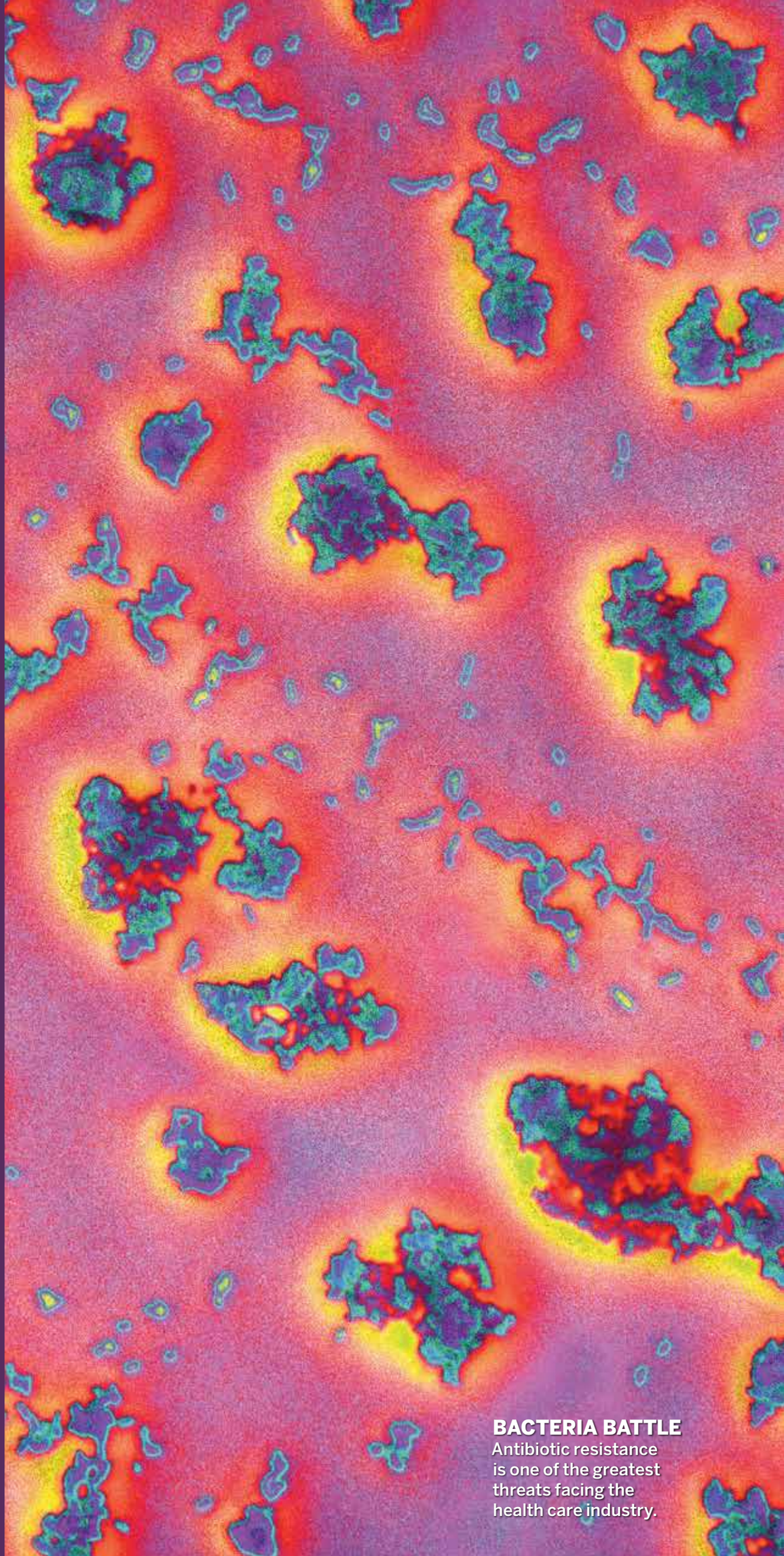
Inquiry

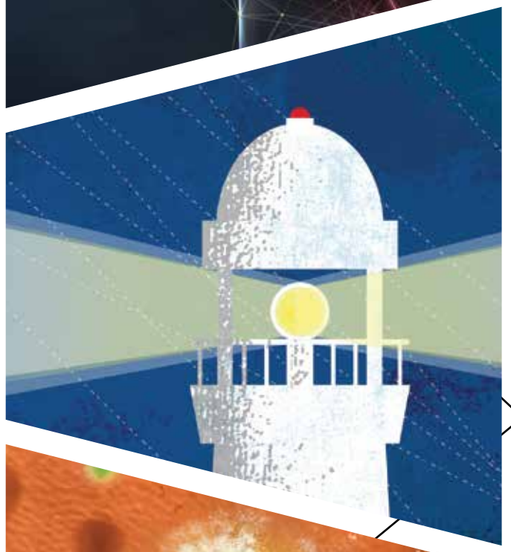


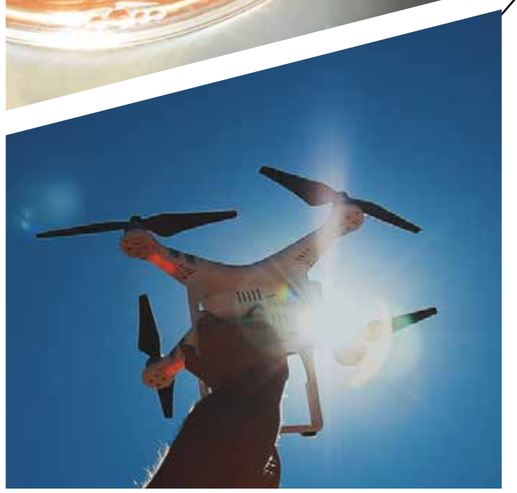
BACTERIA BATTLE
Antibiotic resistance is one of the greatest threats facing the health care industry.

THE UNIVERSITY OF TEXAS AT ARLINGTON

RESEARCH 2019

UTA researchers used UAVs to capture images of debris piles in the aftermath of Hurricane Harvey, helping Beaumont city officials assess the scope of the cleanup.





Inquiry

2019

VP Dispatch

A Year of Growth

UTA's research efforts reach unparalleled heights

Welcome to *Inquiry*, the research magazine for The University of Texas at Arlington. As a rapidly growing Research-1 university, we are excited to share some of the world-class work we are doing.

This year, our annual research expenditures exceeded $100 million for the first time, and we graduated over 200 PhDs for the fifth straight year. Our growth in research mirrors the overall growth at UTA—we now have over 60,000 students (on-campus and online) and awarded more than 13,700 degrees during the 2017-18 academic year.

Our research investments are closely aligned with UTA's *Strategic Plan 2020: Bold Solutions | Global Impact* and its four themes: Health and the Human Condition, Sustainable Urban Communities, Global Environmental Impact, and Data-Driven Discovery. Research efforts on each of these themes are presented in the following pages.

We have continued to make significant investments in the infrastructure of UTA. In September, we opened the Science & Engineering Innovation & Research (SEIR) building, a state-of-the-art facility for life and health science research that was designed with collaboration as a major goal. SEIR houses our newest center of excellence, the North Texas Genome Center, which currently has two Illumina NovaSeq 6000 high throughput sequencers for full genome sequencing services.

UTA is also investing heavily in new faculty. Over the last year, UTA hired 47 tenure or tenure-track faculty, including Florence Haseltine, a member of the National Academy of Medicine and leader in women's health, and Surendra Shah, a member of the National Academy of Engineering and expert in advanced construction cements. This class of new hires is helping us to grow a diverse and technically outstanding faculty across our eight colleges.

UTA is strongly focused on the public impact of our research and works closely with industry in our region, state, and country to transition research results into use. We had 29 U.S. and foreign patents issued last year and have already licensed several. UTA also had two faculty selected as fellows of the National Academy of Inventors, which brings our total number to 15, the most in Texas.

As you read *Inquiry*, I hope you come to better understand the depth and breadth of research at UTA. We are committed to providing an environment where our researchers can thrive and make discoveries that push forward the frontiers of knowledge, while developing the research talent needed for the future. I hope you stay connected with us as we work to change the world.

Go Mavericks,

Duane B. Dimos
Vice President for Research

Inquiry

Editorial Director
Jessica Bridges

Art Director
Brody Price

Editorial Contributors
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Amber Scott

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Vistasp M. Karbhari

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Senior Associate Vice President for Institutional Advancement
Joe Carpenter

Creative Director
Joel Quintans

Inquiry is published annually by Institutional Advancement under the direction of the Office of Research Administration.

All inquiries and comments should be addressed to bridges@uta.edu.

On the cover: The bacteria *Haemophilus influenzae*. By Kent Wood/Science Source

uta.edu/inquiry

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Leading Edge

A new era of research at UTA

In September 2018, The University of Texas at Arlington officially opened its Science & Engineering Innovation & Research building, a state-of-the-art facility that will further establish UTA as a leading health science research and teaching institution.

"The building itself is a space that will catalyze and accelerate our teaching and research efforts," says Duane Dimos, vice president for research. "As an urban-serving Carnegie R-1 research university, we needed a space that could act as the focus for an innovation ecosystem to drive our regional economy and strengthen North Texas as a center for biotechnology and health science research."

Innovative leader appointed

Elizabeth Merwin was recently appointed dean of the College of Nursing and Health Innovation.

Dr. Merwin previously served as professor and executive vice dean for Duke University's School of Nursing and as professor of psychiatry and behavioral sciences for its School of Medicine. She is an accomplished faculty leader and researcher whose work focuses on improving care for underserved populations, particularly minorities and those from rural communities.

Lauded scholars join faculty

UTA added two eminent scholars to its faculty: Florence Haseltine, a professor in the College of Nursing and Health Innovation, and Surendra Shah, the new Presidential Distinguished Professor of Advanced Construction Materials. A member of the National Academy of Medicine, Dr. Haseltine is a biophysicist and reproductive endocrinologist who has been at the forefront of health technology since the early 1980s. Dr. Shah, a National Academy of Engineering fellow, is a world-renowned leader in cement-based materials.

Illustration by Lara Tomlin

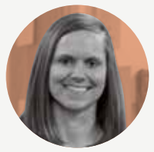
Health and the Human Condition

A century ago, the average American lived about 55 years. Today, we are likely to make 80. Unrelenting scientific curiosity and exploration have made this dramatic increase possible and led to life-saving breakthroughs in the diagnosis and treatment of diseases and other ailments. But progress that improves our quality of life extends beyond the physical realm. Examination of the arts and humanities helps us understand the nature of the human condition and the cultural and social fabric that characterizes our existence and contributes to our wellbeing.

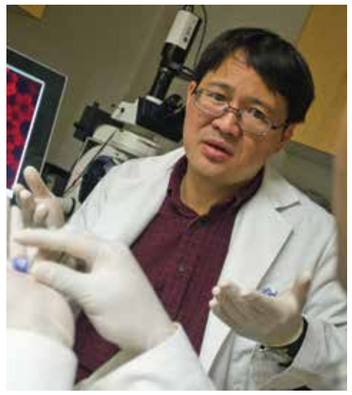
HHC QUICK HITS

Sarah Rose, associate professor of history and director of UTA's minor in disability studies program, was awarded the Martha Arbuckle Award, given by the Texas Governor's Committee on People with Disabilities each year.

Mark Haykowsky, the Moritz Chair in Geriatrics in the College of Nursing and Health Innovation and a leading expert on exercise physiology and heart failure rehabilitation, was elected a fellow of the American College of Cardiology.



Laura Kunkel, associate clinical professor of kinesiology and certified athletic trainer, was the sole recipient of the coveted Emerging Educator Award from the National Athletic Trainers Association.



CANCER MOTEL

Device lets cancer cells check in, but not check out

A roach trap may not be the first analogy a scientist would reach for when discussing a new cancer-attracting medical device, but bioengineering Professor Liping Tang thinks it fits.

"Our cancer trap works just like a roach motel, where you put in some bait, and the roach goes there and dies," he says. The implantable medical device, which Dr. Tang and his team patented in Europe, attracts, then kills, circulating cancer cells. It can be used for early diagnosis and treatment of metastasized cancer, as well as combined with traditional chemo and radiation therapies.

According to Tang, the nano-sized device was designed to be injected under the skin "to recruit the cancer cells into a small area where we can treat them with less overall side effects to the whole body." The trap releases different chemokines, or regulatory proteins, to attract any circulating cancer cells. It then exposes them to chemotherapeutic agents, which should eliminate any potential spreading.

In Tang's lab, the trap has proven effective on several kinds of cancer cells, including breast cancer, prostate cancer, and leukemia.

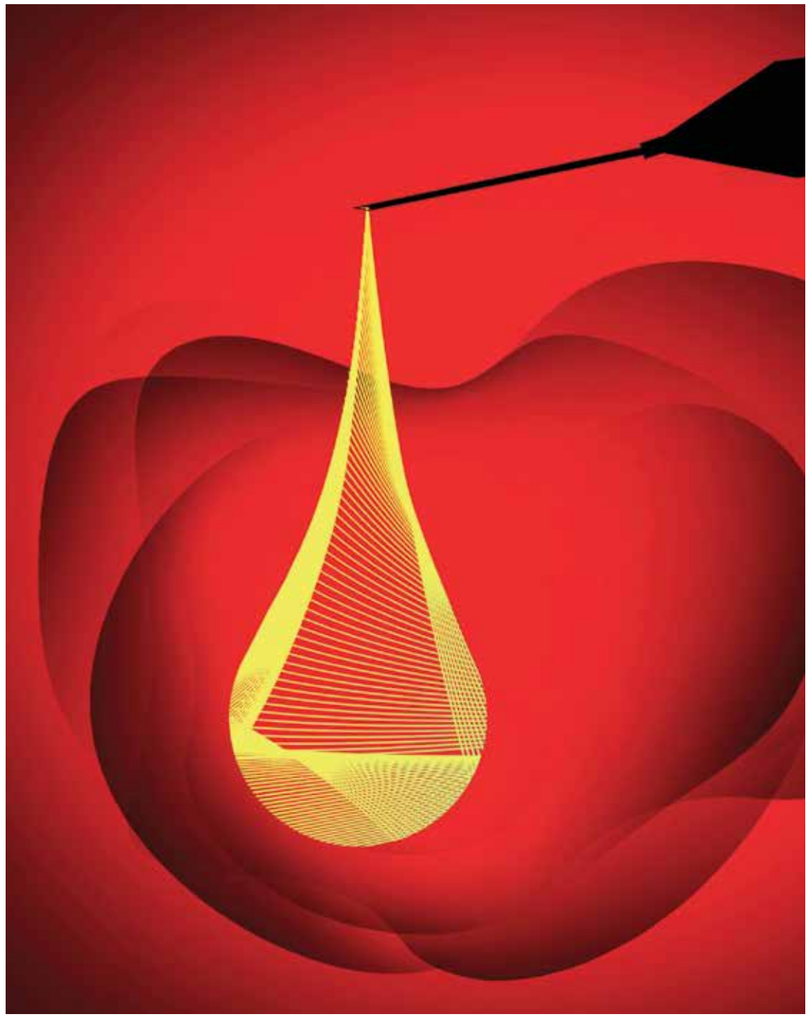


Illustration by Brian Stauffer

HEART RESTART

New hydrogel could repair damage from a heart attack

Every 40 seconds, someone in the U.S. has a heart attack. Should they survive, their heart rhythm, pumping action, and blood circulation could sustain major damage. But a UTA scientist hopes to stem those effects, thanks to a new hydrogel that could repair heart tissue.

Bioengineering Professor Yi Hong and his team—which includes Professor Kytai Nguyen, Associate Professor Jun Liao, and Ge Zhang from the University of Akron—are developing a biodegradable, bioactive hydrogel that could be injected into the heart to promote the regrowth of new tissue cells.

Their work builds on existing research that shows injecting a hydrogel can promote the development of new muscle cells and help restore function in the heart. But the team hopes to take this one step further by developing a biogel that combines the scaffolding and repair properties with nanoparticle-based drug delivery technologies.

"Our goal is to significantly increase the recruitment of stem cells to the heart, accelerate cardiac repair, and improve cardiac function after a heart attack," says Dr. Hong.

NANO KNOW-HOW

The modified nanoparticles can also carry chemotherapy drugs directly to the tumor site.

Nursing professor using nanoparticles to treat cancer

Esophageal cancer causes nearly 16,000 deaths in the U.S. each year, according to the American Cancer Society. But tumors can be difficult to detect, often hidden in the normal tissue of the throat and hard to find with an endoscopic probe. To remedy that, a UTA nursing researcher is using nanoparticles to more effectively detect and treat the disease.

Associate Professor Zui Pan and her colleagues have manufactured polypeptide nanoparticles with tumor-targeting properties and near-infrared fluorescence for better tissue imaging. The modified nanoparticles can also carry chemotherapy drugs directly to the tumor site. This nanoparticle-based platform could allow a surgeon to spot the affected area clearly to remove it or help doctors see the extent and location of the cancer so they can consider alternative therapies.

Dr. Pan's collaborators are UTA postdoctoral fellow Yan Chang and graduate student Chaochu Cui, along with Ohio State University Professor Mingjun Zhang and postdoctoral fellow Zhen Fan. The team's research was published in *Nature Communications*.

EN ROUTE

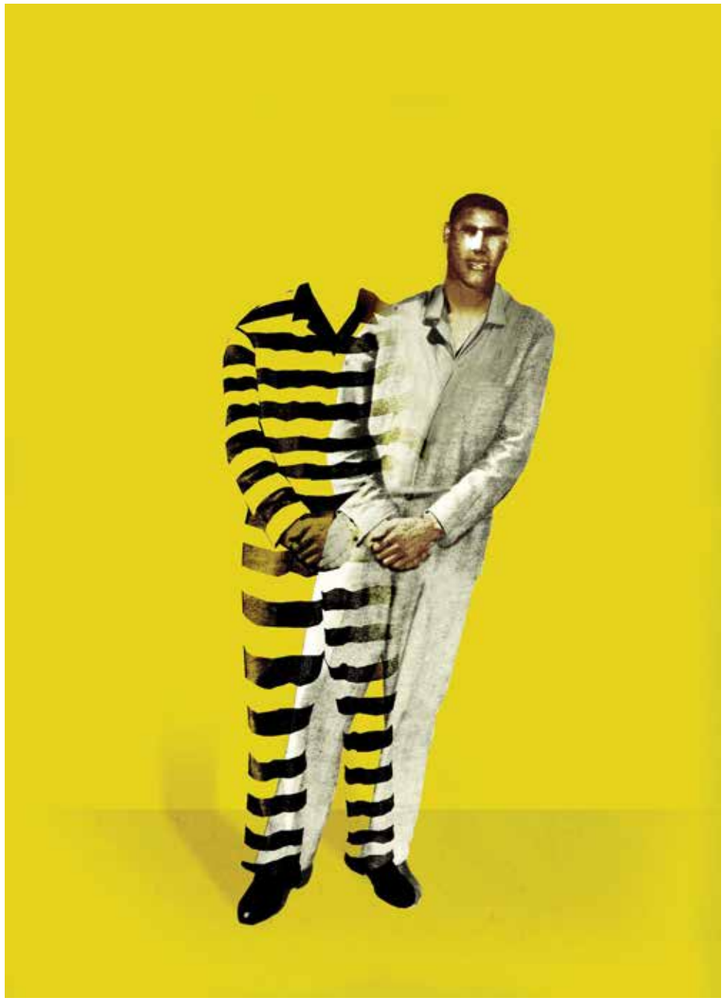
Helping former criminal offenders re-enter the community

When it comes to reforming previous criminal offenders, support is key. Research indicates that strong networks of support reduce recidivism. But lack of access to transportation, especially to and from jobs and services, has been identified as a major barrier to successful re-entry for this population.

To combat this, a multidisciplinary team was awarded a National Institute for Transportation and Communities grant to link transportation to services like medical access, employment centers, and educational opportunities. The team comprises social work Assistant Professor Anne Nordberg, criminology and criminal justice Associate Professor Jaya Davis, and civil engineering Associate Professor Steve Mattingly.

They are partnering with Unlocking DOORS, a re-entry brokerage firm that assists former offenders by arranging services like housing and job retraining.

"This project will transcend regional re-entry issues and create a framework that can be adapted to similar conditions nationally," says Dr. Davis.



SURGE

"If done correctly, the upgrade will save billions of dollars annually."

Boosting national power grids

Optimizing U.S. power grids—increasing grid efficiency, reliability, and security while reducing costs—is a priority for federal organizations from the National Academy of Engineers to the Department of Energy. Two UTA electrical engineers believe they can help.

Assistant Professor Ramtin Madani and Associate Professor Ali Davoudi received a National Science Foundation grant to develop massively scalable computational methods for power scheduling.

One of the biggest challenges to optimization is scalability. Drs. Madani and Davoudi plan to cast the problems in optimization theory—a common math language—then develop algorithmic tools and techniques to solve them.

According to Madani, operating and upgrading the existing infrastructure can be complicated, since the software has existed for decades. "It's very difficult because the physical laws that govern the flow of electricity are massively simplified in current models, which aren't working and have been in place since 1962," he says. "But if done correctly, the upgrade will save billions of dollars annually."

Illustration by Brian Stauffer

SUBURBIA

Urban sprawl may have a negative effect on life expectancy

Forget safety in numbers: Urban sprawl may be killing us, literally. A study by a UTA urban researcher shows a correlation between sprawl and decreased life expectancy in the U.S., despite what we spend on health care.

Shima Hamidi—an assistant professor in the College of Architecture, Planning, and Public Affairs—and two directors of the National Institutes of Health published their research in the *International Journal of Environmental Research and Public Health*.

"What the study shows is that the United States is not among the countries with the highest levels of life expectancies despite the highest levels of expenditures on health care," says Dr. Hamidi. "Changes in the ways we shape our cities and neighborhoods have to be made to address this challenge."

Research Vice President Duane Dimos believes Hamidi's study is particularly significant to the Metroplex. "North Texas is quickly approaching megacity status. With that size must come alternative ways of looking at basics like transportation and construction."

Sustainable Urban Communities

Developing more sustainable communities is vital to strengthening our economy, enhancing everyday life, and providing a foundation for lasting prosperity. Opportunities abound to make urban regions more livable, including reducing pollution, preserving ecosystems, and offering a variety of transportation and housing choices. Today's urban communities demand better building design, land-use planning, and improved infrastructure. They also broaden horizons and enlighten minds through cultural, recreational, and educational programs.

SUC QUICK HITS

Adrian Parr, dean of the College of Architecture, Planning, and Public Affairs, was named UNESCO chair of water and human settlements.

Anand Puppala, associate dean for research in the College of Engineering and a professor of civil engineering, was named a fellow of the United Kingdom's Institution of Civil Engineers, the world's oldest civil engineering society.

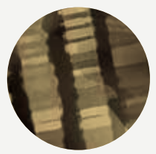
Architecture Professor **Don Gatzke** was elected to the College of Fellows by the American Institute of Architects.

Data-Driven Discovery

Data fuels important decisions at every level of society. The exponential growth and availability of big data presents numerous challenges and opportunities. It is voluminous, fast, increasingly complex, and comes in a range of formats. But if managed effectively, big data can deliver powerful benefits. It can result in more accurate analyses in fields ranging from health care to genomics to business informatics to physics. More accurate analyses lead to more confident decision-making. And better decisions can mean greater operational efficiencies, cost reductions, and decreased risk.

DDD QUICK HITS

Physics Professor **Jaehoon Yu** and Assistant Professor **Jonathan Asaadi** are working on the ICARUS particle detector at Fermilab. The UTA team is responsible for the data acquisition system and is developing a neutrino event triggering system.



UTA and Texas A&M University established the Texas Genomics Core Alliance to increase access to and decrease costs of cutting-edge, high-throughput genomics sequencing technologies.

The British Library Endangered Archives Programme extended a project led by history Professor **David LaFevor** to digitize colonial documents in Cuba, part of its initiative to preserve endangered documents relating to pre-industrial societies.

HACKED

Computer scientist designing new ways to test security

The average computer data breach in the U.S. can cost a company upward of $7.9 million, according to a study by IBM and the Ponemon Institute. Recently, the National Institute of Standards and Technology awarded computer science Professor Jeff Lei and Dimitris Simos of SBA Research Inc. a three-year, $585,000 grant to shore up security vulnerabilities in blockchains and Internet of Things systems.

"Blockchains have the potential to change the way we do business, significantly reducing costs and increasing efficiency," says Dr. Lei. "Machines can do many things better than humans, but first people must have confidence that the security factors work in the machines."

Lei and Simos will use interaction testing—a technique that systematically exercises interactions between factors to trigger security vulnerabilities—to create test cases and determine if security has been compromised. Interaction testing, while widely used in general testing of software systems, has not been regularly applied to security testing. Lei says this is due to the fact that "the negatives are often much larger than the positives, and it requires creativity to come up with scenarios to break the system."

ZOOM

"With memory becoming more expansive, we need to involve programmers to make it more efficient."

Speeding up computers through cache access

Song Jiang knows the importance of a cache in computer memory systems. Now, the computer science associate professor is exploring how these hardware components can be improved by allowing direct access to programmers.

"Efficient use of a software-defined cache allows quick access to data along with large memory," explains Dr. Jiang. "With memory becoming more expansive, we need to involve programmers to make it more efficient. The programmer knows best how to use the cache for an application, so they can add efficiency without making the cache a burden."

Every time a computer accesses its memory, it must go through the index of all the data stored there. But each task slows the machine and negates any gains that a large memory provides. In contrast, a software-defined cache allows the computer to automatically combine or skip steps to access the data without having to go through the index, making the process much faster.

Jiang has developed prototypes that he will test to determine if they can run applications efficiently even with very large data sets on large memories.

STAR BRIGHT

Identifying gaps in space transportation systems

Though the space race may have cooled down, the U.S. still looks to the skies as an opportunity for exploration—and defense. To that end, aerospace engineering Professor Bernd Chudoba is developing a "Strategic Transportation Roadmap for Defensible Space," with funding from the Air Force Research Laboratory headquarters. The roadmap focuses on a parametric space architecture that will be essential in the future and provides a primer to identify emerging individual technology studies.

Dr. Chudoba and his team have been building a generic system that combines government space programs like NASA and private space companies with military space programs, resulting in an AI-driven "unified toolbox" that could allow planners to look broadly at issues of defensible space, space exploration, and space colonization.

"By enriching the planners' forecasting toolbox, we will affect military spending strategies, technology investments in hypersonic speed, reusable space launch, AI, and more," he says.

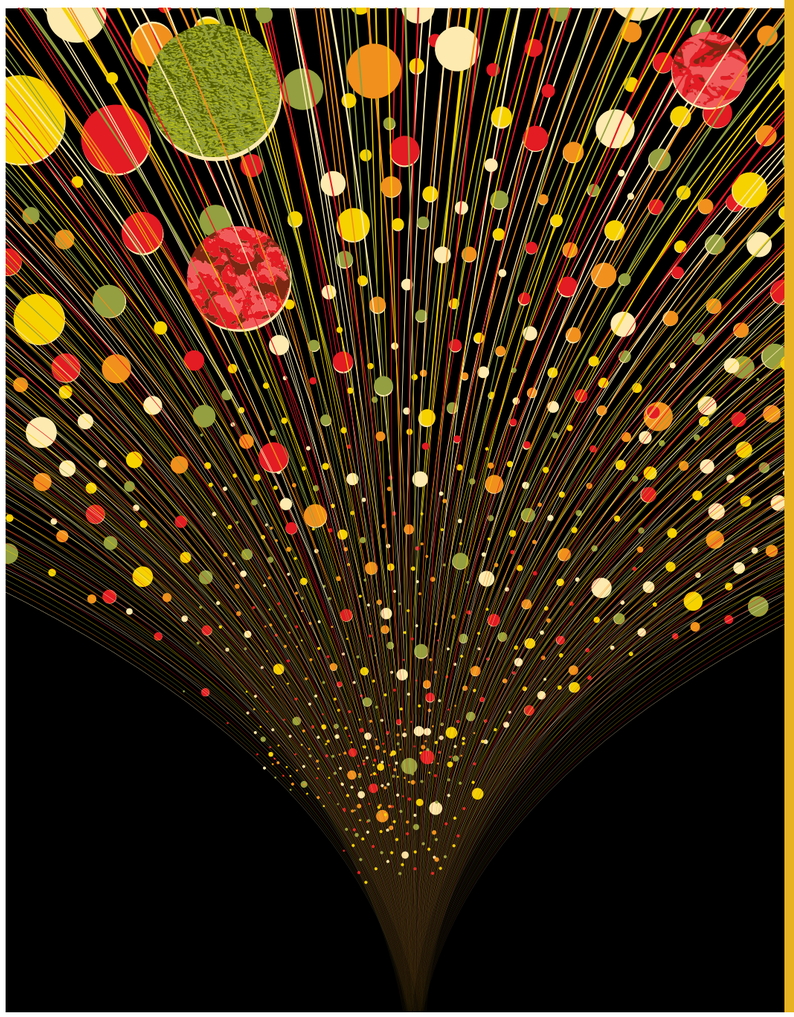


Illustration by Daniel Hertzberg

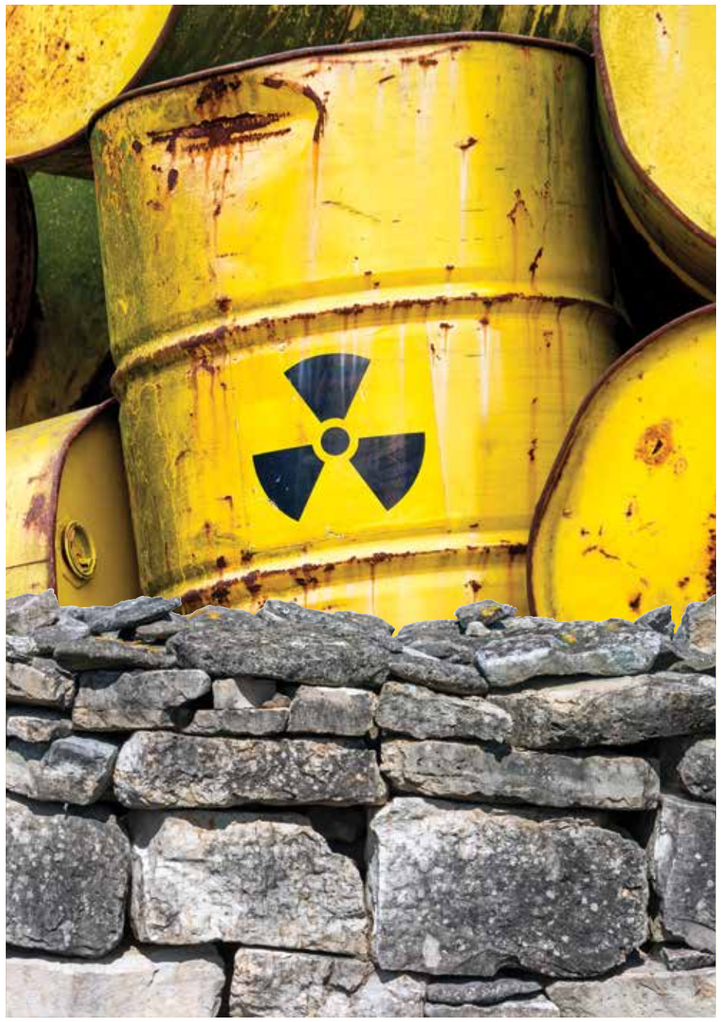
SOLID

Testing rock formations as barriers for nuclear waste

Would you trust just any material to protect you from nuclear elements? High-level nuclear waste geological repositories are designed to be secure for millions of years, so the materials forming the barriers should be sound enough to withstand natural events and leakage from the waste containers.

"Max" Qinhong Hu, associate professor of earth and environmental sciences, is investigating six types of low-permeable rock formations—including granite and clay—for their potential as barrier materials for nuclear waste repositories. He was awarded a three-year grant of nearly $568,000 from the U.S. Department of Energy's Nuclear Energy University Program for his research.

Dr. Hu will look for materials that are the most appropriate—with respect to geological, physical, and chemical attributes—for isolating and containing any potential leakage of nuclear wastes. He will also investigate how radioactive atoms, or radionuclides, from the waste can move through pore spaces in barrier materials and host rock.



TRASHED

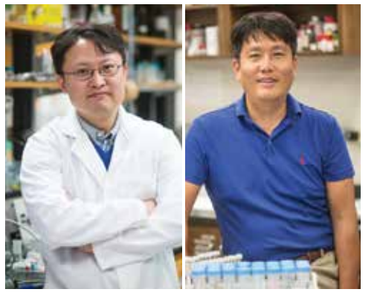
"After the national tragedy in 2017, something had to be done. They were out of time."

New partnership aims to solve Ethiopia's waste management issues

In March 2017, a landfill in Addis Ababa, Ethiopia, collapsed and slid onto nearby homes, killing 113 people. In response, city officials called civil engineering Professor Sahadat Hossain for help.

"I was the only international expert allowed to the landfill after its collapse," says Dr. Hossain, who is also director of UTA's Solid Waste Institute for Sustainability (SWIS). "I had been working with the city of Addis Ababa since 2015, but after the national tragedy in 2017, something had to be done. They were out of time. It wasn't a question of when; it was a question of how."

The capital city signed a five-year, $4 million agreement with Hossain, UTA, and Kotebe Metropolitan University (KMU) to tackle the growing demand for sustainable urban development, specifically waste management. As part of the collaboration, SWIS will help Addis Ababa's waste management facility become a Center of Excellence and will work with KMU and city officials to plan projects for solid waste management and other related topics.



REFRESH

Creating a system to clean contaminated soil and water

What do nonstick cookware, food packaging, and fire retardants have in common? They all use film-forming foams called PFASs (per- and polyfluoroalkyl substances) to repel water and oil and fight hydrocarbon-based fires. Though useful, PFASs have a downside: Due to the extraordinarily strong C–F bonds they contain, the foams do not break down easily under normal conditions and are resistant to chemical reaction, contaminating soil and groundwater near the areas where they are made, used, and disposed.

That's where civil engineering Associate Professor Hyeok Choi comes in. He and chemistry Associate Professor Junha Jeon are using a U.S. Department of Defense grant to devise a system to allow easier cleanup of soil and groundwater contaminated by PFASs.

"Cleanup of environments that are contaminated with PFASs is a difficult, expensive process," says Ali Abolmaali, chair of the Civil Engineering Department. "Dr. Choi and Dr. Jeon's research in this field gives them a unique perspective that they can apply to the problem and use to create a solution that will benefit the environment while saving tax dollars."

Global Environmental Impact

As concerned citizens of the global community, we must recognize and live within environmental limits. Future generations will survive only if we maintain the delicate balance of our planet through thoughtful stewardship of its natural resources. With the world's population exceeding 7.5 billion, the need to conserve these essential elements is increasingly critical. Becoming more environmentally efficient helps us better manage our shrinking water supply, clean the air we breathe, reduce our carbon footprint, and protect our biodiversity.

GEI QUICK HITS

Biology Professor **Jonathan Campbell**, Associate Professor **Eric Smith**, and **Alexander Hall** ('16 PhD) described a previously unknown species of snake that was discovered inside the stomach of another snake in a paper for the *Journal of Herpetology*.

Yue Deng, professor of physics, was appointed to the National Academy of Sciences' Committee on Solar and Space Physics.

Dereje Agonafer, Jenkins Garrett Professor in the Department of Mechanical and Aerospace Engineering, was named a member of the National Academy of Engineering.

Closer Look

Kinesiology Assistant Professor Michael Nelson's Applied Physiology and Advanced Imaging (APAI) Laboratory is focused on questions related to human health and cardiovascular disease, especially cardiac physiology and vascular regulation. Located in the new Science & Engineering Innovation & Research building, the lab's current projects include studies of diastolic function in women with coronary microvascular disease, ectopic fat deposition in cardiomyocytes as a mechanism for cardiac dysfunction, and cardiac function and skeletal muscle blood flow regulation in heart failure with preserved ejection fraction.

1 The ultrasound machine can take detailed pictures of the heart, like the one shown on the screen.

2 Doctoral student T. Jake Samuel performs an echocardiogram on the patient's heart to see how it is beating and pumping blood.

3 The device on the patient's wrist and index finger is measuring beat-by-beat arterial blood pressure.

4 Ryan Rosenberry, a doctoral student in Dr. Nelson's lab, performs an ultrasound on the patient's brachial artery, the large artery in the upper arm, to assess vascular health and function. Master's student Sauyeh Zamani assists.

5 This data acquisition platform is complete with an analog-to-digital acquisition system and associated software, bioamps, Doppler audio transformer, and near-infrared spectrometer. Together, this multimodality approach provides a comprehensive assessment of cardiovascular function.

6 (Not shown in this photo) The APAI lab also uses magnetic resonance imaging and spectroscopy to study cardiac function and metabolism in patients with ischemic heart disease and heart failure.

Optimizing Human Performance

From tying our shoes to monitoring our blood pressure, humans perform the tasks of daily life with little thought. But within each action lies the potential to maximize our overall performance. UTA researchers are uncovering ways to help us realize our full potential.

BY AMBER SCOTT ILLUSTRATION BY MINA DE LA O

When civil war broke out in his home country of Libya, Maher Abujelala was an undergraduate student studying computer science in Washington. He soon began hearing reports of his fellow Libyans losing limbs or becoming paralyzed in battle.

"It was then that I started becoming interested in the health care applications of my field of study," he says. "I wanted to find a way to contribute to my society through education, so I sought graduate programs that would allow me to bridge computer science with health care."

He found what he was looking for at The University of Texas at Arlington. Now a fourth-year Ph.D. student in Professor Fillia Makedon's Heracleia Human-Centered Computer Laboratory, Abujelala is working on projects in smart-robot based rehabilitation, building cognitive and physiological assessment systems, and experimenting with advanced simulations using sensor technologies.

"The general idea of my research is to monitor and assess human activities and performance and utilize technologies to enhance quality of life," he explains. "When I graduate, I will go back to my home country, where I will work hard to leverage the knowledge I gained at UTA and adapt it to the postwar needs of my society."

In broad terms, Abujelala's research falls under the category of human performance research, a multidisciplinary field that looks at any task-centered action humans perform and considers how it could be improved. He is one of a number of researchers at the University who are taking a closer look at human performance along the lifespan—using their different perspectives to design new methods, systems, and insights that may lead to a healthier and happier future for us all.

Starting Strong

In a gym on UTA's campus, children ranging in ages from 4 to 16 are working on rewiring their brains. Not that they know that. The students are grouped in clusters, working on a variety of activities. Some are cutting shapes from paper. Some are navigating a simple obstacle course. Others are bouncing balloons. All are having a great time.

These students are part of Priscila Caçola's Little Mavs Movement Academy, a free group motor skill intervention program for children with movement and coordination difficulties. The activities are designed to help them improve both fine and gross motor skills, focusing specifically on body coordination, balance, and manual dexterity.

"These are kids who have a hard time with basic motor function, like writing or tying their shoes," says Dr. Caçola, associate professor in the Department of Kinesiology. "They lack certain baseline skills that we often take for granted."

Now in its sixth year, Little Mavs has helped hundreds of kids not only improve their motor function, but also build confidence and self-esteem as they work alongside peers who have similar difficulties.

Little Mavs is housed in Caçola's Developmental Motor Cognition Laboratory, which primarily focuses on investigating the development of motor behavior in children and adolescents. The lab explores screening and diagnostic tools related to motor coordination disorders in children and proposes intervention, training, and rehabilitation protocols.

"Our ultimate goal is to understand motor development and how it progresses across the lifespan," she says. "We look specifically at the cognitive aspect of movement—what happens when our planning and feedback abilities are compromised? And how can we improve that?"

Answering those questions is paramount to helping these kids grow both physically and mentally so they can thrive later in life.

"The human condition is all about performance, and especially motor performance," says Caçola. "It's the beginning of everything. If you don't have the ability to perform and move optimally, it limits your ability to interact with the world. UTA is taking a preventative approach—not just at my lab, but across disciplines."

Top: Priscila Caçola (left) with Cheryl Anderson, associate professor emeritus of nursing. Bottom: Mark Haykowsky with a FitSTEPS participant.

Working Smarter

Increasingly, interacting with the world as a human means working with computers and artificial intelligence (AI) in all their iterations. In Dr. Makedon's Heracleia Human-Centered Computer Laboratory, researchers are focused on this human-computer interaction, applying advanced AI methods to build task-driven human simulations to observe user behavior and assess the user's cognitive or physical needs. The work conducted through Heracleia runs the gamut from improving the assessment of executive function in children to developing a program that enables personalized rehabilitation therapy for individuals suffering from brain injury, motor disabilities, and other cognitive impairments.

Makedon, the Jenkins-Garrett Professor in the Department of Computer Science and Engineering, is also founder and director of the National Science Foundation (NSF)-funded iPerform Center, which works with industries to develop computer-based innovations that enhance human performance at all levels. In turn, this leads to better productivity and increased safety and worker retention.

In late 2017, Makedon earned a $999,638 NSF grant to develop iWork, a smart, robot-based service system that assesses workers' physical, cognitive, and collaborative skills while they perform manufacturing tasks in a simulated, lab-controlled setting. The ultimate goal is to discover the best way to prepare workers for the industry of the future, where employees will need to safely and efficiently collaborate with advanced robots.

"Things have changed in the workplace, particularly in production," she notes. "Robots used to be kept in separate physical spaces, but now humans must work alongside them."

The interdisciplinary team collaborating on iWork includes computer science and engineering Associate Professor Vassilis Athitsos and Morris Bell, a psychology expert from Yale University.

"iWork will assess and train both human and robot co-workers, producing personalized, low-cost vocational training solutions that have huge economic and societal impacts," Makedon says. "It could also impact millions of people seeking to retrain for a manufacturing job, including those facing a type of learning or aging disability or returning from military service with health issues."

Heart Healthy

When Mark Haykowsky, professor and Moritz Chair in Geriatrics in the College of Nursing and Health Innovation (CONHI), measures human performance, he generally looks at matters of the heart—its size, shape, and how well it delivers oxygen to the rest of the body. Specifically, he's focused on "oxygen uptake," or the body's oxygen consumption in ml/kilogram/min per body weight.

"When we measure oxygen uptake, we're looking at the peak oxygen uptake required for independent living," he explains. "My research program examines the biological mechanisms for the decline in health-related fitness in individuals at risk for or with heart failure and the role of exercise training to restore cardiovascular and skeletal muscle function."

Together with a team of CONHI researchers, he is using a $308,000 grant from the National Institutes of Health to study the mechanisms and management of exercise intolerance in older heart failure patients with preserved ejection fraction (HFpEF), the fastest-growing type of heart failure. The mortality rate for these patients is high, and the primary symptoms they suffer are fatigue and exercise intolerance. In extreme cases, patients may not have the energy for even the most basic physical functions.

"Like climbing a flight of stairs," Dr. Haykowsky says. "It's hard for healthy individuals to fathom, but when the oxygen cascade—the delivery of oxygen from outside air to the body's systems—is compromised, it can be a challenge to complete even the simplest tasks of daily living."

Haykowsky, who directs the Integrated Cardiovascular and Exercise Physiology and Rehabilitation Laboratory, also oversees the FitSTEPS for Life Cancer Rehabilitation program. FitSTEPS is a free, community-based nutrition and exercise program designed to help cancer patients increase mobility and boost endurance while undergoing treatment.

Programs like FitSTEPS are especially important for older breast cancer patients, for whom a leading cause of mortality is cardiovascular disease. The best intervention, Haykowsky says, is exercise.

"Breast cancer patients tend to have very low fitness—to the extent that, for some individuals, performing the activities of daily living can become quite difficult. However, studies show that exercise is an effective intervention to attenuate the decline in fitness that occurs during chemotherapy."

Brain Games

While Haykowsky and other CONHI researchers are looking at heart function, George Kondraske, an electrical engineering and bioengineering professor, has developed a framework for computer tests and games that track brain performance.

His General System Performance Theory (GSPT) allows users to measure different aspects of the brain. In this systems approach, a human can be viewed as a set of subsystems, each of which possesses different types of performance resources.

"GSPT tells us how to develop the performance measures," says Dr. Kondraske. "It allows us to make tasks that are target-specific so we get an accurate picture of where people's brain performance capacities are using unifying standards and test methods."

GSPT was used to develop two web- and mobile app-based tools—RC21X and the Roberto app—that empower users to monitor their brain performance. Kondraske is chief architect of both. UTA and Home Base Impairment Co. Inc., the parent company that provides the tools, signed a licensing agreement to use GSPT in these and similar applications. Users include medical and academic researchers, professional athletes, insurance companies, and individuals suffering from brain diseases like Alzheimer's.

"Humans are driven to seek higher levels of performance, period."

"The idea is to bring the whole picture into view so we can put everyone on the same spectrum of human performance," says Kondraske. "It doesn't matter where you are on the spectrum; it matters what performance resources you have available."

He believes that human performance lives at the heart of health and the human condition.

"It cuts across the whole spectrum of the human individual, including those who have less than the average amounts of human performance resources. Humans are driven to seek higher levels of performance, period." i

A Growing Health Crisis

UTA scientists are creating new ways to fight antibiotic resistance.

BY SARAH BAHARI

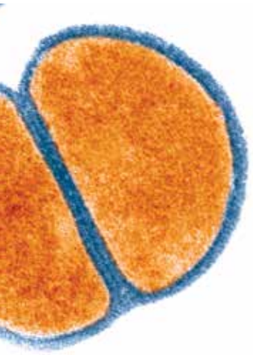
PHOTOGRAPH BY ADAM VOORHES

While studying influenza in 1928, a British scientist noticed that mold had developed on a petri dish in which staphylococci was growing. That scientist was Alexander Fleming, and he had just discovered penicillin, the world's first antibiotic. One of the greatest advances in medicine, these so-called wonder drugs would save millions of lives over the next century and radically improve the way we treat bacterial infections.

Yet today, an antibiotics crisis looms. A growing number of people are dying from infections and strains of pneumonia, tuberculosis, and other diseases that have become impervious to antibiotics, due partially to the drugs' overuse. Without action, many modern medicines soon could be rendered completely ineffective.

Scientists at The University of Texas at Arlington are addressing the escalating public health issue. Researchers from a variety of fields are harnessing the body's natural defenses to fight bacteria, studying enzymes to facilitate the development of new drugs, and seeking new and improved ways to treat infections in hospitals and military facilities.

Their research, which has drawn millions of dollars in grants, is urgent. The Centers for Disease Control and Prevention (CDC) warns that antibiotic



resistance is one of the most pressing challenges of our time—each year in the United States at least 2 million people fall ill from antibiotic-resistant infections, and some 23,000 people die from them. Further, such infections are associated with close to $20 billion in direct medical costs annually, according to the Alliance for the Prudent Use of Antibiotics.

The crisis extends far beyond the United States. In India, for example, more than 58,000 babies died in one year as a result of infections with resistant bacteria, typically passed on from their mothers.

At UTA, bacteria research got a recent boost with the 2018 opening of the Science & Engineering Innovation & Research building. The $125 million, state-of-the-art facility is helping to push the University forward as a leading health science research and teaching institution. Employing the modern concept of research lab neighborhoods, the facility drives collaboration and creativity across a multitude of disciplines, including science, engineering, nursing, kinesiology, and public health.

"Our research programs on antibiotic resistance are evidence of UTA's growing expertise in the health science field, as well as the University's commitment to lead on a national scope," College of Science Dean Morteza Khaledi says. "Research being done in laboratories here could lead to life-saving breakthroughs that benefit all of us."

A BIOLOGICAL BOOST

Mark Pellegrino has a question.

"What if we could stimulate the body's own defenses to fight and protect against pathogens like bacteria?"

This query lies at the heart of a $1.8 million grant the biology assistant professor received from the National Institutes of Health. Leading a team of UTA researchers, Dr. Pellegrino—who joined the University in 2016 from Memorial Sloan Kettering Cancer Center in New York—is looking at how mitochondria defend themselves in an effort to develop new ways to boost immunity and improve resistance to bacteria.

"If I understand how a car runs, I can fix it. In many respects, the human body is similar."

Mitochondria play a critical role in cells. They are responsible for turning the sugar, fat, and protein we eat into forms of energy the body needs to survive. They also help to regulate cell death, a necessary process to prevent the spread of infection or growth of a tumor.

When mitochondria are stressed by diseases, toxins, or infections, a protein enters the cell nucleus and binds to certain DNA sequences to unlock genes to repair the mitochondria. That signaling pathway is called the mitochondria unfolded protein response.

In previous research, Pellegrino identified a protein, known as ATFS-1, that regulates the signaling pathway in *C. elegans*, a primitive worm about 1 millimeter long that shares numerous characteristics with humans. Both the protein and signaling mechanism are instrumental in helping mitochondria defend against pathogens, he found.

"Because of their critical roles in the cell, mitochondria are clear targets of pathogens," explains Pellegrino, whose initial discovery that mitochondria are important to innate immunity was published in *Nature* in 2014.

Using the same small worm, he is now studying how those pathogens interact with mitochondria's defense and repair system. These discoveries could lead to new treatments for bacterial infections and some cancers.

"Antibiotic resistance is growing, and the number of new antibiotics being developed is extremely limited," Pellegrino says. "We know that we must develop new treatment methods. An alternative is not to simply treat the bacteria, but to boost our own immune systems and improve our body's resistance."

A ROADMAP FOR ENZYMES

Thousands of enzymes are at work in the human body, speeding up the chemical reactions necessary for everyday functions, such as digestion, blood clotting, and toxin removal.

The human body depends on these enzymes for survival, yet the way many of them function remains a mystery. To that end, a biochemist at UTA is studying a set of enzymes in hopes of creating new drugs to fight bacterial infection, cancer, and even neurodegenerative diseases.

"If I understand how a car runs, I can fix it," says Brad Pierce, associate professor of biochemistry. "In many respects, the human body is similar. Enzymatic pathways can be considered as interconnecting components of a complex machine. Without knowledge of how these components interact, it is nearly impossible to repair. But if we understand how these enzymes function collectively, we can begin to rationalize how to develop effective strategies to treat diseases associated with enzymatic dysfunction."

Dr. Pierce, who recently received nearly $430,000 from the National Institutes of Health to continue his work, is mapping the function of enzymes related to the metabolism of sulfur, which is one of the most abundant elements in the body.

"Despite its physiological importance, there is still a great deal we don't know about how sulfur is metabolized in the human body," Pierce says. "Our research seeks to change that."

Enzymes involved in the sulfur-oxidation process are gaining attention as potential drug targets for the development of antibiotics and therapies for cancer and inflammatory disease, in large part because patients with autism, Down syndrome, and Alzheimer's demonstrate abnormal sulfur metabolism.

To study the processes, Pierce is mapping three key enzymes—cysteine dioxygenase, cysteamine dioxygenase, and 3-mercaptopropionic acid dioxygenase. He and his team use a rapid-mix, freeze-quench technique to monitor the progress of chemical reactions at millisecond intervals. Ultimately, Pierce wants to create a step-by-step picture of how these enzymes function in both mammals and bacteria.

Specifically, he wants to better understand how the behavior of the enzymes changes in the presence of pathogens like bacteria.

"As with most things, the devil is in the details," Pierce says. "Only by mapping out how human and bacterial enzymes deviate can we identify tailored therapies for specific pathogens. These will be less likely to elicit adverse side effects on our own physiology. In short, by understanding the function of these enzymes, we can rationalize the synthesis of entirely new therapeutic agents."

A TRANSFORMATION FOR TREATMENT

Each year in the U.S., thousands of patients pick up bacterial infections while receiving care in hospitals. According to the CDC, on any given day about one in 31 hospital patients has a health care-associated infection, increasing the risk of it spreading to others and, in turn, prolonging their hospital stays.

With antibiotics quickly becoming less effective, new treatments are needed to battle infectious diseases in hospitals and military facilities. That's why Associate Professor He Dong is developing a method to treat and heal antibiotic-resistant infections not with drugs, but with a synthetic nanomaterial.

"We desperately need new ways to fight the growing number of antibiotic-resistant infections," Dr. Dong says. "Synthetic antimicrobial nanomaterials have the potential to transform the health care industry and the use of conventional antibiotics."

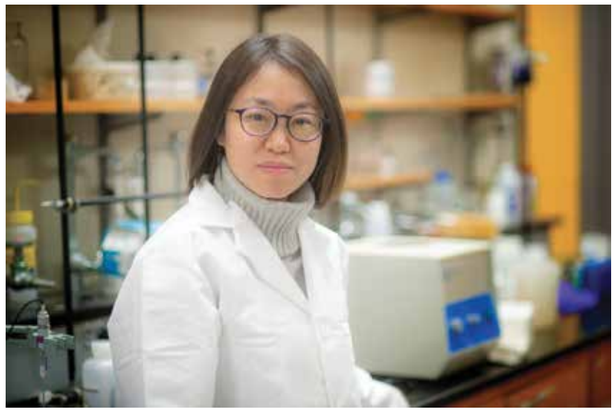
Scientists first discovered antimicrobial nanomaterials about 30 years ago, but their use stalled because they are toxic toward healthy human cells.

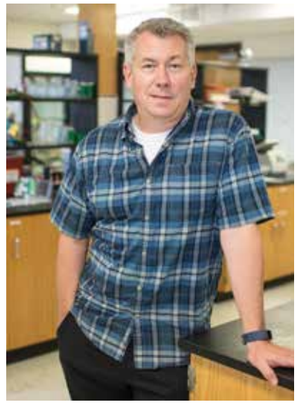
Using a new technique, Dong and her team are developing materials that only target toxic bacteria and are biocompatible with healthy mammalian cells. Called synthetic self-assembling antimicrobial nanofibers (SAANs), the peptides self-assemble into a larger nanofiber shape that can punch holes in the bacteria membrane, killing the pathogen. Compared to traditional antibiotics, they may be less prone to developing antibiotic resistance because genetic modification of the cell membrane, which they target, is more difficult. The molecules also have the potential to treat infections on external surfaces and internally through oral or intravenous treatments.

Dong was awarded a prestigious National Science Foundation Faculty Early Career Development (CAREER) grant worth nearly $500,000 for her work. As part of the project, she is hoping to further understand how SAANs are so effective against bacteria without harming healthy cells.

Her collaborators include faculty from UTA's Department of Bioengineering and clinicians in the Division of Infectious Diseases and Geographic Medicine at UT Southwestern Medical Center. Once they have developed the materials, the team will test the antimicrobial activity in different animal models to evaluate its effectiveness.

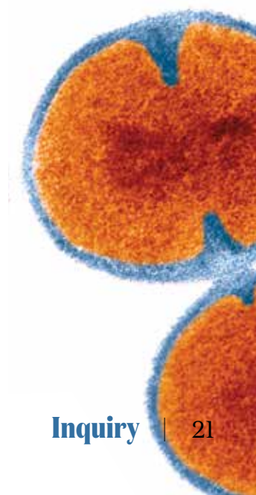
"Today's antibiotics crisis requires us to think outside of the box for the next generation of treatment," Dong says. "We are confident these antimicrobial nanomaterials can lead to real, life-saving applications in hospitals and military facilities." i

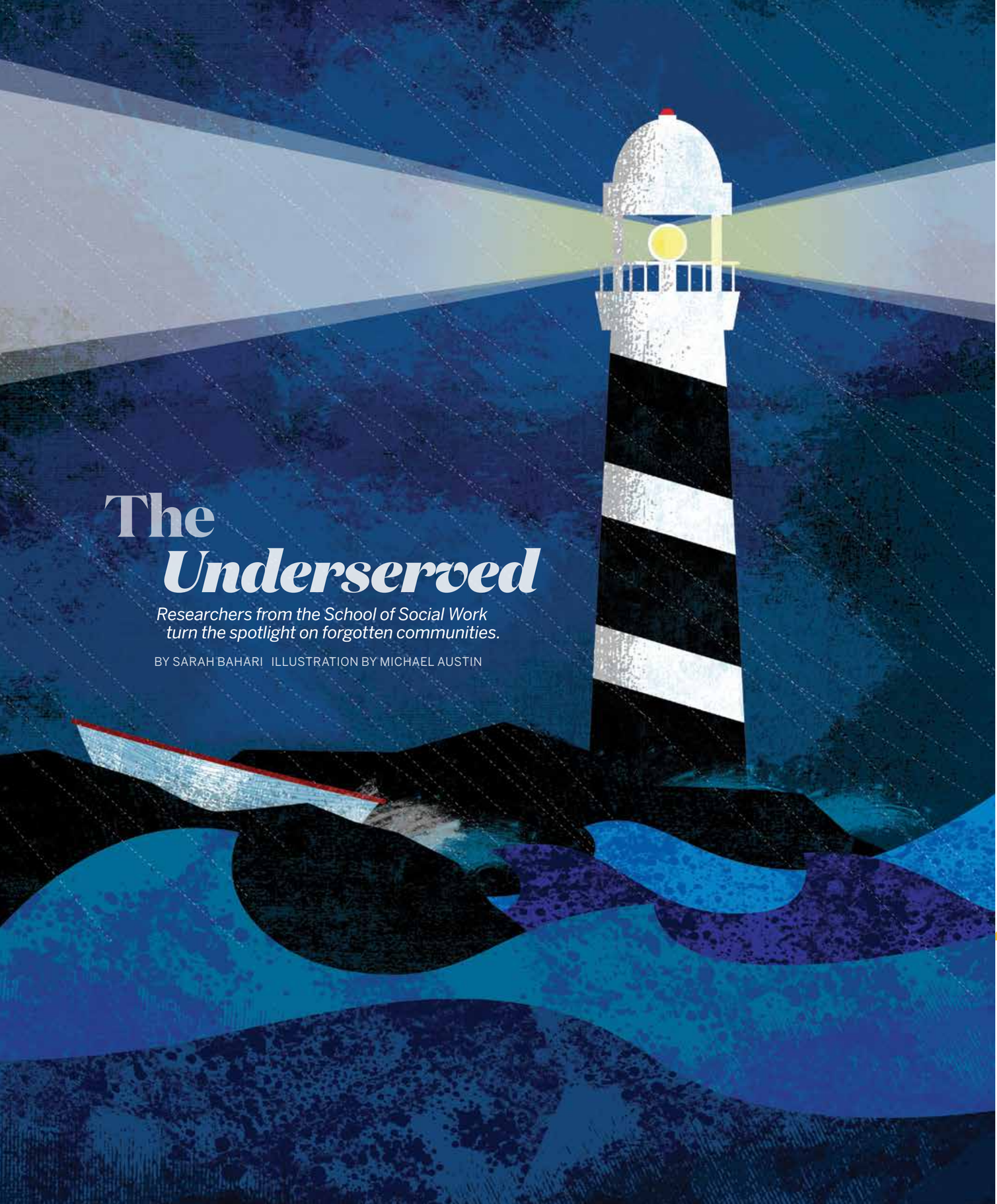




From left: Associate Professor He Dong, Associate Professor Brad Pierce, and Assistant Professor Mark Pellegrino.

Bacteria images by Biomedical Imaging Unit, Southampton General Hospital/Science Photo Library





The *Underserved*

Researchers from the School of Social Work turn the spotlight on forgotten communities.

BY SARAH BAHARI ILLUSTRATION BY MICHAEL AUSTIN

Nine refugee camps blanket a stretch of the border between Thailand and Burma.

In the past decades, the Karen people have fled to these camps to escape war and religious persecution. Yet the area is soaked in squalor. Bamboo roofs sit atop overcrowded shanties. Food and medical care are scarce. Violence is a part of life.

Many will never leave. Yet others are granted refugee status in countries around the world, including the United States. Resettlement can bring its own stress, from language barriers and culture shock to lack of employment and financial worries.

Despite this, mental health care options for Karen refugees and others are severely lacking. But a professor at The University of Texas at Arlington hopes to change that by studying how we can provide critical mental health care to refugees.

"When refugees arrive in the United States, they are at their most vulnerable. They have experienced the worst of what the world has to offer," says Diane Mitschke, an associate professor of social work. "We have an obligation to support and help them. As social workers, we are uniquely qualified to help shape the care they desperately need."

Dr. Mitschke's research is part of a growing body of work at UTA aimed at reaching historically underserved communities and populations. In addition to refugees, researchers are studying American Indians and adolescent mothers to gain insight into these groups, which have long been ignored by society—including academia.

Developing a better understanding of these communities can help health care professionals provide more efficient and high-quality services, researchers say, ultimately enabling them to become successful members of society.

"Through research, social workers bring attention to the issues and causes of social and economic injustices affecting marginalized, disadvantaged, and underserved populations," says Scott Ryan, dean of the School of Social Work. "Using evidence-based research, we are committed to the guiding themes and principles outlined in UTA's strategic plan by

finding solutions that improve the health and human condition and that help sustain urban communities like the Dallas-Fort Worth Metroplex."

Mental Health of Refugees

Hser Gay Paw was just 9 years old when her family fled Thailand for the United States.

She remembers her parents struggling to understand how to complete the piles of paperwork, how to pay bills—even how to adjust to American foods.

"Assimilation can be so hard," says Paw, who was a Karen refugee and is now a freshman at UTA. "It takes a toll."

As a teenager, Paw began volunteering as an interpreter at the Agape Clinic in east Dallas, which provides health care for underserved populations such as refugees and undocumented immigrants. That's where she met Dr. Mitschke, a volunteer who had begun to take a research interest in the mental health of refugees.

Mitschke noticed a look of shock among new refugees as they tried to navigate daily life in the United States, and she wondered how she, as a social worker, could help.

Given the stakes, that question is critical. Roughly 3 million refugees have resettled in cities and states across the country since 1980, bringing diverse beliefs and cultures.

"The community is so grateful for this research. Our struggles need to be heard. Our challenges need to be heard. It is amazing to have this sort of spotlight."

"As a whole, they are an incredibly resilient group of individuals who continue to have hope for the future," Mitschke says. "The more we can do to help them thrive in the U.S., the more likely it is they will become productive members of society who enrich our communities through their cultures and ideas. We are all the better for it."

To begin, Mitschke reached out to Catholic Charities in Fort Worth, which works with refugees from around the world, and developed a study to evaluate different delivery methods of mental health care.

For eight weeks, refugees from Burma, Burundi, the Democratic Republic of Congo, Rwanda, and Bhutan received one of three counseling methods: office-based, home-based, and peer-based community. Forty refugees participated in each.

Upon completion, participants filled out mental health surveys. Mitschke found that home- and peer-based counseling were equally effective in treating post-traumatic stress disorder (PTSD), depression, and anxiety. Office-based counseling, which required transportation and child care, proved the least effective.

"Our results were very encouraging," Mitschke says. "A peer-based, community model, which would be the most cost-effective, has enormous potential to treat PTSD and other issues. This helps us develop new, innovative ways of providing mental health care for underserved populations."

Mitschke's work with refugees continues. In another project, she is collaborating with Beverly Black, UTA's Jillian Michelle Smith Professor in Family Violence Research, to promote healthy relationships and prevent relationship violence among adolescent refugees. Most recently, she worked with a graduate student to study the impact of spirituality and religiosity on mental health among Syrian refugees.

For Paw and other refugees, Mitschke's work has provided a catharsis.

"The community is so grateful for this research," Paw says. "Our struggles need to be heard. Our challenges need to be heard. It is amazing to have this sort of spotlight."

Needs of American Indians

Some 60,000 American Indians from 174 federally recognized tribes call North Texas home. Yet little is known about this population, including their medical, social, and cultural needs.

In fact, nearly all of the existing research on American Indians focuses on those who live on reservations, even though three-quarters of the population now lives in cities and urban areas such as North Texas.

Working with the Urban Inter-Tribal Center of Texas, an interdisciplinary group of UTA professors designed a study to unearth such data, which will not only help the center provide more targeted services, but also apply for federal, private, and state grants to improve the health of its members.

"The United States has an obligation to provide health care to American Indians based on the history and treatment of its people," says Paul Conrad, an assistant professor of history. "But we found there are many needs not being met."

In addition to Dr. Conrad, the team includes Maria Scannapieco, director of the Center for Child Welfare in the School of Social Work and a Distinguished Professor; Barbara Raudonis, associate professor of nursing; and Kelly Visnak, associate librarian.

The researchers first led a series of three focus groups with 41 participants. Based on those discussions, they developed a needs assessment survey, which they handed out at powwows and cultural events around the region. They received 370 replies.

Throughout the surveys, participants reported a need for more culturally specific mental health care and substance abuse treatments for adults and youths, affordable child care and after-school programs, Native-oriented domestic violence programs, and better access to medical specialists such as optometrists. Participants also sought more cultural and social events.

From left: Diane Mitschke's work focuses on refugees; Paul Conrad collaborates with American Indians in North Texas.

"The bottom line is the American Indian community has a great need for culture-specific care and programs," Dr. Scannapieco says. "It is very difficult to apply for and win grants without showing data. We hope the Urban Inter-Tribal Center of Texas can use this data to meet some of these needs."

Conrad adds that the report also seeks to provide a deeper sense of understanding about a community that is critical to our nation's history. "We live on what was once native land, and I think it's important to have a better sense of who the American Indians are in North Texas. We view this project as the start of an ongoing relationship with this community."

Teenage Mothers and Birth Trauma

Cheryl Anderson first read about psychological birth trauma in medical literature a few years ago. Defined as a form of mental or emotional distress suffered by some mothers following childbirth, it can materialize into depression or PTSD.

Dr. Anderson, an associate professor of nursing with a background in maternal health, posed a question: "If a grown woman can experience psychological birth trauma, what about a 14-year-old girl?"

Working with the county hospital of Fort Worth, she and her team interviewed more than 300 women between the ages of 13 and 19. Their interviews indicated that young women can be particularly susceptible to fears of dying, loss of control, uncontrolled pain, and limited support during labor, all of which have been associated with symptoms of traumatic stress.

While mining the results of the research, Anderson noted that nearly three-fourths of the young mothers they interviewed were Hispanic, not surprising given Texas' demographics (nearly 40 percent of Texas residents are Hispanic or Latino, according to the U.S. Census Bureau). Birth rates for young Latinas are higher than any other group—38 out of 1,000 compared to 23 out of 1,000 for the rest of the population—so Anderson wanted to explore birth trauma for this ethnic group.

She and her team analyzed a small sub-sample of the Hispanic mothers, 66 in total, using a tool that measures acculturation, or the process in which a person from one culture adopts the practices and values of another culture. They found that immigrants with less acculturation showed a higher likelihood of experiencing symptoms related to birth trauma, possibly enhanced by a language barrier or lack of support system.

Anderson believes further research is needed on all adolescents, including Hispanics, and psychological birth trauma. "Adolescents can be particularly vulnerable to suffering traumatic birth experience, and health care providers should monitor symptoms immediately after birth, as well as several months following hospital discharge." i

The Sky's the Limit

Unmanned aerial systems are changing the way we gather information, do business, and respond to emergencies. But with new technology comes new challenges. UTA hopes to provide a guiding light. BY MELINDA MAHAFFEY ICDEN

The first primitive unmanned aerial vehicles (UAVs) emerged in 1849, when Austrian forces, in an attempt to quash a rebellion in Venice, used hot air balloons launched from a ship 4 miles away to bomb the city. Although that particular plan didn't prove to be an effective military maneuver—some of the balloons apparently drifted back over Austrian lines—the usefulness of UAVs was immediately clear: They could gather intel or conduct an operation without risking the life of a human operator.

College of Engineering Associate Dean Anand Puppala prepares a UAV for testing at the UTA Research Institute.

But UAVs—which can range in size from a small aircraft to a flyer that fits in the palm of your hand—are also lauded for their efficiency and cost benefits, and in the last few years the commercial market has, well, taken off. They've been used successfully in a number of applications, from monitoring crop health to inspecting property damage. Consulting firm McKinsey & Company estimated that commercial drone activity was worth $1 billion in 2017, compared to $40 million just five years before.

Still, much work on these flying computers remains to be done, and that's where UTA comes in. From its numerous National Science Foundation (NSF) grants to its certificate programs training the next generation of experts, the University continues to make its mark in UAV research, helping this dynamic industry find its wings.

IMPROVING DATA COLLECTION

In April 2018, Anand Puppala, associate dean for research in the College of Engineering, wrapped up an 18-month research project with the Texas Department of Transportation (TxDOT) that investigated the use of UAVs for infrastructure monitoring. He and his team conducted surveys of roads, a bridge, a railroad corridor, and multiple materials stockpiles, and worked with TxDOT to vet their flight operations manual. The researchers found that UAVs provide data more quickly, safely, and cheaply than traditional monitoring methods.

Under Dr. Puppala's guidance, Cody Lundberg, a research engineer at the UTA Research Institute (UTARI) and an FAA-certified UAV pilot, along with postdoctoral scholar Surya Sarat Chandra Congress traveled around the state gathering high-definition infrastructure images. In Sherman, Texas, for example, the duo conducted two 10-minute UAV flights along a stretch of highway, using the attached digital camera to capture data about pavement conditions such as roughness, rutting, and cracking. Back at UTA, Dr. Congress geotagged the images and created a dense point cloud from the data. With these virtual models, the team could then analyze different pavement performance characteristics in fine detail using commercially available image analysis software and UTA-developed algorithms.

When Congress and Lundberg conducted their flights, warning signs were posted, but all lanes remained open, and the pilot and crew were stationed at a safe distance from the road. In addition to increasing safety, using UAVs can save time because the drone gathers all of the data about each attribute simultaneously and in the same way—there's no need to take separate measurements for each characteristic as with traditional methods.

Congress believes that with the current technology, UAVs can serve as a complement to those traditional methods by helping transportation personnel zero in on problematic areas.

"You can collect the data of thousands of miles with UAVs to find the critical areas and then conduct the costly traditional surveys on those specific stretches."

Puppala echoes that sentiment. "The accuracy [of UAV-provided data] won't be as good as the expensive laser-based profilers, but if I can get close, not too far from the real values, I think people may consider this as a tool to use."

An implementation phase of the project began in September. The researchers are spending six months developing training materials, and Congress has traveled to nine major TxDOT districts to conduct training sessions with engineers, surveyors, and administrators on using UAVs in the field for data collection and on flight operation protocols. The team also demonstrated the data collection abilities of UAVs in different applications—intersection, building, and planimetric mapping; pavement forensics; stockpile volumetric studies; and bridge and communication tower surveying.

This work with TxDOT has served as a springboard for other projects. With aid from a yearlong Rapid Response Research grant from the NSF, Puppala and collaborators from Louisiana State University used UAVs and smartphones to capture images of debris piles from 2017's Hurricane Harvey at eight sites in Beaumont, Texas. Once back at UTA, Congress used photogrammetry—the science of measuring distances from two or more photographs—to create highly accurate 3D models. The purpose was to develop a step-by-step methodology that could better estimate the volumes of piles of trash, which in turn could help municipalities improve future cleanup efforts and allow them to budget appropriately.

"Our goal was to really help them understand from an engineering point of view how to estimate the amount of volume so they could get a better handle on how long the cleanup process takes and how many truckloads they'll need," Puppala says. "All of those things they can plan."

He and his team are also building on their work in a new project with the Harris County Toll Road Authority, which oversees toll roads in the Houston area. The researchers will use UAVs to assess the conditions of bridges, roads, and existing signage.

"Infrastructure dollars are very limited," Puppala says, "and the UAVs quickly and safely provide important data that helps agencies identify where they want to invest their dollars for maximum value."

ENABLING UAV TEAMWORK

Despite the benefits UAVs bring, the technology does present challenges. For example, it can be difficult for a single vehicle to perform a complex mission because, due to its small size, the drone may not be able to carry all the needed sensors. Using multiple UAVs brings its own issues, however: If the mission has a series of tasks that must occur in a certain order, it may not be best to launch the UAVs together because they have relatively limited flying times. Ideally, the UAVs need to be able to communicate with each other to figure out the optimal sequence for collecting data.

"Though each of them is highly optimal, when you put them together and you restrict communication between certain channels, the performance of the overall team may not be as optimal," says Kamesh Subbarao, associate professor in the Mechanical and Aerospace Engineering Department. "If it is not optimal, then what does it depend upon and how can we mitigate those circumstances?"

Dr. Subbarao, who is also the director of UTA's Aerospace Systems Laboratory, is using a four-year, $795,427 Basic Research Challenge grant from the Office of Naval Research (ONR) to answer those questions. He'll quantify how teams of UAVs perform in coordination by examining the sensitivity of individual vehicles to certain variables and then build algorithms based on those metrics that will allow operators to effectively predict how these grouped vehicles will work together.

"Our relationships with industry and academic partners, as well as our FAA certification, make UTA and UTARI ideal for pursuing meaningful research in unmanned aerial systems."

One metric, for example, examines how multiple vehicles perform when they are being directed to a GPS location and need to determine which vehicles are the closest. A second metric looks at how they pass information when only some of them know where to go. And a third examines how closely they can fly without colliding and what conditions might affect that answer.

"What complicates the whole thing is the communication dynamic," Subbarao says, noting that those networks can unpredictably weaken, resulting in delays or dropouts.

The resulting algorithms can be applied to any type of unmanned vehicle—land, water, or air—or a mix of vehicles. Subbarao and his team will refine their work through simulations using small mobile robots that will run around their lab floor. Eventually, they will build aerial vehicles and validate their results in a confined test arena, such as the ones UTARI offers.

This research builds on a three-year grant Subbarao received from the Air Force Research Laboratory in 2016 to examine how time delays during information transfer can affect cooperating spacecraft. The new control algorithms he developed address how ground rovers can still successfully reach their destinations, talk to each other, and avoid collisions even if there is a short loss of network connectivity or the signal is delayed.

"The algorithm compensates for the delay, and the rovers still can perform the mission," Subbarao says. Now with the ONR grant, "we have to understand how those algorithms can be applied to aerial vehicles, and whether they can be applied with very little modification or if the extent of modification required has yet to be determined."

In the unmanned systems industry, where the challenges are tightly woven together, the interdisciplinary experience students gain at UTA is invaluable.

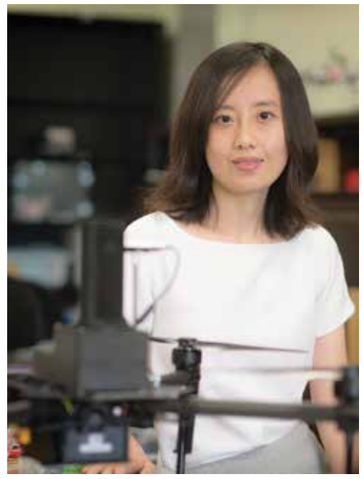
IMPROVING PERFORMANCE THROUGH NETWORKING

Emergency response is an application that would benefit from multiple vehicle coordination, allowing UAVs to perform more complicated missions. While a single UAV could be sent out to bring back images or video of, for example, a wildfire, vital time would be lost to downloading and processing the information. Multiple UAVs networked together, however, could send data in real-time, allowing emergency responders to respond faster and potentially saving lives and property.

To date, most of the available hardware and software has been designed either for a single application or a single vehicle. But with the aid of a three-year, $998,803 NSF grant, Yan Wan, associate professor in the Department of Electrical Engineering, is building a generic system that researchers from various disciplines can use in their work involving networked UAVs. The flexible, modular design of this open-network aerial computing platform will provide an infrastructure for experts from fields like computer science, electrical engineering, and aerospace engineering to build on as they tackle components related to their own specific areas of interest. Such a system is expected to save both time and money.

Dr. Wan's co-principal investigators on the project, which began in September 2017, hail from the University of Puerto Rico–Mayagüez, the University of North Texas, and Texas A&M University–Corpus Christi. Frank Lewis, electrical engineering professor and the Moncrief-O'Donnell Endowed Chair at UTARI, serves as an adviser. (Wan and Dr. Lewis are also collaborating on a four-year, $815,019 ONR project that began in June 2018 to develop performance guarantees for networked multi-body systems, using UAV pursuer-evader games as a case study.)

The first prototype is already available and includes a lightweight UAV-mounted computing device with connection ports and virtualization support, a UAV and antenna cooperative control system, and a broadband wireless communication system that allows multiple UAVs to network. The platform gathered tremendous attention when presented at the 2018 International Conference on Unmanned Aircraft Systems.



From left: Associate Professor Kamesh Subbarao, Associate Professor Yan Wan, and Professor Frank Lewis.

INCREASING SAFETY FOR THOSE BELOW

While Amazon CEO Jeff Bezos made a splash with his 2013 announcement of a Prime Air service that would deliver packages to customers' doorsteps, there remain unanswered questions about how the widespread use of commercial drones will impact those on the ground.

To address these concerns, Wan and Subbarao are collaborating with Atilla Dogan, associate professor of aerospace engineering, on a $550,000 NSF project to quantify the risk UAVs pose as they fly over populated areas. The team will then develop an autonomous decision algorithm that will keep UAVs below a predetermined acceptable risk level as they execute their tasks.

Manfred Huber, professor in the Department of Computer Science and Engineering, and Brian Huff, associate professor in the Department of Industrial, Manufacturing, and Systems Engineering, also serve as co-principal investigators on the grant.

"Our objective is to increase public acceptance of unmanned aerial system (UAS) technology by demonstrating safe operation in various risk conditions, and to benefit commercial UAS use and the related job market," Dr. Dogan says.

MAKING UAVS SMARTER

Meanwhile, at UTARI, researchers are working on new ways to improve UAV performance. At the June 2018 International Conference on Unmanned Aircraft Systems, Senior Research Scientist Aditya Das, Lundberg, and research scientist Hakki Sevil presented a paper on using groups of UAVs, called swarms, to locate an object of interest. One smarter UAV would fly at a higher altitude and perform a scan for the object, which could be anything from an infrastructure component, like an oil drill or fire hydrant, to an improvised explosive device. The vehicle would then deploy smaller, less intelligent drones to capture side and/or lower altitude views of the found object in higher definition, and from all that data create a 3D model, or orthophoto.

"It's meant to be a flexible system, where you could deploy as many vehicles as you need and build that 3D model onboard, so you could have it before the UAV landed to give to an inspector," Lundberg explains.

Because UTARI has an FAA certificate of authorization to fly drones in the area around its facility, the researchers were able to conduct experiments outside, and they used drones to scan for an obscured trash can.

UTARI is also bringing the University's expertise in unmanned systems directly to business and industry. In a recent partnership, the Automation and Intelligent Systems division, led by Dr. Das, collaborated with simulation software company ZedaSoft Inc. UTARI helped the Fort Worth-based business develop its physical UAV capabilities by modifying a commercially bought drone, programming the autopilot, conducting systems checks, and educating company leaders about regulations, among other tasks. Lundberg also originally served as UAV pilot.

"Our relationships with industry and academic partners, as well as our FAA certification, make UTA and UTARI ideal for pursuing meaningful research in unmanned aerial systems," says Mickey McCabe, the executive director of UTARI.

PREPARING FUTURE UAV INNOVATORS

Since 2014, UTA has been training its undergraduate and graduate students to serve as the next generation of experts in this burgeoning field through a multidisciplinary UAS certificate program. In this unique offering, students are team-taught in the introductory course by professors from a variety of engineering departments. In the second semester, the students split themselves into teams and build an unmanned vehicle to compete in a series of challenges.

Subbarao says that the programs increase their graduates' employment prospects. "The certificate puts the spotlight on them and their skill sets. When they go out into the unmanned systems industry, they'll have to work with people from other disciplines to improve the capability of the vehicles, and they already have that experience."

In the unmanned systems industry, where the challenges are tightly woven together, the interdisciplinary experience students gain at UTA is invaluable.

WILL WE ONE day get around via passenger drones? And will we actually have packages seamlessly dropped onto our doorsteps? Only time will tell if this *Jetsons*-like future will become a reality. But as the potential for unmanned aerial systems continues to take off, impacting everything from infrastructure to emergency response, UTA is ready to meet the accompanying challenges through its research and faculty know-how, industry and business partnerships, and focus on educating the next generation of experts. i

Patented Success

Promoting innovation and the commercialization of research

Smart Seat Cushion

UTA patented a smart seat cushion that uses changes in air pressure to redistribute body weight and help prevent the painful ulcers that can form from sitting in a wheelchair for long periods of time. The technology can also be used to create liners for prosthetics that adapt their shape to accommodate changes in body volume during the day while maintaining a comfortable fit.

"Pressure ulcers caused by long periods of sitting without relieving pressure at bony regions such as the tailbone frequently occur in people who spend a significant amount of time in wheelchairs," says Muthu Wijesundara, co-inventor of the technology and chief research scientist at the UTA Research Institute. "In the case of prosthesis users, poor fitting of the prosthesis leads to pressure injuries for amputees that can severely affect their daily lives."

Cancer killer

UTA was awarded U.S. and international patents on a nanoparticle material that can be activated by light, microwave, X-ray, or ultrasound to kill multiple kinds of cancers.

"This new nanoparticle material has many properties that improve upon traditional photodynamic cancer therapies, where light is used to activate a particle that kills cancer cells," says inventor and physics Professor Wei Chen. These advantages include reduced side effects for patients, as healthy cells are not affected by treatment; low cost; ease of manufacture; and applicability to multiple cancers.

3D point-of-gaze headset

Revolutionary eye-tracking technology invented at UTA will allow users to navigate electric wheelchairs and other mobile platforms without their hands. The University received a patent for a 3D point-of-gaze headset that resembles a pair of ski goggles, with cameras on top and eye-trackers embedded in the lenses.

The device, invented by Lecturer Christopher McMurrough, feeds data into a program that models the user's surrounding environment and what is currently being looked at by projecting the line of vision out and crossing it with the 3D view from the camera. The technology can also allow the wearer to communicate to a robotic platform when he or she would like to use an object, such as a glass of water.

FACULTY NEWS

GRANT | FELLOWSHIP | APPOINTMENT | AWARD | PAPER

Provost Newest Inventors Fellow

UTA Provost **Teik C. Lim** was named a fellow of the National Academy of Inventors. Election to NAI fellow status is the highest professional distinction accorded to inventors who have demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development, and the welfare of society.

An internationally recognized scholar in structural vibrations and acoustics, modeling, and simulation technology, Dr. Lim holds three patents for active noise cancellation in collaboration with colleagues at Ford Motor Co. The company used those critical patents to improve the driving experience and maintain a technical competitive edge in vehicle quietness.

"That collaboration was one of my most interesting, challenging, and fruitful projects at Ford Motor Co.," says Ming-Ran Lee, who works at Ford. "The research investigation led to three landmark U.S. patents and one application still pending."

With the election of Lim and LK Mestha (see below), UTA now has 15 NAI fellows, the most of any Texas university.

LK Mestha, an adjunct professor in the Department of Electrical Engineering and director of biometric research at KinetiCor Inc., was elected to the National Academy of Inventors. He has received 246 patents and has worked for companies such as GE Global Research, Xerox Research Center, the Superconducting Super Collider, and Rutherford Appleton Laboratory.

Social work Assistant Professors **Kathy Lee** and **Rebecca Mauldin** won the Best Human Services App Idea Award at the 2018 Social Work, Education, and Social Development Conference for SageServe, an app that provides older adults with online-based volunteer opportunities.

Subhrangsu Mandal, associate professor of chemistry and biochemistry, and psychology Associate Professor **Linda Perrotti** received a $439,360 grant from the National Institutes of Health to investigate the link between ovarian hormones and the blood cholesterol balance in the body.

Jamie Rogers—Distinguished Teaching Professor and associate chair of the Industrial, Manufacturing, and Systems Engineering Department—was named a fellow of the Accreditation Board for Engineering and Technology.

The National Institutes of Health awarded **Michael Nelson**, assistant professor of kinesiology, a five-year, $3.3 million grant to study the link between fat storage in the heart and cardiovascular disease.

Wayne Crawford, assistant professor of management, co-authored a study in *Occupational Health Psychology* on how using a mobile device at home for work purposes has negative implications for an employee's work life and relationships.

Presidential Distinguished Professor of Physics **David Nygren** and

Illustration by Lara Tomlin

Assistant Professor **Ben Jones** received a $1 million grant from the U.S. Department of Energy to build a detector that may offer insight into the universe's matter-antimatter imbalance.

Department of Art and Art History Lecturer **Billi London-Gray** won a Puffin Foundation grant for her ongoing project, The Loop and Saw Choir.

Hanli Liu, an expert in brain imaging and professor in the Bioengineering Department, was among 26 women named by the *Dallas Business Journal* as winners of the fifth annual Women in Technology Awards, which celebrate and honor the tech mavericks who are forging the way for both women and future tech leaders in Dallas-Fort Worth.

Civil engineering Professor **Jim Williams** was named president of Chi Epsilon, the national civil engineering honor society.

Anand Puppala, civil engineering professor and associate dean for research in the College of Engineering, won a $600,000 contract from the U.S. Department of Transportation regional center and TxDOT to employ geopolymers for soil modification and sustainable cement materials to strengthen highway embankments.

Distinguished University Professor in electrical engineering **Weidong Zhou** published a paper in the journal *Advanced Materials* with John Rogers, a world leader in the field of bioresorbable or biodegradable electronics, that describes their use of flexible optical waveguides in biosensors.

The National Science Foundation awarded a three-year, $750,000 grant to electrical engineering Professor **Michael Vasilyev** to address the challenges of large-scale deployment of quantum communication systems.

Robert Gatchel, Distinguished Professor of Psychology and the Nancy P. and John G. Penson Endowed Professor of Clinical Health Psychology, led a federal advisory group that published its recommendations on the prevention of acute and chronic pain to the Federal Research Pain Strategy, an interagency committee that oversees the government's long-term strategic plan to support pain research.

The National Oceanographic and Atmospheric Administration awarded civil engineering Assistant Professor **Yu Zhang** a $515,565 grant to apply inputs from the joint polar satellite system to create a paradigm that could be applied to the National Water Model and allow both services to be considered in predictions and warnings.

Purnendu "Sandy" Dasgupta, Hamish Small Chair of Ion Analysis in the Department of Chemistry and Biochemistry, won the 2018 American Chemical Society's Division of Analytical Chemistry Chemical Instrumentation Award.

Robert Magnusson, the Texas Instruments Distinguished University Chair in Nanoelectronics and an electrical engineering professor, won a $360,000 National Science Foundation grant for his research into band flips and bound states in leaky-mode resonant photonic lattices.

Shima Hamidi, assistant professor in the College of Architecture, Planning, and Public Affairs, and doctoral students **Jinat Jahan** and **Somayeh Moazzeni** published "Does Location Matter? Performance Analysis of the Affordable Housing Programs with Respect to Transportation Affordability in the Dallas-Fort Worth Metropolis" in the *Transportation Research Record Journal*.

The National Science Foundation awarded biology Professor **Esther Betran** a $570,197 grant for her research on transposable elements, or "jumping genes."

A study published in *Hypertension* provides potential insight into the higher prevalence of hypertension reported in black men. It was written by **Jennifer Vranish**, postdoctoral research fellow; **Paul Fadel**, professor of kinesiology and College of Nursing and Health Innovation associate dean; **David Keller**, professor and chair of the Department of Kinesiology; and doctoral students **Jordan Patik** and **Benjamin Young**.

The National Institutes of Health awarded a $441,000 grant to build new imaging technology that will study blood vessel function in patients with heart failure to **Michael Nelson**, assistant professor of kinesiology; **Mark Haykowsky**, professor and Moritz Chair in Geriatrics; and **Fenghua Tian**, bioengineering faculty research associate.

Kyungsuk Yum, an assistant professor in the Materials Science and Engineering Department, and doctoral student **Amirali Nojoomi** developed a process by which 2D hydrogels can be programmed to expand and shrink in a space- and time-controlled way. They published their groundbreaking research in *Nature Communications*.

Yi Hong, associate professor in the Bioengineering Department, is leading an interdisciplinary team that will use a five-year, $1.6 million grant from the National Institutes of Health to develop a new method of treating a vaginal prolapse before the vagina completely detaches.

John Romig, assistant professor of special education, was recognized by the Council for Exceptional Children's Division for Research with a 2019 Student Research Award.

Frank Lewis, the Moncrief-O'Donnell Professor of Electrical Engineering, and Associate Professors **Yan Wan** and **Ali Davoudi** received a $220,000 National Science Foundation grant for their work into controlling power networks and other complex dynamic systems more effectively during unexpected events.

Krishnan Rajeshwar, Distinguished University Professor of chemistry and biochemistry, was appointed editor in chief of the *ECS Journal of Solid State Science and Technology*, a publication of the Electrochemical Society.

Civil engineering professor **Sahadat Hossain** won a $1.37 million proof-of-concept contract from TxDOT to use recycled plastic pins to strengthen mechanically stabilized earth walls on North Texas highways.

Muhammad Farooq Wahab, a research engineering scientist, was named to the "Analytical Chemists Top 40 Under 40 Power List" of young analytical scientists, published by the British magazine *The Analytical Scientist*.

Civil engineering Associate Professor **Michael Zaretsky** and College of Architecture, Planning, and Public Affairs Dean **Adrian Parr** secured a $1 million UT System STARs (Science and Technology Acquisition and Retention) grant to further their research in sustainable water management.

Michele Bobadilla, assistant provost for Hispanic student success and senior associate vice president for outreach services and community engagement, received the prestigious 2018 Medallion of Excellence in Education, Science, Medicine, or Civil Rights from the Congressional Hispanic Caucus Institute.

Endel Iarve, professor of mechanical and aerospace engineering, is leading a $1 million U.S. Air Force Research Laboratory grant looking at establishing fatigue and durability standards for materials used in aircraft.

Frank Foss, associate professor in the Department of Chemistry and Biochemistry, and **Regina Urban**, clinical assistant professor in the College of Nursing and Health Innovation, both won the UT System Board of Regent's highest honor, the 2018 Regents' Outstanding Teaching Award for excellence in the classroom.

Andrew Makeev, director of the Advanced Materials and Structures Lab and a professor of aerospace engineering, received two Office of Naval Research grants worth nearly $1.5 million. One is to upgrade UTA's unique computed tomography facilities; the other is to study the physics phenomena governing the manufacturing irregularities or defects in composite parts.

David Hullender, professor of mechanical and aerospace engineering, was named a 2018 Piper Professor by the Minnie Stevens Piper Foundation. The award recognizes outstanding college professors across Texas.

Helping Caregivers

Social work Assistant Professors **Noelle Fields** and **Ling Xu** won a $459,994 National Institutes of Health grant for their research on reducing the burden and stress of caregivers for Alzheimer's patients and increasing their wellbeing and knowledge of the disease. They are working with the Senior Companion Program on the project, part of the Corporation for National and Community Service.

"Family caregivers are the main providers of support to people with dementia, and they are faced with many challenges in their role compared to non-dementia caregivers," Dr. Xu says. "Those challenges include high levels of stress, depression, and anxiety."

She and Dr. Fields hope to create a cost-effective and sustainable intervention that the Senior Companion Program can use across the nation.

"To date, few studies have used lay providers for dementia caregiving interventions and no studies have used the Senior Companion Program as a platform for this type of family caregiver intervention," Fields says. "Our intervention, the Senior Companion Program Plus, adds a component specific to dementia family caregivers."

Illustration by Lara Tomlin

Early Insight

Supporting research experiences at the undergraduate level

Summer research academy

Senior Michael Oladugba spent last summer studying mutations in the DNA of fruit flies at the University of Cambridge as part of the UT System's Summer Research Academy Abroad program.

"I learned important skills that are vital in biology research," he says. "I appreciated the opportunity for this intensive hands-on experience in a top British laboratory."

Previously, Oladugba participated in the Louis Stokes Alliance for Minority Participation's (LSAMP) Summer Research Academy, which qualified him for the abroad program. LSAMP was established to increase the number of underrepresented minority students pursuing STEM careers.

Model student

During her time at UTA, Misty Martin took full advantage of the University's many undergraduate research opportunities. In her first semester, the recent honors graduate in chemistry joined the Achieving Success in Science through Undergraduate Research and Engagement program, which allowed her to participate in drug-discovery research. She also received an Honors College Undergraduate Research Fellowship, a Louis Stokes Alliance for Minority Participation fellowship, and participated in the Summer Undergraduate Research Fellowship program at UT Southwestern's Graduate School of Biomedical Sciences.

"Misty is a model of the quality and tenacity we encourage in undergraduate researchers at UTA," says Kevin Schug, Shimadzu Distinguished Professor of Analytical Chemistry.

Coral Collaboration

Biology undergraduate student Lea Jinks was part of a team of researchers that found a correlation between a strong immune response in diseased corals and a lower expression of genes associated with growth and reproduction. Along with Associate Professor Laura Mydlarz and graduate students Lauren Fuess and Whitney Man, she analyzed full transcriptomes of three healthy and three diseased specimens of *Eunicea calyculata* suffering from Eunicea Black Disease. They discovered that diseased corals showed higher activity among groups of genes that work together around stimulus, immune response, and biological adhesion processes. The team published its findings in *Royal Society Open Science*.

The State of

RESEARCH

at

THE UNIVERSITY OF TEXAS AT ARLINGTON

THE STATE OF RESEARCH

The University of Texas at Arlington was first designated by the Carnegie Classification of Institutions of Higher Education as a Research-1 "Very High Research Activity" institution in 2015. This R-1 status was reaffirmed in late 2018, demonstrating the University's status as a growing research powerhouse and the model 21st-century urban research university.

UTA also reached new highs in research expenditures in 2018, exceeding $100 million for the first time, a growth of 30 percent over three years. Included in that total is $45.3 million in restricted research, a milestone for Texas Tier 1 status that moves the University closer to achieving the coveted designation.

"UTA's research capacities are increasingly recognized by our peer institutions, who are working with us on projects on the cutting edge of modern science and medicine," says Duane Dimos, vice president for research. "These accomplishments come as UTA is consolidating its position as a research authority in the North Texas region. Surpassing the $100 million barrier for overall expenditures is a real step forward for UTA."

UTA RESEARCH INSTITUTE

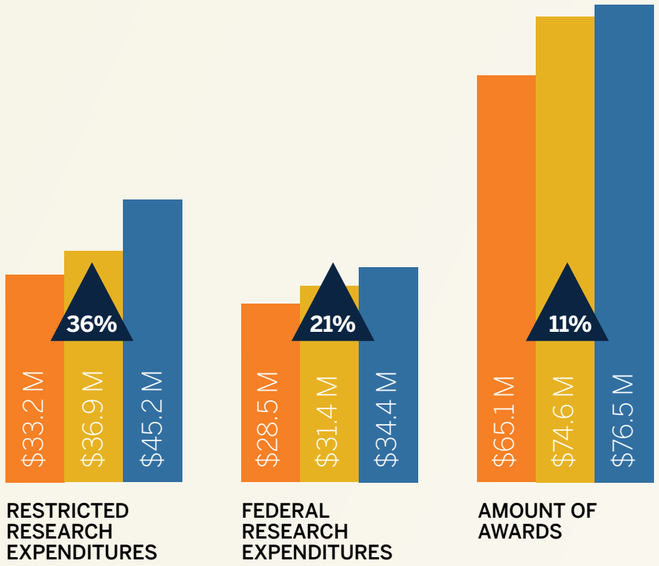
100+
Industry Collaborations in 3 Years

20+
Startup Companies

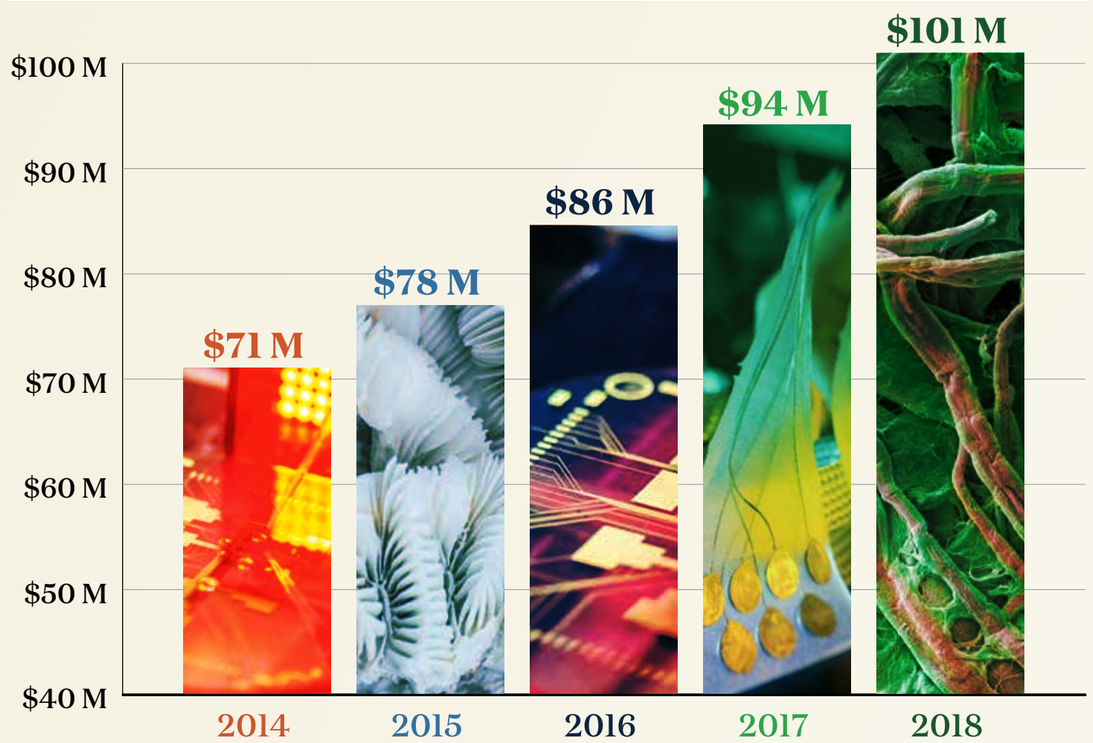
100+
Patents Issued Over 5 Years (with UTA)

RESTRICTED AND FEDERAL RESEARCH EXPENDITURES

for fiscal years 2016, 2017, and 2018

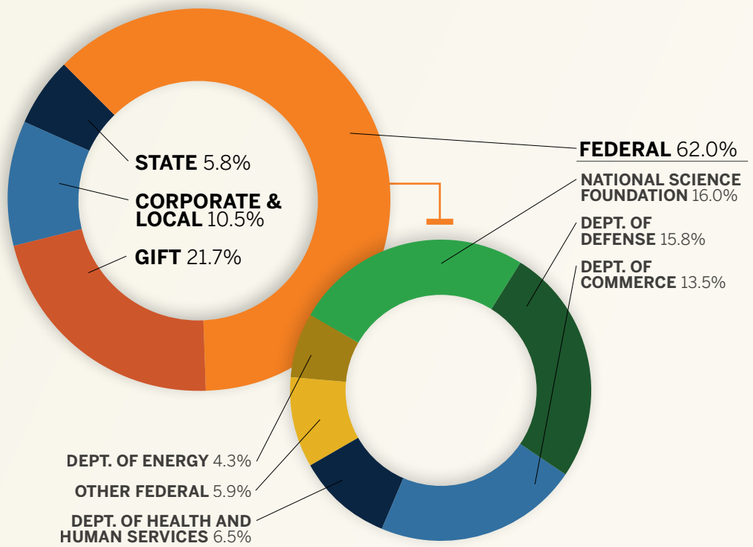


UTA TOTAL RESEARCH EXPENDITURES *by fiscal year*



EXTERNAL RESEARCH EXPENDITURES BY SOURCE

fiscal year 2018



BY THE NUMBERS

UTA is one of only
14 universities
in the U.S. to achieve the designations of **Carnegie R-1 Very High Research Activity** and **Hispanic-Serving Institution**

All of the **College of Engineering's Graduate Programs** are ranked in the
TOP 100
in the nation by *U.S. News & World Report*

The College of Education's **Online Master's Degree in Curriculum and Instruction** is
Ranked #1
in the U.S. (*College Choice*, 2018)

U.S. News & World Report ranked the **Social Work Graduate Program**
#32
in the U.S. for 2019

More than
200
Ph.D. students graduated in 2017-18 for the 5th year in a row

UTA has
15 fellows
of the **National Academy of Inventors**, the most of any Texas university and the
6th most
in the nation

Showcase

Previewing a new work by UTA faculty

This map of New Spain, created by Alexander von Humboldt in 1810, shows the area American revolutionaries hoped to claim.

The Battle of Medina

In his award-winning book, *Arredondo: Last Spanish Ruler of Texas and Northeastern New Spain*, history Adjunct Professor Bradley Folsom explores the life of one of North America's most ruthless leaders. Read an excerpt below.

On August 18, 1813, some 1,400 Mexican revolutionaries and American adventurers pursued 330 Spanish cavalrymen into a grove of oak trees a few miles south of San Antonio, Texas. At the time, Spain claimed Texas as part of its vast American empire. The revolutionaries wanted to change this. They hoped to drive the Spanish army out of Texas and use the province as a foothold from which to bring independence to the rest of Spanish America. [...]. Believing the few cavalrymen to be all that remained of the Spanish army in Texas, and hence, the only thing preventing them from realizing their dreams, the revolutionaries and their American allies followed their prey into the oak grove, unaware they were walking into a trap.

As the pursuers would soon learn, the cavalry were only scouts for a much larger 1,830-man Spanish army that had been sent to Texas to restore royalist rule. While the cavalry were luring the Americans and revolutionaries to the oak grove, the Spanish commander, Brigadier General Joaquín de Arredondo, had aligned the rest of his army in a V formation and given them orders to hold their fire until the enemy came within 40 yards. The royalist soldiers obeyed, watching from concealed positions as the Americans and revolutionaries entered the oak grove and the open end of the V. When they reached the predetermined distance, Arredondo's soldiers opened fire, decimating the front line of the oncoming force and sowing confusion through its ranks. Many revolutionary infantrymen fled. Spanish cannons cut down most of those who did not. American cavalry tried to outflank the Spanish artillery, but Arredondo's more experienced cavalrymen drove them back. After four hours, even the most optimistic among the revolutionaries and Americans realized the day was lost. They fled the battlefield, hoping to reach the Louisiana border and safety within the United States. Most would not make it.

The Battle of Medina, as the clash in the oak grove would come to be known, was one of the deadliest and most one-sided battles in North American history, with some 1,300 of the 1,400 men of the American and revolutionary army dying in the conflict and its aftermath. Joaquín de Arredondo's Spanish forces suffered only 55 dead. The battle was also historically significant. The royalist victory helped suppress the three-year-long revolution against the Spanish colonial government that had raged across northeastern New Spain, and it put on hold hopes that Texas would be independent or become a part of the United States. The Battle of Medina also made Brigadier General Arredondo the most powerful man in northeastern New Spain. i

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