep up. As a result, the visual experience of virtual reality is an imperfect, less-detailed representation of the real world.

"Today's immersive virtual reality experiences are still very limited by the computing and communication capabilities. Many technological challenges are still ahead in order for us to have photo-realistic and fully interactive immersive experiences," Li says.

That's why Li is developing technological work-arounds to make the huge volume of data more manageable. Essentially, he wants to make it possible for anyone in the world with a GoPro to livestream their experience to anyone else in the world wearing VR goggles. Think of it this way: You put on a headset while sitting in your office or living room, in the dead of winter, and fly along in real time with a skydiver in the tropics at 15,000 feet.

Li is exploring two technological innovations that, in tandem, show the promise of delivering a lifelike, real-time, immersive virtual reality experience. The first is developing algorithms to compensate for a portable camera's inferior-to-the-eye ability to capture detail, and essentially "fill in the blanks" in the visual data to create a more lifelike image. The second involves advancing the science of data compression to deliver the processing speeds necessary to allow for real-time decision-making by the user — keeping up with their up-and-down or side-to-side movements.

"Video technology has come a long way. Now we have bigger screens with more pixels, higher-quality pixels, but the experience is still passive. You just sit back and see," Li says. "Immersive video allows you to directly interact with and explore the content. There is a concept called Six Degrees of Freedom (DoF) interaction, that is, to be able to turn your head and walk in the scene. That is what motivates the new research in enabling immersive visual communication."

Li says the technology exists to capture and transmit a realistic image. But the data stream is too massive for everyday use — about 100 times larger than the existing internet can carry. Combining advances in visual-capture and data-compression algorithms would put these capabilities in devices for home use. Like most consumer electronics, he expects the technology to be expensive initially, but become more affordable as the technology matures, eventually coming into the reach of the average consumer.

Once the data capture and compression hurdles are overcome, an array of possibilities beyond armchair skydiving will open up. Two-way, real-time communication and multi-user coordination could be just the beginning.

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

RESEARCH INTERESTS
Image analysis, video compression and machine learning

JOINED UMKC
2015

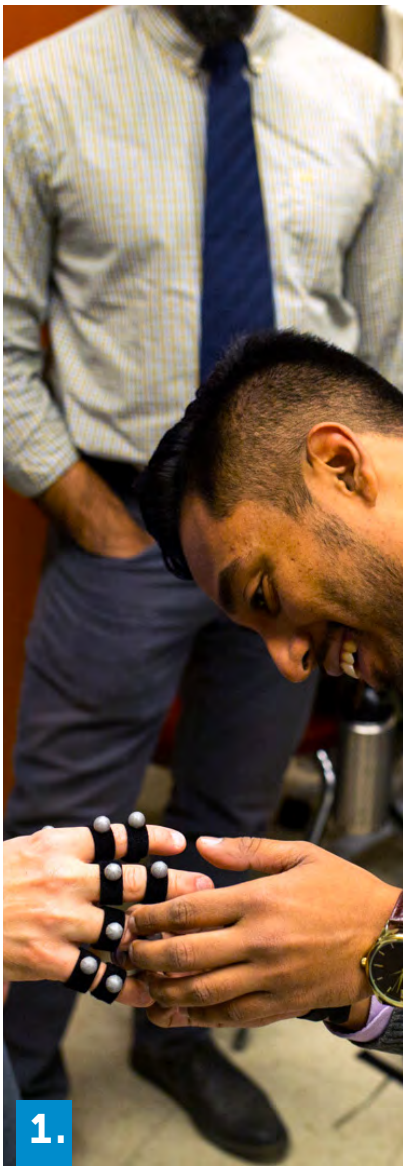
▼ While VR goggles like these can transform the world around its wearers, work is still being done to improve data streaming to create more lifelike experiences in real time.

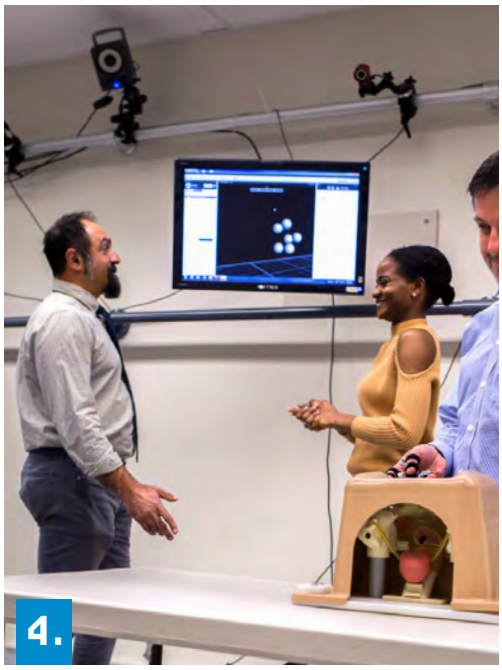
HOW SOON COULD THIS TECHNOLOGY BE MADE AVAILABLE TO CONSUMERS?

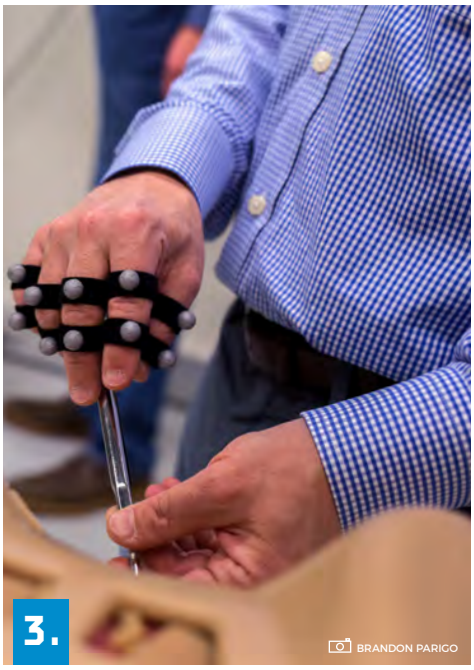
2-3 years, with continuous improvement on compression effciency

HOW COULD THIS TECHNOLOGY BE USED?

- Real-time visual surveillance for security and border control
- Smart cities
- Intelligent traffic engineering
- Remote medicine and remote surgery
- Remote immersive classrooms for virtual labs
- Sports training in virtual worlds







▼ **1.** Motion sensors are placed on Professor Gary Sutkin, M.D., MBA, which monitor and track his hand movements during pelvic sling surgery reenactments. **2.** A closer look at a trocar, the instrument used to insert a sling around the urethra during surgeries. **3.** Sutkin re-enacts a surgery on a pelvic anatomy model inside the SCE Human Motion Laboratory. **4.** The feedback from the motion sensors allow Sutkin and his team to determine which hand movements are more likely to cause surgical errors.

GETTING A BETTER GRIP

BY KELSEY HAYNES

New technology aims to reduce error rates in common surgery

APPROXIMATELY 2 PERCENT of the 180,000 mid-urethral pelvic sling surgeries performed each year result in surgical error. In complicated surgeries, a 2 percent error rate doesn't seem too bad. However, in procedures like this, 30 percent of those errors end in fatality. According to Gary Sutkin, M.D., MBA, associate dean of women's health at the UMKC School of Medicine, that fatality rate is too high.

Pelvic sling surgeries are designed to support a woman's urethra to keep it from dropping during physical activity. To accomplish this, an instrument called a trocar is used to insert a sling around the urethra.

Although it is a minimally invasive surgery, Sutkin says it's considered high-risk, and the rate of error has everything to do with the surgeon's hand movements. Even the slightest slip can be fatal.

That's where School of Computing and Engineering faculty Stylianou and King come in.

In an effort to reduce the error rate, Sutkin has partnered with a pair of engineering experts, Antonis Stylianou, Ph.D., and Gregory King, Ph.D., PE, to create ultra-realistic virtual and physical models of the pelvic anatomy so they can study proper pathways for the trocar in order to avoid injuries to the patient.

Pelvic sling surgeries, perhaps, can be best described as blind procedures. There is no tool for the surgeon to see the patient's pelvic organs. The team has been working in the SCE Human Motion Laboratory to visualize Sutkin's movements as he re-enacts the surgery using pelvic anatomy models and motion sensors. This helps the team track the location of the trocar inside the body and gain feedback to determine what movements cause surgical errors.

"Our project at this point is targeting two issues: identify the best surgeon upper extremity motions to achieve best results, and create virtual and physical models that can be used to train surgical residents," says Stylianou. He adds that this technology will be extensively tested for its efficacy to reduce surgical errors before it's implemented in hospitals and clinics.

Currently, the team is working to manufacture the physical model. Once they demonstrate the efficacy of their practice methods using the 3-D models and motions sensors, they want to create a system that provides real-time feedback to the surgeon during the operation to track how close the trocar tip is to a patient's vital organs.

According to King and Stylianou, the system will give a warning when the trocar is close to puncturing a vital organ, thus preventing errors in surgery. This model can also be used to create software that projects a heads-up display onto surgeons' eyeglasses, showing them where the trocar tip is and if they are on the right path toward a successful procedure.

Next steps for the project include the creation of the physical model and a first round of tests where surgeons' performance experiences will be compared to novices. After that, a training program for surgical residents will be developed to see if they can increase their performance and reduce error rates. Training for surgical residents will begin after the Fall 2018 semester.

/FAST FACTS: PELVIC SLING SURGERIES

Risk of injury:

5-10% Bladder

1% Bowel

3% Blood Vessels

2% Risk of mesh complications

Average patient age:

52
53
54
55
56
57
58

180,000 pelvic sling surgeries performed each year

Source: International Osteoporosis Foundation

//GREGORY KING, PH.D., PE
Associate professor, Mechanical Engineering

RESEARCH INTERESTS
Musculoskeletal biomechanics of human motion, which includes a number of applications including balance impairment in older adults, ergonomics and human performance

JOINED UMKC
2007

//ANTONIS STYLIANOU, PH.D.
Assistant professor, Department of Civil and Mechanical Engineering; Director of Musculoskeletal Biomechanics Research Laboratory

RESEARCH INTERESTS
Musculoskeletal biomechanics, computational joint biomechanics, orthopaedics and multibody dynamics and modeling

JOINED UMKC
2010

//GARY SUTKIN, M.D., MBA
Professor, UMKC School of Medicine; Associate dean and Victor and Caroline Schutte Chair in Women's Health; Residency director and vice chair, Obstetrics and Gynecology; Female Pelvic Medicine and Reconstructive Surgery

RESEARCH INTERESTS
Surgical safety

JOINED UMKC
2016

▼ The team of researchers working to reduce error rates in pelvic sling surgeries. L to R: Mary Okafor, Md. Arifuzzaman Arif, Gary Sutkin, M.D., MBA, Gregory King, Ph.D., PE, Antonis Stylianou, Ph.D., Safeer Siddicky and Fizza Mahmud

WASTE PROCESSING TECHNOLOGY IMPROVES GLOBAL HEALTH

BY PATRICIA O'DELL

UMKC professor receives third round of funding to treat human waste management

IT'S A PICTURE not many can paint in their minds, at least not accurately — a picture of the dire conditions in remote villages in Africa and India. Those conditions entail the extreme health risks many face, including children, due to poor sanitation practices. But Gary Foutch, Ph.D., has seen it firsthand. So the last six years of his research has focused on sanitation technology that can kill ascaris roundworm, a soil-transmitted parasite that has been wreaking havoc in these remote communities.

"You know the pictures you see of nearly starving children with big bellies? They're most likely infected with these worms, which take the nutrition from any food the child eats," he says. "Some of these kids will pick up handfuls of gravel and eat it just to get the feeling of being full."

Foutch, research faculty in the School of Computing and Engineering, recently received his third round of funding from the Bill and Melinda Gates Foundation in conjunction with their initiative to "Reinvent the Toilet." He and his team are developing a device that will process fecal sludge to eliminate parasites in an effort to combat malnutrition and death.

"The Gates Foundation wanted to fund systems that would run off the grid, didn't use water and focused on reinventing the toilet," says Foutch of his first round of funding. "I printed off the request for proposal and laid it on my desk. Every day I came in and I read it. After about two months, my idea crystallized. I wrote it up and sent it in. There were more than 5,000 of these two-page applications. They funded 57 of us."

Foutch started the project at Oklahoma State University, where he had spent 34 years of his career before moving to Kansas City and UMKC in 2014. While at OSU, he and his team created a simple machine to process fecal waste in a way that kills ascaris lumbricoides, the parasite that plagues children in areas with poor sanitation. The machines are meant to be used in communities that primarily use pit latrines.

"The issue of infection comes when waste stays in the pit latrine. It has to be hauled away," he notes. "Sometimes the latrines simply get filled and the community has to dig another one, which leaves contaminated material in the ground. As a result, the communities in which this is happening continue to get infected."

> *Latest estimates indicate that more than 880 million children are in need of treatment for these parasites.*
>
> – WORLD HEALTH ORGANIZATION (2017)

Foutch's work directly addresses these issues. By using these new machines, called viscous heaters, to sanitize waste, Foutch says communities won't put themselves at risk when closing or opening a new latrine.

His team has now completed the machines, one of which can process a couple hundred liters of fecal sludge an hour, and another that can process 1,000 liters of waste an hour.

The 200-liter model is in the lab, but the 1,000-liter model is on a site in Isipingo, South Africa, as part of the sewage treatment works.

"We created it, proved it worked, then we scaled up," Foutch says. "We built both units and they work incredibly well. We had some construction challenges, but they're robust technologies that seem to work."

We've migrated our efforts to concentrate on processing sludge in large quantities. The 1,000-unit processor — the larger one — is a little over my height and about a foot in diameter. On a smaller scale, we could build one to fit on the back of a tractor so sludge could be processed while it's being collected."

And Foutch's project isn't the only one addressing this important public health issue. Foutch notes that in both Africa — where he is often working — and in India, progress in sanitation has come from multiple initiatives.

"India has developed a program to eliminate these sanitation practices in two years and set up systems for cities to compete against one another to be the first to do so. To pay for it, they are taking different approaches, such as advertising. They put in attractive toilets — the kind you might see at a sporting event — and sell advertising on the outside. It generates enough money to pay for it and keep it clean," he says.

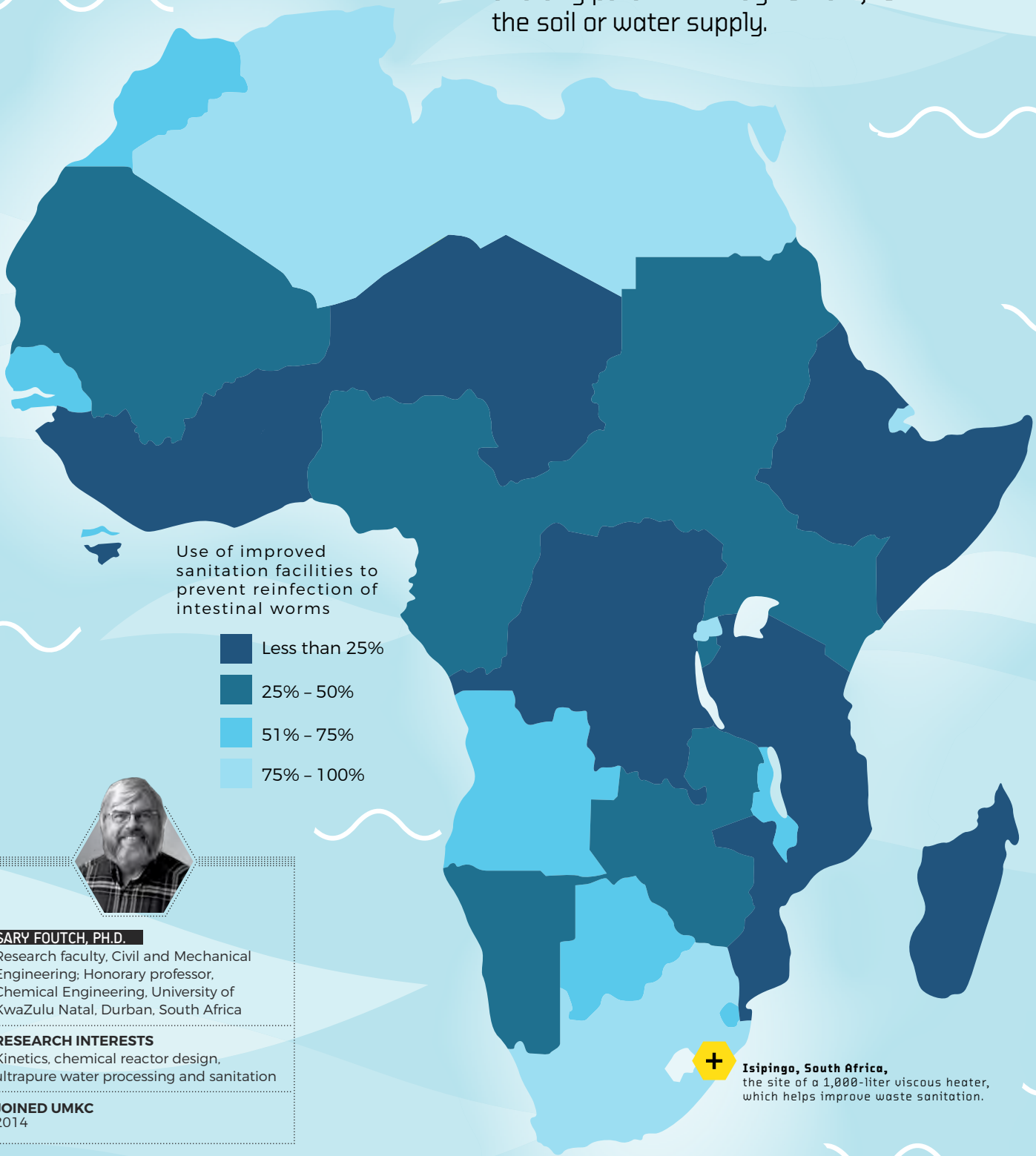
Along those lines, this stage in Foutch's project is focused on commercialization.

"It's very possible that this whole project will wrap up by the end of 2018. The likely result is a company somewhere in the world will be making viscous heaters for commercial applications involving sludge," he says.

But it's not solely the academic or technical achievement that continues to drive Foutch.

"This system is very beneficial to me personally because I feel as if I'm contributing to solving a health problem on a global scale."

Forty percent of the world's population lives in areas with poor or inadequate sanitation, many of whom live in Africa. These conditions create the opportunity for waste, and any parasite it may contain, to re-enter the soil or water supply.



//GARY FOUTCH, PH.D.
Research faculty, Civil and Mechanical Engineering; Honorary professor, Chemical Engineering, University of KwaZulu Natal, Durban, South Africa

RESEARCH INTERESTS
Kinetics, chemical reactor design, ultrapure water processing and sanitation

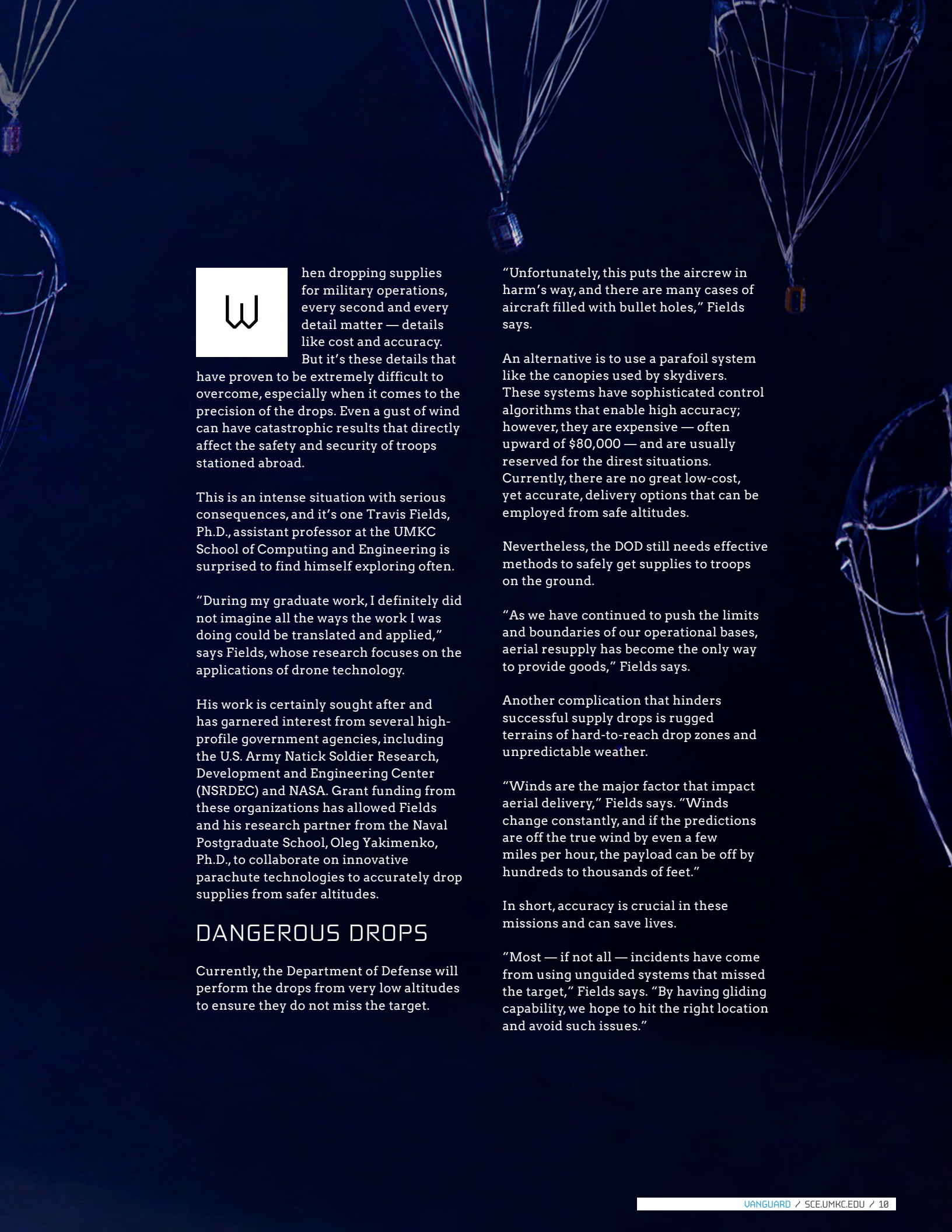
JOINED UMKC
2014

Isipingo, South Africa, the site of a 1,000-liter viscous heater, which helps improve waste sanitation.

OPERATION: AIR SUPPLY

BY BRIAN SCHNEWEIS

Covert and cost-effective parachute drops



When dropping supplies for military operations, every second and every detail matter — details like cost and accuracy. But it's these details that have proven to be extremely difficult to overcome, especially when it comes to the precision of the drops. Even a gust of wind can have catastrophic results that directly affect the safety and security of troops stationed abroad.

This is an intense situation with serious consequences, and it's one Travis Fields, Ph.D., assistant professor at the UMKC School of Computing and Engineering is surprised to find himself exploring often.

"During my graduate work, I definitely did not imagine all the ways the work I was doing could be translated and applied," says Fields, whose research focuses on the applications of drone technology.

His work is certainly sought after and has garnered interest from several high-profile government agencies, including the U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC) and NASA. Grant funding from these organizations has allowed Fields and his research partner from the Naval Postgraduate School, Oleg Yakimenko, Ph.D., to collaborate on innovative parachute technologies to accurately drop supplies from safer altitudes.

DANGEROUS DROPS

Currently, the Department of Defense will perform the drops from very low altitudes to ensure they do not miss the target.

"Unfortunately, this puts the aircrew in harm's way, and there are many cases of aircraft filled with bullet holes," Fields says.

An alternative is to use a parafoil system like the canopies used by skydivers. These systems have sophisticated control algorithms that enable high accuracy; however, they are expensive — often upward of $80,000 — and are usually reserved for the direst situations. Currently, there are no great low-cost, yet accurate, delivery options that can be employed from safe altitudes.

Nevertheless, the DOD still needs effective methods to safely get supplies to troops on the ground.

"As we have continued to push the limits and boundaries of our operational bases, aerial resupply has become the only way to provide goods," Fields says.

Another complication that hinders successful supply drops is rugged terrains of hard-to-reach drop zones and unpredictable weather.

"Winds are the major factor that impact aerial delivery," Fields says. "Winds change constantly, and if the predictions are off the true wind by even a few miles per hour, the payload can be off by hundreds to thousands of feet."

In short, accuracy is crucial in these missions and can save lives.

"Most — if not all — incidents have come from using unguided systems that missed the target," Fields says. "By having gliding capability, we hope to hit the right location and avoid such issues."

SAFER LANDINGS

With cost and accuracy needs in mind, Fields, Yakimenko and SCE students are testing a cruciform, or cross canopy system, that is manufactured with two rectangular nylon panels that are sewn together. This process, according to the researchers, is significantly easier and less expensive than trying to create the complex shape of the parafoil.

"This system, which is probably an order of magnitude cheaper than those based on a parafoil, demonstrates a capability to rely on a calculated aerial release point and uses a limited control authority to steer toward a desired point of impact," Yakimenko says.

The package is fitted with an airborne guidance unit that features sensors and Raspberry Pi, a credit-card-sized computer, to provide real-time situational awareness. Additionally, the Raspberry Pi controls a motor that pulls on a particular suspension line of the parachute and allows for more accurate gliding to reach the desired target.

As Fields and his team continue to test this novel system, they have been fortunate to have unique experiences and grant support along the way.

TEST RUNS

Fields and his team recently had an opportunity to do testing from UH-60 Black Hawk helicopters at the Army Yuma Proving Ground.

"It was a great opportunity and enabled us to show that our system really is steering and could be a more cost-effective method for aerial delivery," Fields says.

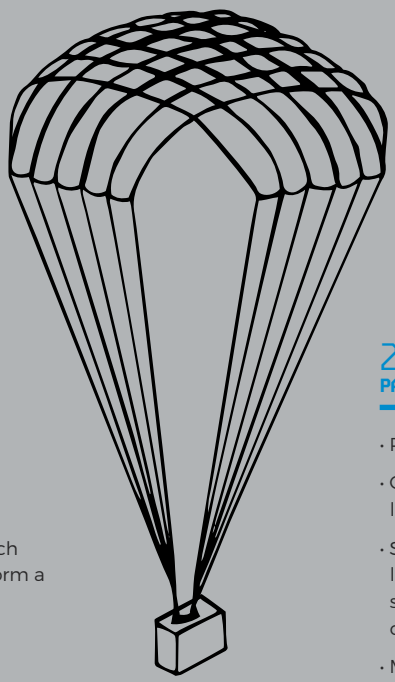
Fields also secured $75,000 from NASA's Established Program to Stimulate Competitive Research to further explore unmanned systems and models. NASA even provided the team with five days of fully supported testing in its vertical spin tunnel at the NASA Langley Research Center, the only one of its kind in the Western hemisphere. Additionally, the primary partner in the research, the U.S. Army NSRDEC, has provided more than $160,000 since 2015, with more funding set to arrive this year.

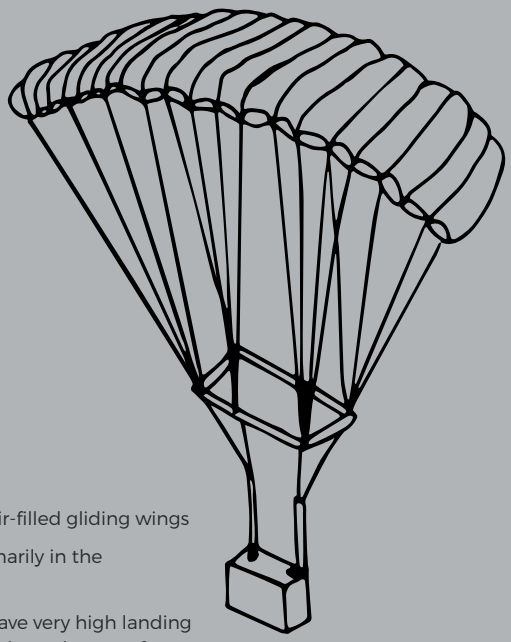
The funding, Fields says, is essential to the research and has helped the team run experiments at Camp Roberts in California on several occasions. Camp Roberts is an Army National Guard base with a restricted airstrip, McMillan Airfield, used for unmanned aircraft. While there, the team uses both fixed-wing and large multirotor unmanned aircrafts to carry packages up to 4,000 feet and then deploy the systems. To gain additional insight into the parachute guidance performance, the team uses a quadcopter to chase after the parachutes to collect video footage of the descent. This helps diagnose what the system is doing and adjust for future tests.

"Going to Camp Roberts is absolutely crucial for us to test our steering and

/CRUCIFORM VS. PARAFOIL SYSTEMS

Several self-guided aerial delivery approaches have been developed throughout the past 20 years, each aiming to provide a low-cost, simple and accurate precision-delivery system.





1/ CRUCIFORM

- Introduced by A. Forichon in 1961
- Symmetrical design
- Composed of two identical fabric rectangles, crossed and joined to each other at the square intersection to form a flat surface having four equal arms
- Oftentimes rotate during descent
- Inexpensive

2/ PARAFOIL

- Relatively inefficient, air-filled gliding wings
- Can be controlled primarily in the lateral direction
- Small-scale parafoils have very high landing location accuracy (thanks to the use of sophisticated path-planning and flight-control algorithms)
- Missions using these are expensive to execute

guidance methodologies," Fields says. "Out there we can go higher and farther away than in the national airspace around Kansas City, which currently limits operations to 400 feet without a waiver."

Though the tests are only the beginning of developing and implementing this technology, Fields is happy to report positive results.

"We have performed two tests from 4,000 feet above ground where we were within 10 feet of the target, and a test from 6,000 feet where we were near 300 feet from the target," Fields says. He adds that the success their work has seen is directly attributable to the support from the UMKC School of Computing and Engineering and the passion the students have. Yakimenko agrees.

"I enjoy working with the undergraduate and graduate students from UMKC because of their desire to be involved in real-world, defense-related applications, as well as their creativity, readiness, thoroughness and willingness to stay for several days in a desert, where we usually conduct our tests," Yakimenko says. "I know I can always rely on Dr. Fields' team."

The team's system has great potential to increase precision delivery capabilities for critical military missions, particularly when costs inhibit more complex parafoil-based deliveries. Fields' system features descent profiles that are not currently achievable with other glide systems, which means his system can achieve more accurate drops, more successful missions and save more lives.

"This low-cost approach opens up the potential for semi-precision delivery in a variety of scenarios well beyond military use, including aid relief for situations like the hurricane in Puerto Rico or any other major disaster or crisis," Fields says. "I believe this will be a transformational technique for aerial delivery operations in both military and humanitarian relief efforts in the years to come."

"I definitely did not imagine all the ways the work I was doing could be translated and applied."

//TRAVIS FIELDS, PH.D.
Assistant professor,
Mechanical Engineering

RESEARCH INTERESTS
Precision aerial delivery, unmanned aircraft systems, system identification, robotics and flight controls

JOINED UMKC
2013

▼ Assistant Professor Travis Fields, Ph.D., conducts research using unmanned aircrafts, which drop 10- to 15-pound payloads up to 1,600 feet above the ground in restricted airspaces.

BRANDON PARIGO

▼ Professor Yugi Lee, Ph.D., oversees about 20 Ph.D. students who contribute to various research projects involving artificial intelligence and deep learning.

BRANDON PARIGO

THE ART OF ARTIFICIAL INTELLIGENCE

BY ASHLEY BLONQUIST

Powerful technology could advance our nation's health care while cutting costs

THERE'S NO DENYING technology is permeating the health-care industry. Doctors and nurses are trading their pens and papers for tablets that store patient information and streamline note-taking. Digital machines can now take your blood pressure without a cold stethoscope ever touching your arm.

But those two examples don't come close to explaining the power of technology and the potential impact it could make in the lives of caregivers and their patients. Yugyung (Yugi) Lee, Ph.D., a professor at the School of Computing and Engineering, knows just how powerful and positive that impact can be.

Lee's primary focus is to improve the health-care industry using artificial intelligence. We sat down with Lee to get her take on AI and its role in health care, and why some may be resistant to using advanced technology.

Q: How could AI improve the quality of health care?

AI will allow doctors and researchers to focus on making decisions. It does this by collecting and analyzing data and providing more information and context for doctors.

Q: What about reducing health-care costs?

Health-care providers spend a lot of money on things like customer service representatives who take patient information. By using chat-bots — computerized response systems — infused with AI, those providers can save time and money. These bots can interact with patients, provide answers and take patient information just like a customer service representative. But chat-bots save more than four minutes per inquiry. That's an average cost savings of $0.50-$0.70 per interaction.

In total, chat-bots could save organizations $8 billion annually worldwide by 2022.

Q: Do you think the health-care industry has been resistant to AI?

I think health-care providers are resistant to AI because they believe that human intervention is reliable and trustworthy, and they don't have that same confidence in machines.

There's also the possibility they believe their jobs will be replaced by robots. AI solutions won't replace doctors and nurses, but will support them. Not to mention, we are seeing a shortage of doctors and rising health-care costs, which is why it's time to turn to solutions like AI that support doctors and reduce costs.

Q: What other AI projects are you and your students doing?

We are currently working on a cognitive robot that can be useful for patients who may have physical or mental disabilities. It has advanced capabilities such as natural language processing to understand what a patient is asking while analyzing the conversational flow and responses.

We're also studying human behaviors and perspectives through social media data. We analyze texts, tweets, images and videos and use them for scientific inquiry in an effort to improve the health-care industry.

Q: What kind of impact do you think your students will have on the health-care industry?

They can solve real problems that impact human lives. My students and I have achieved exciting breakthroughs in several different realms of health, such as image classification in oral health, helping Alzheimer's patients answer questions through photos rather than words, and an intelligent mobile app for those with hearing disabilities.

Q: What have you learned from your students?

There is no shortcut in research. Continuous, hard work is an essential part of moving a project forward. And, in almost all cases, hard work is rewarded.

Q: What do you hope your students have learned from you?

I hope they have learned to enjoy their research and find a value and joy in it — especially when it comes to creative problem solving and finding innovative solutions to help others. Most of all, I hope they can find their purpose in life on this earth as a scientist or engineer.

//YUGYUNG YUGI LEE, PH.D.
Professor, Computer Science

RESEARCH INTERESTS
Artificial Intelligence, distributed computing and big data analytics, software engineering and semantic web

JOINED UMKC
1999

/DEEP LEARNING IN ARTIFICIAL INTELLIGENCE

Deep Learning is an area of artificial intelligence. Deep Learning technologies can help with accurate detection and prevention of diseases, intelligent decision-making and predicting future outlooks for patients.

THESE ARE JUST A FEW OF THE AI AND DEEP LEARNING APPLICATIONS ALREADY IN USE OR BEING DEVELOPED BY LEE AND HER TEAM TO IMPROVE THE LIVES OF DOCTORS AND PATIENTS.

1/ iHEAR

This mobile app has a wireless receiver that acts as a replacement for hearing aid devices. It has features such as noise filtering, audio recognition, speech recognition and translation.

2/ ORO VISION

This mobile app is used to help detect oral diseases in their earliest stages. It has been implemented in the past year and has diagnosed certain diseases at an accuracy rate of 95 percent.

3/ COGNITIVE VISUAL RECOGNITION TRACKER (CVRT)

This mobile app can help physicians determine trends in patient data. That data can then be used to provide better overall treatment for diseases and predict future analytics.

4/ DEEPBRAIN

This app analyzes patterns from brain images and develops personalized treatments for patients with mental disorders.

THERE ARE SEVERAL WAYS ARTIFICIAL INTELLIGENCE CAN HELP BOTH DOCTORS AND PATIENTS – WHILE SAVING TIME AND MONEY.

DOCTORS

- Help leverage mobile or wearable devices that can collect and transcribe audio, video and written notes during patient visits
- Help clinicians make sense of information and transform raw data into actions
- Detect conditions such as depression, obesity or heart disease by reading into vocal tone or facial expressions

PATIENTS

- Help consumers select doctors or benefit plans by collecting symptoms, then providing valuable answers and resources
- Create personalized treatments for patients with mobility issues because of a stroke, or injuries to their spinal cord or brain

/ACCOLADES AT SCE IN 2017

STUDENT TEAMS

THE SCE BIG BEAM COMPETITION TEAM placed 10th at the national competition.

SCE Steel Bridge Team

THE SCE STEEL BRIDGE TEAM placed 2nd in stiffness and 1st overall for U.S. teams in the international competition.

COMMUNITY AWARD WINNERS

JIM HOGAN, B.S. (CIVIL ENGINEERING '84), was honored with the 2017 UMKC SCE Alumni Achievement Award.

AASHISH CHANDRA, M.S. (ELECTRICAL ENGINEERING '11), was awarded the School of Computing and Engineering Young Alumni Award.

KIRAN CHELLURI, M.S. (COMPUTER SCIENCE '01), was awarded the School of Computing and Engineering Supporter Award.

DST SYSTEMS, INC. was awarded the School of Computing and Engineering Company of the Year Award.

KC STEM ALLIANCE was awarded the School of Computing and Engineering STEM Outreach Partner Award.

FACULTY

ANTHONY CARUSO, PH.D., **AHMED HASSAN, PH.D.**, **DEB CHATTERJEE, PH.D.**, **TRAVIS FIELDS, PH.D.** and **FAISAL KHAN, PH.D.**, were awarded over $7.2 million by the Office of Naval Research for "Short Pulse Research and Evaluation and non-SWaP Demonstration for C-sUAV Study."

ZHIQIANG CHEN, PH.D., was awarded $72,710 by the National Science Foundation for his project "Development of Aerial-Ground Sensing and Data-Enabled Vulnerability-Resilience Modeling for Crop Systems Subject to Drought."

BAEK-YOUNG CHOI, PH.D., was awarded a NASA Faculty Fellowship at NASA Marshall Space and Flight Center for Summer 2017.

MASUD CHOWDHURY, PH.D., was awarded $50,000 under the UM System Fast Track grant from the University of Missouri Economics Initiatives and received a 2017 Leadership Excellence Achievement Program Award from the Missouri Society of Professional Engineers Western Chapter for demonstrating mentoring abilities that encourage students to seek leadership excellence in the engineering profession.

REZA DERAKHSHANI, PH.D., was awarded $79,584 from ZOLOZ for his project "Optokinetic Anti-Spoofing" and $77,048 from ZOLOZ for "Single and Multi-Frame Deep Learning Super-Resolution."

TRAVIS FIELDS, PH.D., was awarded $53,222 by the Naval Postgraduate School for his project titled "Development of Unmanned Aircraft-based Autonomous Airborne Target Tracking and Pursuit"; $80,461 by the U.S. Army Natick Soldier Research, Development and Engineering Center for "Continued Development and Testing of Steerable Cross Canopy Descent Vehicles"; and $224,525 by U.S. Army Natick Soldier Research, Development and Engineering Center for "Advancing Steerable Low-Cost Precision Aerial Delivery Systems."

MEGAN HART, PH.D., was awarded $25,000 by Kansas City Power & Light for her project "Water Testing: Cement-Based Filtration of LaCygne AQC Discharge" and awarded funds to connect international geoenvironmental engineers. This seed grant is to foster long term joint international research and is funded by the National Science Foundation's program to connect women faculty in geotechnical engineering.

AHMED HASSAN, PH.D. and **DERAKHSHANI, PH.D.**, were awarded $58,074 by ZOLOZ for "A Novel Biometric Technique Based on Microwave-Imaging of Deep-Biological Tissue Using Commercial Wireless Devices."

AHMED HASSAN, PH.D. and **ANTHONY CARUSO, PH.D.**, were awarded $440,550 by the Office of Naval Research for their project "RF Coupling Revisited."

JOHN KEVERN, PH.D., was awarded a $175,000 research grant from Iowa State University and the National Academies of Sciences to support his research in "Entrained Air Void System for Durable

Highway Concrete." Kevern was also awarded $33,385 by Marquette University for "Joint Sawing Practices and Effects on Durability" and $62,482 by Wisconsin Department of Transportation policy research program for "Evaluation of Penetrating Sealers Applied to Saw Cut Faces in Concrete Pavement Joints."

FAISAL KHAN, PH.D., was awarded $49,980 under the UM System Fast Track grant from the University of Missouri Economics Initiatives and $40,000 from the National Renewable Energy Laboratory for his project "Creation of an Adaptive Remaining Lifetime Prediction Model of Power Electronics."

VIJAY KUMAR, PH.D., was named a 2017 Distinguished Member by the Association for Computing Machinery.

ZHU LI, PH.D., was awarded $50,000 from Qualcomm Technologies to support his research in point cloud compression; $58,174 by ZOLOZ for his project "Mobile Human Re-Identification"; $15,000 by the National Science Foundation for "University of Missouri-Kansas City Planning Grant: I/UCRC for Big Learning"; and $10,000 from Snap, Inc. for his work related to video compression.

DEEP MEDHI, PH.D., was awarded $16,000 by the National Science Foundation to support two undergraduate students on his project "SRN: On Establishing Secure and Resilient Networking Services." Medhi was also named an Institute of Electrical and Electronics Engineers Fellow for his contributions to optimization and the design of computer-communication networks.

AMIR MEHDIZADEH, PH.D., was awarded $43,973 by the University of Missouri Research Board.

DEB O'BANNON, PH.D., received the Society of Women Engineers' 2017 Distinguished Engineering Educator Award.

Deb O'Bannon, Ph.D., accepting her award.

AJITA RATTANI, PH.D., **NARSI REDDY** and **REZA DERAKHSHANI, PH.D.**, received the Best Paper Award at the 2017 IEEE Homeland Security Symposium for their paper "Gender Prediction Using Mobile Ocular Biometrics: A Feasibility Study."

JERRY RICHARDSON, PH.D., was awarded $20,937 by Water Resources Solutions, LLC for "Woodson County State Fishing Lake Spillway Repair."

SEJUN SONG, PH.D., was awarded $16,000 by the National Science Foundation for "REU Supplement: CC*DNI Networking Infrastructure: Data Driven Research-Wise Network Infrastructure Upgrade" and $63,709 by Futurewei Technologies, Inc. for "Super High Throughput and Low Latency Video Streaming." Song also received a $7,000 unrestricted donation to his laboratory from Mr. Keumtak Oh of the Ministry of Science and ICT, Republic of Korea.

GANESH THIAGARAJAN, PH.D, P.E., was awarded $410,010 by the National Science Foundation for his project "Micro-Macro Scale Investigations to Study Osteocyte Mechanobiology" and $17,000 from the Kansas City Consortium on Musculoskeletal Diseases.

These highlights represent select achievements of our distinguished faculty.

/GET INVOLVED

EVENTS

SAME INDUSTRY DAY
March 26-27, 2018
UMKC Student Union
Details available online at **same.org/GKC**

SCE AWARDS FOR ALUMNI AND FRIENDS
April 26, 2018 | 4:30PM
Awardees include:
- Google Fiber,
  2018 STEM Outreach Partner
- Olsson Associates,
  2018 Company of the Year
- Debby Dilks,
  2018 Supporter of the Year
- DeJ'on Slaughter,
  2018 Young Alumni

2018 SPRING COMMENCEMENT
May 13, 2018
UMKC Volker Campus
Pierson Auditorium

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

CONTINUING ED

ELECTRICAL AND COMPUTER POWER P.E. REVIEW COURSE
Classes held June 4–Aug. 13
Deadline to register: May 28, 2018

LEADERSHIP DEVELOPMENT SERIES
Six, three-hour sessions offered
June–July 2018
Deadline to register: June 8, 2018
Details for all courses are available online at **sce.umkc.edu/continuing-ed**

CIVIL P.E. REVIEW COURSE
Classes held Aug. 21–Oct. 6,
Tuesdays and Thursdays from 6-9pm, with morning practice exam on Oct. 6
Deadline to register: Aug. 13, 2018

PROJECT MANAGEMENT PROFESSIONAL (PMP) CERTIFICATION PREP COURSE
Custom classes available for groups of 10 or larger. Email **scecontinuinged@umkc.edu** for details.

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