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

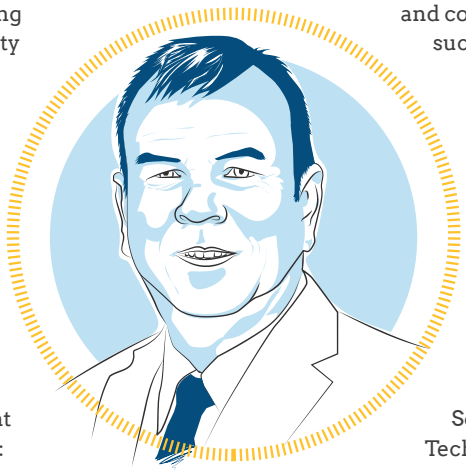
VANGUARD

Advances in Nanotechnology Changing the World

/FROM THE DEAN

Dear Colleagues:

I am excited to introduce our inaugural issue of *Vanguard*, a research magazine highlighting groundbreaking engineering and technology contributions from the School of Computing and Engineering at the University of Missouri-Kansas City.



In this magazine we will share a glimpse of our successes in reaching two of our most important strategic goals: providing our students with a first-class education as we continue increasing enrollment; and supporting cutting-edge research by our faculty as they bring innovation and entrepreneurship to Kansas City and beyond.

After nine years serving as dean, I am pleased to share that we have more than doubled our enrollment and are now the fastest-growing, third-largest school within UMKC. However, what brings me the most pride isn't just our sheer number of students — it's the fact that we continue to embrace diversity, recruit top talent and invest in research.

Since 2008 we have seen a 172 percent increase in female students, the average ACT score of our incoming freshman class has risen from 24.5 to nearly 27, and our research funding has more than tripled.

As Kansas City's university, our relationships with alumni and community leaders like you are invaluable to our growth. We strive to serve Kansas City by producing young graduates prepared for 21st century careers and by engaging in your work.

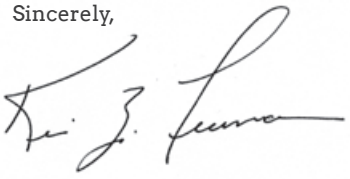
Our faculty, as you will see in this magazine, work locally and globally to provide exciting solutions and cutting-edge technology. I wish we could tell you the stories of every one of their individual and collaborative successes.

Our goal is simple — to introduce the vanguard of new ideas coming-of-age each day inside the walls of the Robert H. Flarsheim Science and Technology Hall.

I welcome you to explore with us the potential SCE has to offer. And remember — we want to connect with you. Each and every one of you shares a connection to SCE and the burgeoning technology and engineering community here in Kansas City. I challenge you to reach out, connect with our faculty and engage in their work.

We are committed to contributing research at the forefront of computer science and engineering. We hope this magazine pulls open the laboratory door and welcomes you to be part of our adventure.

Sincerely,



KEVIN Z. TRUMAN, PH.D.
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**

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School of Computing and Engineering

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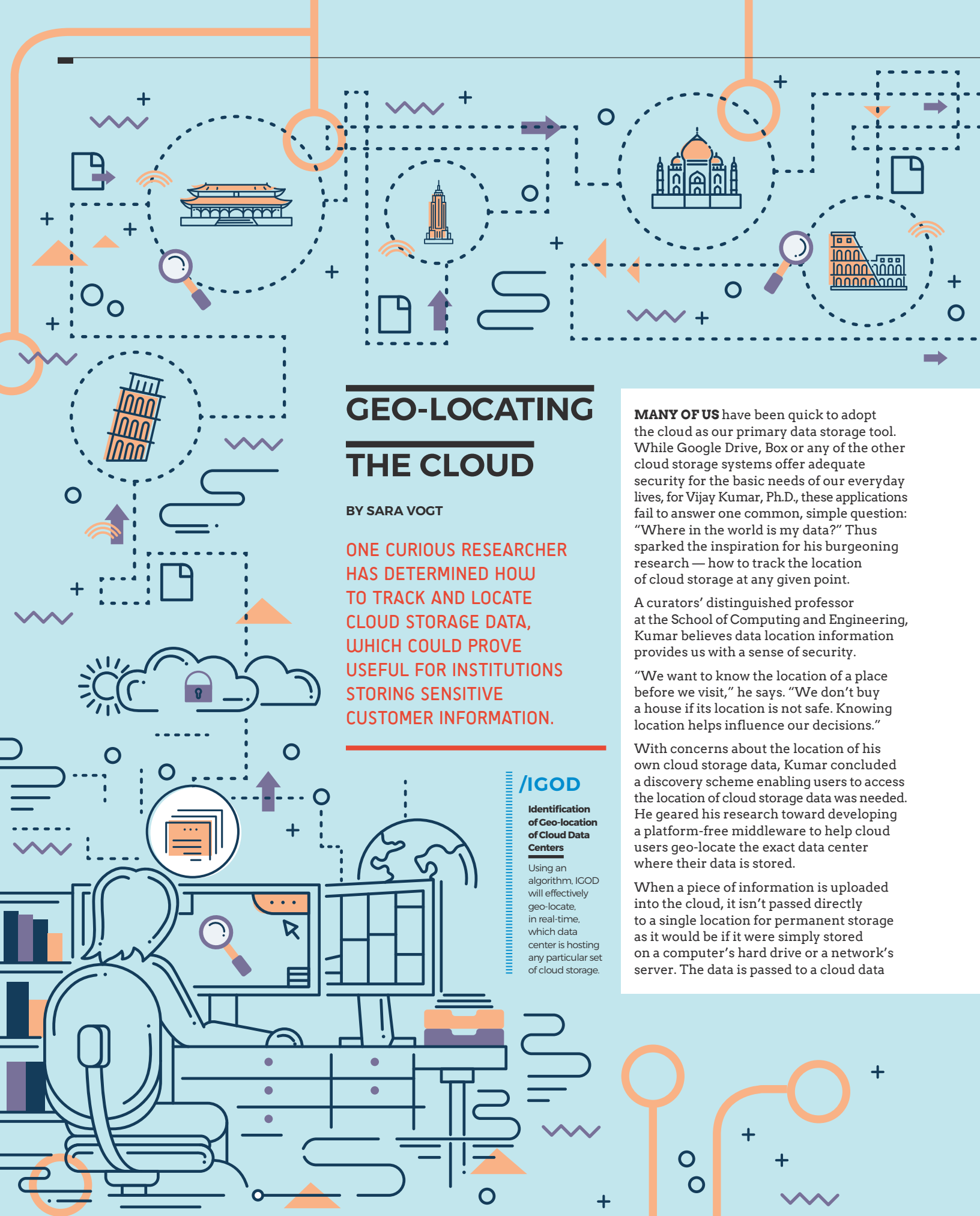


GEO-LOCATING THE CLOUD

BY SARA VOGT

ONE CURIOUS RESEARCHER HAS DETERMINED HOW TO TRACK AND LOCATE CLOUD STORAGE DATA, WHICH COULD PROVE USEFUL FOR INSTITUTIONS STORING SENSITIVE CUSTOMER INFORMATION.

/IGOD

Identification of Geo-location of Cloud Data Centers

Using an algorithm, IGOD will effectively geo-locate, in real-time, which data center is hosting any particular set of cloud storage.

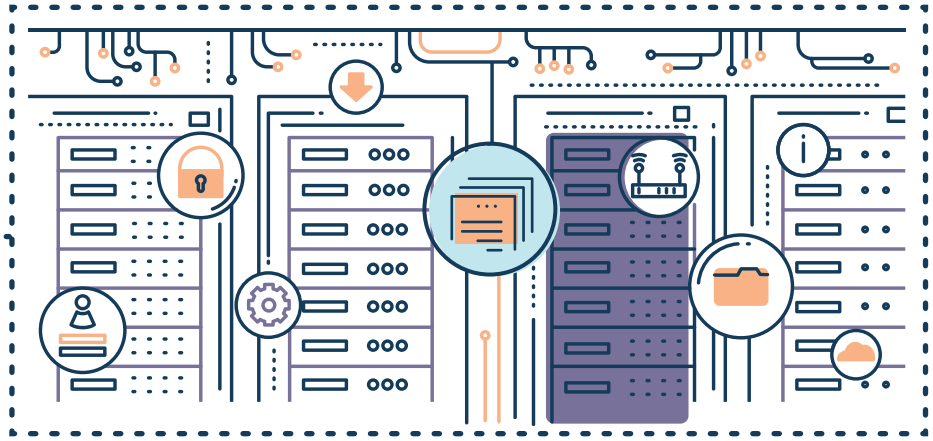
MANY OF US have been quick to adopt the cloud as our primary data storage tool. While Google Drive, Box or any of the other cloud storage systems offer adequate security for the basic needs of our everyday lives, for Vijay Kumar, Ph.D., these applications fail to answer one common, simple question: "Where in the world is my data?" Thus sparked the inspiration for his burgeoning research — how to track the location of cloud storage at any given point.

A curators' distinguished professor at the School of Computing and Engineering, Kumar believes data location information provides us with a sense of security.

"We want to know the location of a place before we visit," he says. "We don't buy a house if its location is not safe. Knowing location helps influence our decisions."

With concerns about the location of his own cloud storage data, Kumar concluded a discovery scheme enabling users to access the location of cloud storage data was needed. He geared his research toward developing a platform-free middleware to help cloud users geo-locate the exact data center where their data is stored.

When a piece of information is uploaded into the cloud, it isn't passed directly to a single location for permanent storage as it would be if it were simply stored on a computer's hard drive or a network's server. The data is passed to a cloud data



solutions provider, who then can store the information in any of the 4,081 data centers located in one of 118 countries.*

"Data could begin its storage journey in a data center in Japan," Kumar explains. "Regular maintenance of the data center could mean your data has to be moved to Slovenia or Croatia, where power outages or security threats could require it be moved to The Bahamas or Ukraine. Storage costs could then skyrocket in those regions, forcing your data solutions provider to move your data one last time to Egypt or Mexico or even to your own backyard at one of the data centers in the U.S."

For businesses with inherently high security needs, particularly financial institutions and health-care providers, cloud data storage is largely viewed as not viable. Without knowledge of where their sensitive data is stored, using cloud storage systems are not feasible for customer security.

Requesting cloud service providers to disclose location information, in the current scheme, is impractical due to the many business and technical requirements of managing data on the cloud exchange. However, if cloud customers, including groups requiring high levels of security protocols, could geo-locate the data center where their data is stored at any given time, they could assure customers their data is safe by establishing and managing their own data location and security processes.

With these security protocol needs in mind, Kumar, alongside his research assistant, Ph.D. candidate Chetan Jaiswal, proposed to develop an efficient and cost-effective solution: IGOD, Identification of Geo-location of Cloud Data Centers. Using an algorithm, IGOD will effectively geo-locate, in real-time, which data center is hosting any particular set of cloud storage.

After nine months of work on the algorithm, Kumar and Jaiswal were confident in their scheme, and IGOD was fully operational.

Initial testing of the completed product was shown to satisfy the security needs of financial institutions, medical service providers and defense institutions. The algorithm utilizes a triangulation approach and round-trip time to precisely geo-locate a desired data center.

As he continues to fine-tune his product and engage with financial institutions and health-care providers about the next step in security for cloud data, Kumar hopes the right opportunity for a partnership and first implementation will present itself.

Jaiswal completed initial testing of IGOD using the Amazon cloud data center location to validate it works properly. Since its publication, the IGOD scheme has received several awards and best papers leading Kumar and Jaiswal to their final step — filing for a patent. ■

*Data Center Map: datacentermap.com/datacenters.html

//VIJAY KUMAR, PH.D.
Curators' Distinguished Professor, Department of Computer Science Electrical Engineering

RESEARCH INTERESTS
Information security; mobile information system databases; energy management; cryptography; sensor technologies

JOINED UMKC
1986

a simple word document could have traveled the globe without anyone ever being the wiser

WHERE IS YOUR CLOUD STORAGE LOCATED?

4,081 data centers in 118 different countries

1,655 data centers operating in the United States

ENGINEERING A BETTER LIFE FOR OLDER ADULTS

BY STACY DOWNS

GANESH THIAGARAJAN OF THE SCHOOL OF COMPUTING AND ENGINEERING HAS TEAMED UP WITH MARK JOHNSON AND SARAH DALLAS OF THE SCHOOL OF DENTISTRY TO STUDY HOW TO BEST ALLEVIATE THE DECLINE OF BONE AND MUSCLE AS WE AGE.

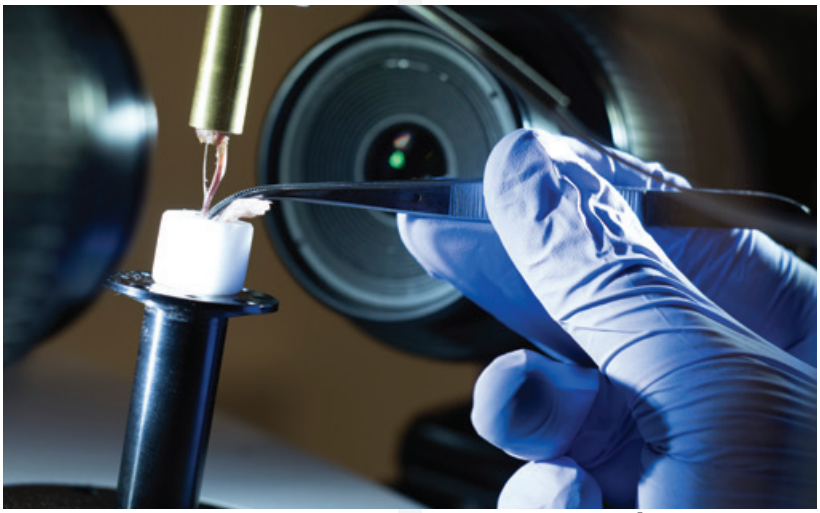
AS A FACULTY ADVISOR to the UMKC School of Computing and Engineering's Big Beam team, Ganesh Thiagarajan, Ph.D., helps students design and build load-bearing structures for bridges. Using bridge-making technology and mouse bones — yes, you read that right — Thiagarajan is finding better ways to support humans as they age, giving them longer, healthier lives.

Thiagarajan has partnered with researchers Mark Johnson, Ph.D., and Sarah Dallas, Ph.D., at the UMKC School of Dentistry, on a multiyear, $1 million-plus research project to examine the effects of aging on bone and muscle. Declines in bone and muscle that occur with normal aging can result in osteoporosis (bone deterioration) and sarcopenia (muscle loss).

The team has hypothesized that bone produces factors that support muscle function, and muscle produces factors that condition bone's response to loading. And aging affects this crosstalk, leading to the decline observed in these tissues. Thiagarajan's research focuses on mechanical signaling in bone.

Now in their final year of National Institutes of Health funding, the team is exploring how bone cells respond to mechanical loading, and how gender and age impact growth of the skeleton and its mechanical responsiveness. Specifically, they are looking at loading in mouse bones to determine how specialized cells embedded in the bone — called osteocytes — sense the load input and how the body responds by preparing for new bone to be formed. This network of osteocytes degenerate as aging occurs.

▼ SIMULATING MECHANICAL STRESS, OR LOAD, ON MOUSE BONES PROVIDES A GLIMPSE INTO REGENERATION



DAN VIDETICH PHOTOGRAPHY

> *Engineers are great at coming up with solutions to problems that biologists, like myself, wouldn't be able to solve on our own.*
>
> — MARK JOHNSON, PROFESSOR, UMKC SCHOOL OF DENTISTRY

Thiagarajan's research is directed towards documenting how this deterioration affects bone mechanics and the ability of these cells to sense loading in order to prevent bone loss in human patients. For example, as estrogen loss in post-menopausal women is linked to bone loss, could loading the skeleton through exercise reverse this bone loss as a treatment for patients with osteoporosis?

/THE NEED FOR REBUILDING BONE LOSS

Osteoporosis

Bone disease that makes a person's bones weak and more likely to break

1 in 2 women and 1 in 4 men will break a bone in their lifetime due to osteoporosis

1/2 OF ADULTS AGE 50+

are at risk of breaking a bone and should be concerned about bone health

Potential Research Solutions

- New exercise therapy
- New pharmaceuticals

Sarcopenia

Gradual loss of muscle mass associated with the aging process

3-5%

of muscle mass can be lost each decade after age 30 if physically inactive

Source: International Osteoporosis Foundation

▼ PROFESSOR GANESH THIAGARAJAN AND HIS TEAM DOCUMENT THE RESULT OF LOAD ON MOUSE BONES

"This research project has given me a great appreciation of the work that biologists do — as I try to understand the biology in order to apply the engineering principles appropriately — the efforts that they put in and the tremendous challenges they face in identifying the source and solution to some of the most debilitating diseases that human beings face," Thiagarajan says.

Johnson and Dallas say Thiagarajan's work on how the skeleton responds to mechanical loading has been valuable to the team.

"He is an engineer who really gets the biology," Dallas says. "His group has devised sophisticated new methods for measuring the deformations that bones undergo when loaded, and to measure these deformations at a global (whole bone) as well as microscopic (individual cell) level. This work supports the biology as it enables us to determine how individual cells respond to the loading input. He also assists in characterizing the changes in bone strength and geometry that occur with aging and determining differences between genders."

The collaboration has been a successful one that has led to many scientific journal publications and remains exciting in its potential.

"As an engineer, Ganesh asks questions I don't think to ask," Johnson says. ■

WHY STUDY BONES IN ENGINEERING AND DENTISTRY?

The School of Dentistry is home to the UMKC Center for Excellence in the Study of Dental and Musculoskeletal Tissues. With a focus on dental and musculoskeletal health, the center integrates investigators from the Schools of Dentistry, Medicine, Nursing and Health Studies, and Computing and Engineering into a powerful, translational team to prevent and treat diseases of mineralized tissue, which includes teeth, cartilage, bone and muscle. Not only could findings be applied to biomaterials and composite research, medical devices, diagnostics and clinical imaging, but results can expanded to veterinary practice and treatment of animal dental and bone disease.

//GANESH THIAGARAJAN, PH.D.
Professor, Department of Civil and Mechanical Engineering

RESEARCH INTERESTS
Bone bioengineering; structural concrete

JOINED UMKC
2002

//SARAH DALLAS, PH.D.
Professor, Department of Oral and Craniofacial Sciences, Director of UMKC Confocal Microscopy Core, UMKC School of Dentistry

RESEARCH INTERESTS
Osteocyte biology in human genetic diseases

JOINED UMKC
2001

//MARK JOHNSON, PH.D.
Professor and Chair of Department of Oral and Craniofacial Sciences, Director of UMKC Center for Excellence in the Study of Dental and Musculoskeletal Tissues, UMKC School of Dentistry

RESEARCH INTERESTS
Osteocyte biology in human genetic diseases

JOINED UMKC
2005

INNOVATING MEDICAL IMAGING

BY STACY DOWNS

WITH A GOAL TO IMPROVE PATIENT LIFE, RESEARCHERS FROM THE SCHOOL OF COMPUTING AND ENGINEERING AND CHILDREN'S MERCY HOSPITAL ARE WORKING TO SOLVE TODAY'S MEDICAL TESTING SHORTCOMINGS.

WITHIN THE KANSAS CITY COMMUNITY, a bioinformatics researcher shares an innovative vision with a local pediatrics physician. Deendayal Dinakarpandian, M.D., Ph.D., and Children's Mercy Hospital's Sherwin Chan, M.D., Ph.D., have been teaming up on research for just more than a year. Yet, they're already making major headway on solving three medical-imaging problems that could improve patient life and operation efficiency.

"Our collaboration is successful because we speak the same language," Dinakarpandian says, an associate professor of computer science electrical engineering.

By language, Dinakarpandian means their shared educational and clinical backgrounds. Both earned medical degrees in addition to graduate degrees in computing and engineering.

One of the major medical issues they currently see is with liver transplants. There are more people who need a transplant than there are donated livers, and it is an expensive procedure that costs hundreds of thousands of dollars.

A common cause of early liver transplant failure is the narrowing of the artery feeding the transplanted liver. Ultrasound is a screening test that then leads to a confirmatory test that also serves as a treatment — an angiography.

Angiography is an invasive procedure with many complications including blood clots, stroke, infection, abnormal heartbeat and, in rare cases, death. Currently, ultrasound screenings refer too many liver transplant patients to angiography testing and treatment through false positives.

"Ideally, we only want to do angiography on those patients with stenosis (artery narrowing) that can be treated and is compromising the transplant," Chan says, who also serves as assistant professor of radiology and pediatrics in the UMKC School of Medicine. "We want to prevent the unnecessary loss of transplant organs."

Dinakarpandian, working with Chan, is developing new early transplant-failure detection protocols through a new blood flow measurement technique. His approach measures the frequency of blood flow for comparison to algorithmic standards, which would reduce the need to have a trained professional to review the outputs for the earliest signs of organ failure in newly transplanted organs.

Current ultrasound screenings only use two data points in a waveform out of the thousands that are available; Dinakarpandian proposes using all of the data points.

"In retrospective testing in patients, our method had fewer false positives by ultrasound thereby decreasing the number of patients who would have gone to angiography if it was used prospectively," Chan says. ■

WHY ARE LIVER TRANSPLANTS IMPORTANT IN THE U.S.?

average cost and first-year expenses
$735,000

people on waiting list
16,000

//DEENDAYAL DINAKARPANDIAN, M.D., PH.D.
Associate Professor, Department of Computer Science Electrical Engineering

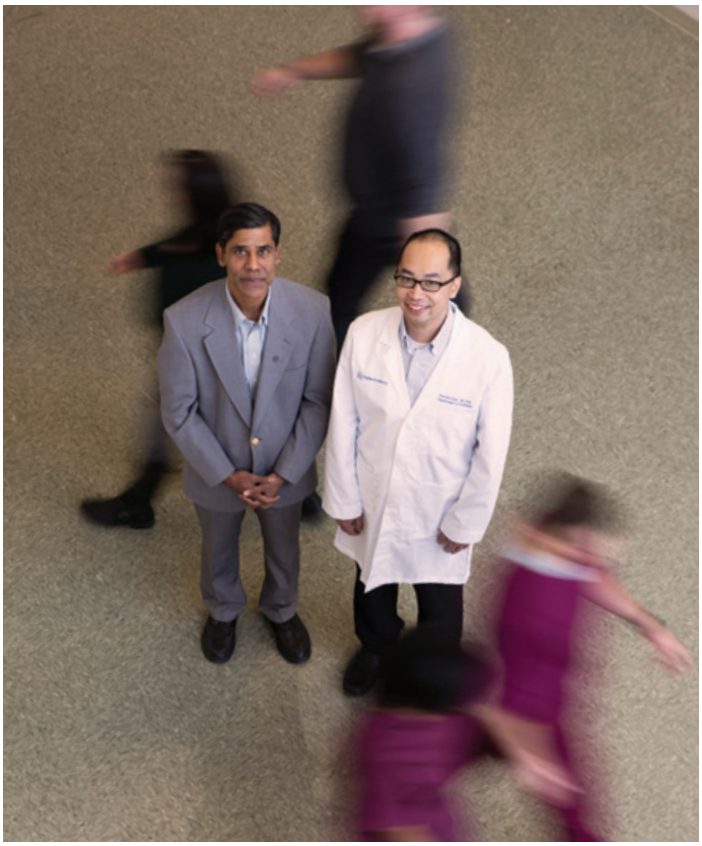
RESEARCH INTERESTS
Medical imaging

JOINED UMKC
2002

//SHERWIN CHAN, M.D., PH.D.
Pediatric Radiologist at Children's Mercy Hospital; Assistant Professor, Pediatrics and Radiology, UMKC School of Medicine

RESEARCH INTERESTS
Medical imaging

JOINED UMKC
2014



BRANDON PARIGO

COMMUNITY IMPACT

How could Dinakarpandian and Chan's research improve patient life?

1/ Liver transplant monitoring

PROBLEM
Too many liver transplant patients receive angiography, an invasive procedure with many complications, because of too many false positives in screenings that detect transplant failure.

PROPOSED SOLUTION
Current screenings only use two data points in a waveform out of the *thousands* that are available; the doctors propose using *all* of the data points. Their method has fewer false positives than the current method, decreasing the number of patients who would have to have the invasive angiography.

2/ Automated feeding-tube detection

PROBLEM
Nurses and physicians on the floor want a radiologist to confirm correct placement of feeding tubes before initiating treatment. When this happens off hours, the reads can be delayed for hours due to other emergencies. Also, some patients in the ICU can have up to 10 different tubes. These tubes often cross in a way that makes following each tube track difficult.

PROPOSED SOLUTION
Developing computer algorithms that can accurately identify tube placement. They're also developing automated solutions that can delineate and distinguish different tubes to make interpretation of X-rays easier.

3/ Improved chest imaging for children

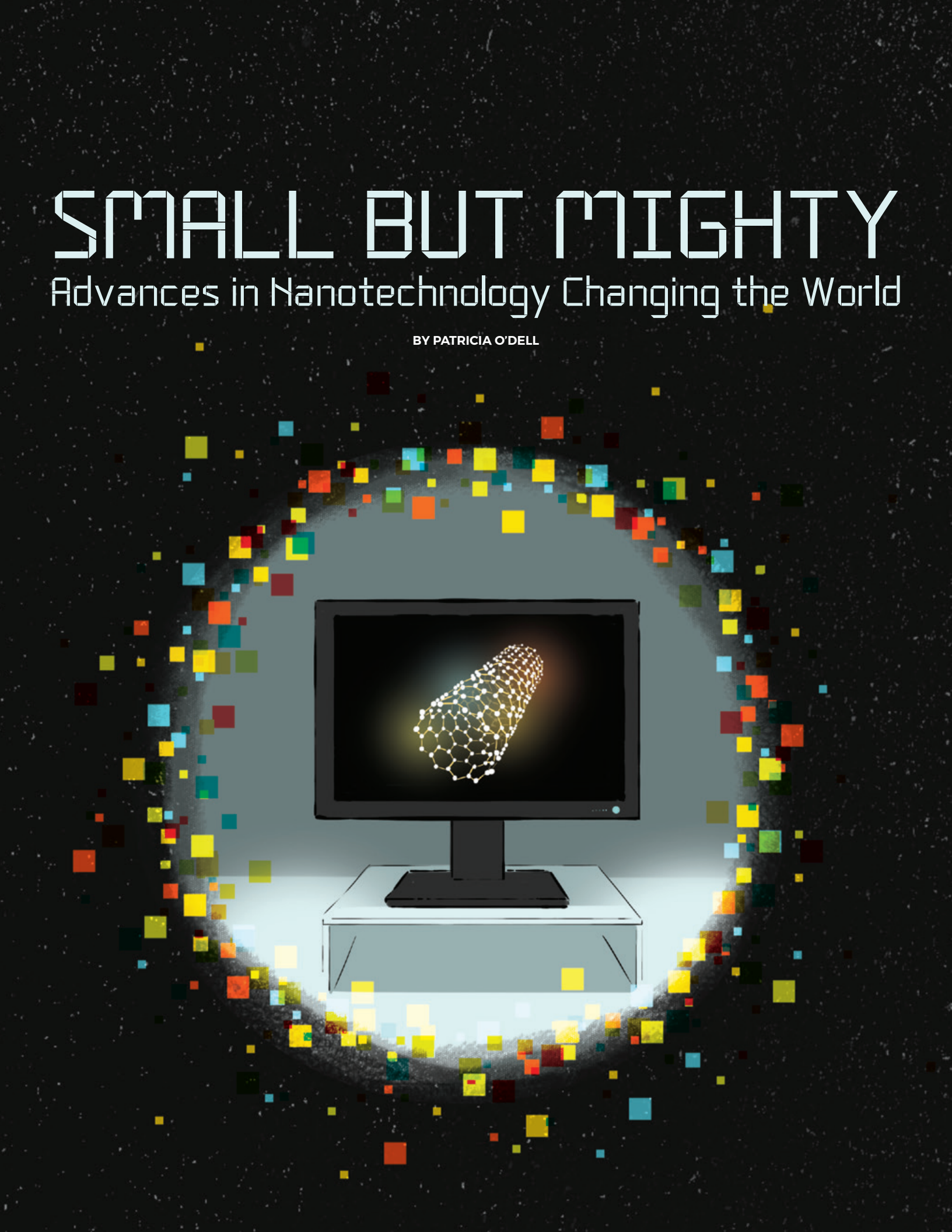
PROBLEM
Many new clinical uses are emerging for chest DTS (digital tomosynthesis) in adults. This technique allows the radiologist to observe anatomical structures with better clarity than a single X-ray with less radiation exposure than CT (computed tomography). The test requires patients to hold their breath and hold still for 11 seconds or the images will be blurred by motion. However, this is not practical for young children.

PROPOSED SOLUTION
Developing hardware and software solutions that will allow detection and measurement of the effects from breathing, and then sharpen the image to reconstruct true anatomy.

SMALL BUT MIGHTY

Advances in Nanotechnology Changing the World

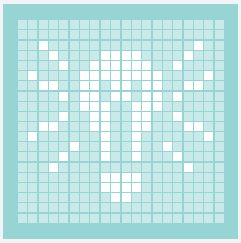
BY PATRICIA O'DELL



HOW WILL NANOTECHNOLOGY RESEARCH AFFECT YOU?

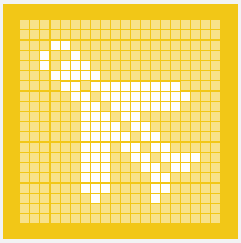
PERSONAL TECHNOLOGY

The change in electronics could be dramatic. Your "monitor" could become as thin and flexible as a poster and light enough that you could hang it on the wall. And it could wirelessly connect to your laptop. Private companies are already studying the use of nanotechnology to create clear, glass screens, like a monitor, that turned on by the touch of a finger.



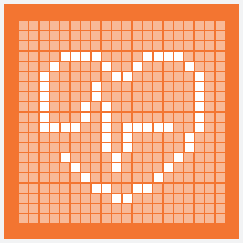
ENERGY

Currently, solar cells are only able to store about 20 percent of the energy they capture from the sun. It's possible that nanotechnology could expand solar cell storage to 40 percent, a capacity that could solve the energy problems of the world.



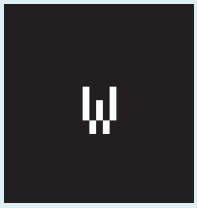
TRANSPORTATION

The goal is to develop a material lighter than aluminum with the same strength that is cheaper to produce. This would create lighter cars and airplanes, even wind technology, that are stronger and more energy efficient.



MEDICAL AND HEALTH

Imagine sensors that could wirelessly alert doctors if fat cells begin to accumulate around a stint that is clearing artery blockage. Imagine chemotherapy so small that doctors could send a nano-capsule with a wireless antenna directly to block one blood molecule. Scientists foresee the ability to use wireless technology to charge pacemakers with a tiny battery.



orking quietly in a warren of nondescript offices on the top floor of a traditional brick and stone building, a group of researchers is studying a technology that has the possibility of radically changing energy creation, medical treatment, transportation and computing. Masud Chowdhury, Ph.D., Ahmed Hassan, Ph.D., and Mostafizur Rahman, Ph.D., emit an infectious enthusiasm as they discuss their passion for nanotechnology and the grants they received from the National Science Foundation, the National Institute of Standards and Technology, and the UMKC Provost's Strategic Plan Funding Program.

This funding — and the research it supports — serves as a catalyst to the School of Computing and Engineering's success.

"Research piques our imagination and keeps us moving forward," SCE Dean Kevin Truman, Ph.D., F.ASCE, says. "When we receive grant funding, especially at the level of these latest nanotechnology grants, it sets the stage for innovation in the industry. These types of opportunities energize the school on a global level. This type of work drives us to teach and inspire the next generation of engineers."

The passion derived from these innovative researchers might seem foreign to those who find the term "nanotechnology" mysterious or intimidating. But while the technology itself is complex, once researchers are consistently able to see at the nano level and successfully manipulate materials, the applications will have significant impact on our everyday lives, down to the devices that we hold in our hands — computers we still refer to as "phones."

"Even the battery in our phones is bulky now," Chowdhury says. "We need to replace conventional methods. We are looking to create something lighter, more flexible, thinner, with better storage."

One nanometer is one billionth of a meter. A single strand of human hair is 100,000 nanometers wide. Manipulation of materials of this miniscule size will revolutionize technology well beyond phones.

"For the last 60 years we have relied on silicon," Chowdhury says. "But the demand is increasing so much in ways that silicon can't provide. It has natural limitations. Silicon is particles separated from sand. It's not transparent. Graphene and nanotubes are different."

It is possible to identify nanoparticles, called "nanotubes," in high heat. While researchers know that fusing nanotubes with other materials provides the outcome they seek — stronger, lighter composites — because of their miniscule size, it's not clear how these compounds are structured.

Hassan is looking at ways to identify and measure these particles. On a rudimentary level, what scientists can see when studying nanotubes is the product of their formation with another material, such as carbon. Because of this fusion, it's difficult to discern the unique properties of the nanotube.

To provide consistency for the research and application, Hassan's method is to work backwards to recreate models of the real thing.

"Currently, existing computer models assume perfectly straight tubes, but in reality the formation of

BRANDON PARIGO

//AHMED HASSAN, PH.D.

Assistant Professor, Department of Computer Science Electrical Engineering

RESEARCH INTERESTS
Nano-electromagnetics; bio-electromagnetics; inverse scattering algorithms; experimental microwave imaging; Terahetz imaging

JOINED UMKC
2015

//MASUD CHOWDHURY, PH.D.

Associate Professor, Department of Computer Science Electrical Engineering

RESEARCH INTERESTS
High-performance issues of VLSI circuits; emerging post-silicon device and interconnect technologies for the next generation integrated circuits; carbon nanotube and graphene-based logic and memory designs; carbon nanotube and graphene-based energy generation and storage devices

JOINED UMKC
2012

//MOSTAFIZUR RAHMAN, PH.D.

Assistant Professor, Department of Computer Science Electrical Engineering

RESEARCH INTERESTS
Beyond CMOS computing with emerging nanoscale devices and novel integration techniques; nanoscale 3-D integrated circuits;neuromorphic computing to mimic mammalian brain's capabilities; proof-of-concept nanoscale experimental prototyping; manufacturing and thermal-aware circuit design

JOINED UMKC
2015

> When we receive grant funding, ... it sets the stage for innovation in the industry.
>
> — KEVIN TRUMAN, DEAN, SCHOOL OF COMPUTING AND ENGINEERING

nanoparticles is never uniform," Hassan says. "There's always randomness, so modeling this way does not correspond to the commercial samples. The actual structure is more like a tumbleweed. Creating these models is much more time-consuming."

Being able to see and understand their electromagnetic signature will enable researchers to explain the results of their experiment and replicate them.

These researchers and the funding their studies attracted established the Center for Interdisciplinary Nanotechnology Research. For this research, each professor will rely on his specialty, but they very much see themselves as a team. From the time Hassan and Rahman joined the school, the group became acquainted through meals with Dean Truman and Ghulam Chaudhry, Department of Computer Science Electrical Engineering chair.

"We received a tremendous amount of support from them," Chowdhury says. "Our team was formed over those meals."

"When we started talking about this, way back over dinner, we were learning about our individual research," Rahman remembers. "I work on circuits, Chowdhury specializes in devices, Hassan in sensors. When we learned about the NSF funding, we started talking about how we could work together."

The diversity of the researchers' specialties provides a unique opportunity. "Our objective is to merge resources for futurization," Rahman says. "Our white paper received fantastic reviews. We will have the capacity to bring great resources to Kansas City. What we're working on is state-of-the-art."

Originally, when these men were sharing ideas, they did not know they would have the opportunity to develop this type of center in Kansas City. Labs this size mostly exist in Switzerland and France. The new operation will house equipment that will enable the team to begin to put theory into practice. The team is waiting for space allocation, but the equipment has been ordered.

Truman is committed to the advancement of this technology. "A decade or two ago this was an emerging area of research," he says. "Now it has become a common theme in the miniaturization of electronic devices, the design of materials for bio-devices, aerospace, automobiles and cell phones. Beyond graduate work, we hope that a select group of undergraduates might discover this area of interest and pursue advanced degrees in these fields."

"We will have the capability to collaborate with other academics. We have a strong, cohesive group of faculty members," Chowdhury says. Along with research, the center will include coursework for graduate and undergraduate students. "We are looking at high school outreach as well. Beyond that we will be working through the youth outreach nonprofit founded by SCE, the KC STEM Alliance, on video conferencing to middle schoolers," he adds.

Hassan thinks UMKC is an exciting place to be. "The school is rising and expanding. I have all the support I need. Because of the collaboration within the department, we are able to look at the project in a broad way. This will be internationally heralded research," he says.

Are they excited? "2016 was very fruitful," Chowdhury says. "We needed the grant money to move forward with our research. It had to come from an external source. The National Science Foundation has a fund rate of 12 to 15 percent. We submitted three grants nationally, and they were all accepted. That's a very good year." ■

The UMKC School of Computing and Engineering has received more than $2 million to establish the Center for Interdisciplinary Nanotechnology Research, which will provide equipment and resources for research, education and outreach.

NATIONAL SCIENCE FOUNDATION
$1.4 million between three grants

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
$321K

UNIVERSITY OF MISSOURI FUNDING FOR EXCELLENCE PROGRAM
$15K

UMKC PROVOST STRATEGIC PLAN FUNDING PROGRAM 2016
$387K

WHAT IS NANOTECHNOLOGY?

Nanotechnology is the ability to see and control individualized atoms. Materials at this scale have enhanced properties — greater strength, lighter weight, increased control of the light spectrum and greater chemical reactivity than their larger scale counterparts. The ability to manufacture materials at this level has implications for every discipline.

"Nano" means one-billionth. Materials at the nanoscale exist in nature. Hemoglobin, smoke, volcanic ash and sea spray are examples.

For more information on nanotechnology visit www.nano.gov.

Cleaning Up: A Filter for Flint

BY SARA VOGT

In areas like Flint, Mich., thousands of people lack access to clean water. This issue affects nearly 6 million Americans and approximately 663 million people globally. Two researchers are on the verge of providing a cost-effective solution that could help improve areas like Flint and beyond.

BRANDON PARIGO

Every day, approximately 663 million people across the globe lack access to safe drinking water. Considering water purification challenges in the undeveloped world, this may be unsurprising, but in fact, six million people in the United States also lack access to safe water.

When Flint, Mich., became primetime news in late 2014, the issue of clean drinking water took hold in our own backyard. Contamination risks, including fecal coliform, total trihalomethanes (TTHM) and lead, devastated the citizens of Flint. Within weeks, this small city north of Detroit, in the state known for its large, freshwater coastline, began to experience a water crisis that still exists to this day.

When emergencies like this happen, innovative research becomes more important than ever. Traditional in-home water filters intended to last two months are lasting, at most, three days in Flint. At $5 apiece, these filters have been far too costly to produce clean water for an entire community.

As the situation in Flint persisted, Megan Hart, Ph.D., and John Kevern, Ph.D., civil and mechanical engineering research faculty in the School of Computing and Engineering, recognized the need for a cost-effective, in-home tool to defend against water contaminants.

"I became an engineer to make the world a better place by enhancing society and the built environments in which we live," Hart says.

Tucked away in the labs in the lower level of the Robert H. Flarsheim Science and Technology Hall, Hart and Kevern have been working on a solution that could be the next big step in the clean water crisis.

With their engineering ingenuity, they explored how concrete — a material typically thought of for its strength and longevity — could act as a permeable and disposable water filter.

Using pervious concrete as a water filter was a relatively new and untested concept — but one with the potential for great impact, not only for Flint but around the world.

Compelled by situations like Flint, Hart and Kevern applied for a $55,000 grant from the National Science Foundation's EAGER program in 2014 — which awards grants specifically to "high risk-high payoff" research initiatives. With that funding, they discovered pervious concrete can provide safer water for pennies on the dollar. This finding propelled their concept from theory to nearing real-life application.

Acting as a large filter, similar to an average household water filter, which could be affixed to the pipes bringing water into

> "I WANT TO HELP PROTECT PEOPLE FROM POLLUTION BUT DO IT AS ECONOMICALLY AS POSSIBLE FOR ALL PARTIES INVOLVED"
>
> — MEGAN HART, ASSISTANT PROFESSOR, SCHOOL OF COMPUTING AND ENGINEERING

▼ ASSISTANT PROFESSOR MEGAN HART SHARES HER PASSION TO MAKE A DIFFERENCE WITH HER TEAM OF STUDENT RESEARCHERS

the home or business, Hart and Kevern's concrete filter solution has been able to remove nutrients and heavy metals from water for more than 450 days — at a fraction of the cost.

Kevern says by developing formulas of concrete to target specific toxins, he and Hart have created a product that can target the unique needs of various communities battling contaminated water. Their concrete solution has the potential to provide homes with long-lasting protection.

Looking forward, Hart says she and Kevern are now working to identify industry partners to bring their vision to commercialization.

Water treatment plants throughout the country are tasked with ridding our drinking water of these toxic contaminants prior to entering our homes. However, as we have seen in Flint and other communities, this system is not always effective, and therefore, water filters in our homes are the last line of defense.

"Between Dr. Kevern and I, our areas of expertise uniquely overlap to provide a surprising and cheap alternative for cleaning water that is easily transferred to anyone, pretty much anywhere," Hart shares. "I want to help protect people from pollution but do it as economically as possible for all parties involved." ■

//MEGAN HART, PH.D.

Assistant Professor, Department of Civil and Mechanical Engineering

RESEARCH INTERESTS
Expansive clay soils, collapsible soils; groundwater and geochemical influences on soil stability

JOINED UMKC
2014

//JOHN KEVERN, PH.D., PE, LEED

Associate Professor, Department of Civil and Mechanical Engineering

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 by-product utilization

JOINED UMKC
2008

/STAND-OUT STUDENTS AT SCE

As the fastest growing school at UMKC, the School of Computer and Engineering is full of impressive students. From working alongside professors in the research labs to getting involved on campus and in the community, they are well on their way to becoming the next vanguard of engineers and technology professionals. Meet some of SCE's stand-out students.

KATRINA FLYNN

Senior | Major: Information Technology | Minor: Business Administration

"UMKC has played a large role in preparing me for my future. I truly believe that each UMKC professor or professional staff member really cares about every individual student and their career aspirations."

When Katrina Flynn visited campus as a high school senior, she instantly knew—UMKC was home, and she was going to be very happy here.

Wanting to study in a city bigger than her hometown of Papillion, Neb., Katrina was excited to explore all that UMKC's urban location had to offer.

While all the off-campus amenities brought this future IT professional to Kansas City, Flynn credits her on-campus commitments for enriching her college experience and allowing her to give back in exciting and meaningful ways.

One of her favorite opportunities has been representing UMKC and SCE as a campus ambassador.

"Sharing my story and helping prospective students make their college decision has been incredibly fulfilling," Flynn says. "My favorite time as a student has been getting to meet new people."

In preparation for her career, she completed two full-time internships in her field: the first at ConAgra Food, located in her home state, and the other at Protiviti, a business solutions firm located in Overland Park, Kan. As an IT consulting intern at both places, she had the opportunity to travel onsite to clients to perform internal audits.

At the conclusion of her internship experience, Flynn was thrilled when she was offered a full-time position, which she will begin after graduation.

MAZEN MANSOUR

Senior | Major: Mechanical Engineering

What do you get when you combine a love for innovation, technology, math and physics? An engineer, of course! Those passions are what Mazen Mansour credits for his desire to study mechanical engineering.

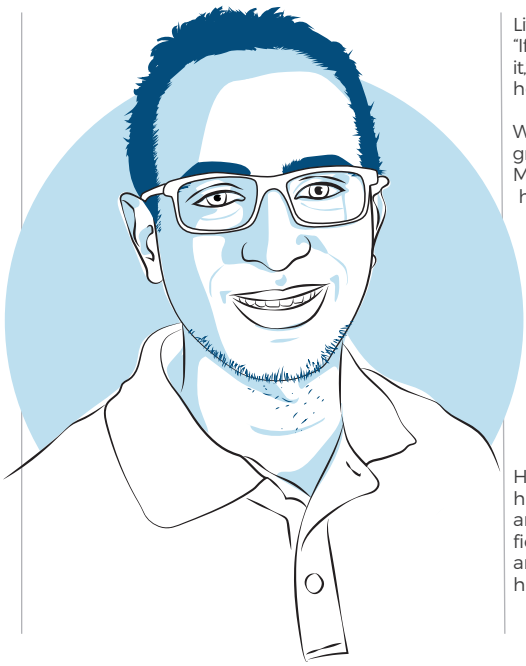
Born in Egypt and raised in Kuwait, Mansour is a long way from home, but his commitments on and off campus have allowed him to build a network and connect with his fellow students.

He serves as vice president of Pi Tau Sigma, the mechanical engineering honor society, as a student ambassador, tutor, teacher's assistant and campus host.

Mansour recently worked as a research assistant to Travis Fields, Ph.D., SCE's resident drone expert. Focusing on aerial delivery systems allowed Mansour to experience practical application of the concepts he mastered in the classroom.

Beyond his experiences with SCE, Mansour is currently training to complete his first half marathon and enjoys playing soccer and tennis.

His athleticism also sparked an interest in rowing club — the newest campus adventure he plans to try out this year.



Living by the the motto, "If they can do it, I can do it," there is no limit to what he can accomplish.

With his undergraduate graduation approaching, Mansour is proud to have been accepted to SCE's five-year B.S. to M.S. program, where he will complete his master's degree with only one extra year of study — as long as he is able to resist any job prospects that present themselves in the coming months!

His interest in applying his degree in the power and renewable energy fields is likely to bring ample opportunity in his future.

"The fact we have all the best engineering firms just minutes from campus made me apply to UMKC. Since my sophomore year, I have been proud to be a Roo."

/ACCOLADES AT SCE IN 2016

FAREED ADIB (B.S. COMPUTER SCIENCE '00), chief technology officer for Vista Equity Partners, was honored with the 2016 UMKC SCE Alumni Achievement Award for his impact in the field of mobile technology.

DEB CHATTERJEE, PH.D., was elected to the Union Radio-Scientifique Internationale as a new full-member by the members of the United States National Committee.

ZHIQIANG CHEN, PH.D., received $72,710 in seed funding from EPSCoR and received $49,571 from the National Science Foundation's funded Transect program for his project, "Development of Aerial-Ground Sensing and Data-Enabled Vulnerability-Resilience Modeling for Crop Systems Subject to Drought." Chen's team, comprising Yugi Lee, Ph.D.; Zhu Li, Ph.D.; Travis Fields, Ph.D.; Ceki Halmen, Ph.D.; and Alexis Petri, Ed.D., received $200,000 from the Provost Strategic Funding Plan Program for the proposal titled "UMKC Center for Big Imaging and Smart City Technologies."

BAEK-YOUNG CHOI, PH.D., received $50,000 from the National Science Foundation for "Child Tracking and Detection – A Public Safety Application Through Mobile Crowd Sensing."

MASUD CHOWDHURY, PH.D., was promoted to tenured associate professor. He was awarded a single-PI regular National Science Foundation grant worth $461,111 for his work in nanotechnology, and he received $103,553 from MIHRAB Nanotechnology Inc. for "Printable and Flexible Micro-Supercapacitor Using Graphene and Carbone Nanostructure."

EyeVerify Inc., the startup founded by **REZA DERAKHSHANI, PH.D.**, based on his biometric identification software, sold to Ant Financial Services Group for an undisclosed amount.

TRAVIS FIELDS, PH.D., received $41,500 from the Naval Postgraduate School Gliding-Based Aerial Resupply for Humanitarian Relief, $54,195 from Draper Laboratory for the "Development and Testing of an Autonomously Controlled Rotating Cross Parachute," and $49,981 from the University of Missouri FastTrack Initiative for his project titled "Transforming Structural Health Monitoring Technology with 3D Printed Sensors."

PREETHAM GOLI, PH.D., and **FAISAL KHAN, PH.D.**, received $39,750 from the University of Missouri Research Board for their project titled, "Detection of Aging Related IGBT Bond-Wire Lift-off Using Spread Spectrum Time Domain Reflectometry."

AHMED HASSAN, PH.D., **MASUD CHOWDHURY, PH.D.**, and **MOSTAFIZUR RAHMAN, PH.D.**, received funding from the National Science Foundation for "II-NEW: Experimental Characterization and CAD Development Testbed for Nanoscale Integrated Circuits." The team also received a commitment for $772,061 in funding for new research in the areas of micro- and nano-electronics and nanotechnology.

FAISAL KHAN, PH.D., received an $80,000 award from the Department of Energy for the project "Creation of an Adaptive Remaining Lifetime Prediction Model of Power Electronics."

YUGI LEE, PH.D., was promoted to full professor. Lee's research involves big data analytics and applications, cloud computing and medical informatics.

ZHU LI, PH.D., received a $30,000 grant from Samsung Research America for his research project, "All IP Media Standardization," and $50,000 from Qualcomm Technologies Inc. for "Capturing and Coding/Compression of 3D Point Cloud."

PRAVEEN RAO, PH.D., received a $100,000 NRC Research Associateship Senior Research Award for his proposal, "Probabilistic Inference on Social Media Data to Prevent Potential Cyberattacks," and $50,000 from the National Science Foundation for the project titled "Scalable Knowledge Management for Risk Analysis in Finance."

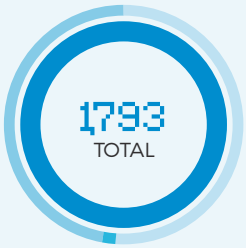
SEJUN SONG, PH.D., received $20,000 from the Cisco Research Center for his research in "Open Reality Measurement and Monitoring Agent Framework for Software-defined Network."

These highlights represent select achievements of our distinguished faculty.

For a complete list of student, faculty and staff accolades at SCE, check out **sce.umkc.edu/accomplishments**.

/FY 2016 FAST FACTS

ENROLLMENT

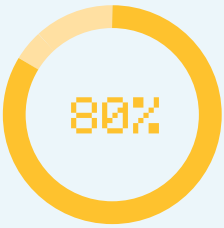


- 900 | Undergraduate
- 820 | Master's
- 73 | Ph.D.

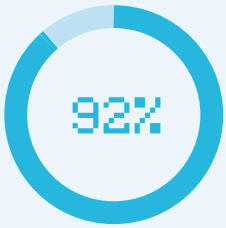
Students from
34 STATES AND
30 COUNTRIES

110% Increase in SCE enrollment since 2008

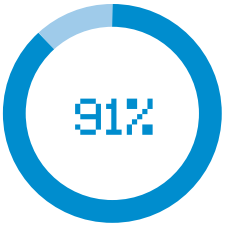
172% Increase in female enrollment since 2008



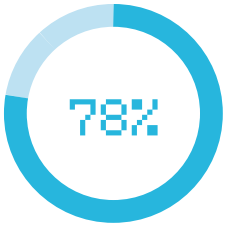
Students who complete internships before graduation



Students who receive financial aid



50 of 55 full-time faculty hold terminal degrees



Recent graduates who live in Kansas City

37,000+

Local K-12 students impacted annually by SCE outreach programs*

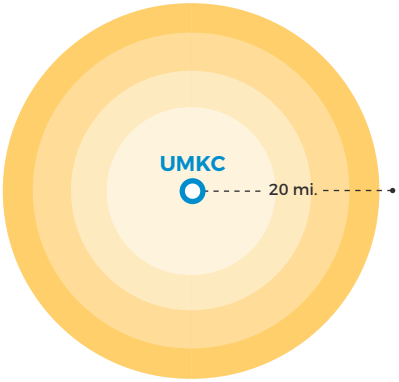
**Coordinated through the KC Stem Alliance, founded and managed by SCE*

32x

Increase in donations to SCE since 2012

125+

Companies that have benefited from SCE Continuing Education



PROFESSIONAL PIPELINE

The UMKC campus is within 20 miles of over 250 engineering and computing firms.

Kansas City area companies that hire SCE graduates include:

- Black & Veatch
- Burns & McDonnell
- Cerner Corp.
- DST Systems
- Garmin International Inc.
- General Motors Co.
- HDR
- Henderson Engineers Inc.
- HNTB Corp.
- Honeywell FM&T
- H&R Block
- JE Dunn Construction
- Kansas City Power and Light
- Kiewit
- MRIGlobal
- Sprint Corp.
- Terracon
- UMB Bank

Research funding tripled from 2008 to 2012

RESEARCH

Sources of research funding include:

- Black & Veatch
- Cisco
- Ewing Marion Kauffman Foundation
- EyeVerify/Ant Financial Services Group
- Honeywell FM&T
- Kansas City Power and Light
- NASA Goddard Space Flight Center
- National Science Foundation
- Samsung

ACCREDITATION

The Bachelor of Science degree programs in Civil, Electrical and Computer, and Mechanical Engineering are accredited by the Engineering Accreditation Commission of ABET.

The Bachelor of Science in Computer Science and Bachelor of Information Technology degree programs are accredited by the Computing Accreditation Commission of ABET.

abet.org

WHERE **IMAGINATION** TURNS INTO **REALITY**

At UMKC's School of Computing and Engineering, students are challenged to meld innovative thinking with technical principles. With our unique location in the heart of Kansas City — an emerging STEM hub — students have opportunities to land great internships with tech and engineering companies. Graduates leave SCE fully prepared for 21st-century careers, ready to change the world.

THE PLACE FOR **DISCOVERY**. THE PLACE FOR **ACHIEVEMENT**. THE PLACE FOR PEOPLE **GOING PLACES**.

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