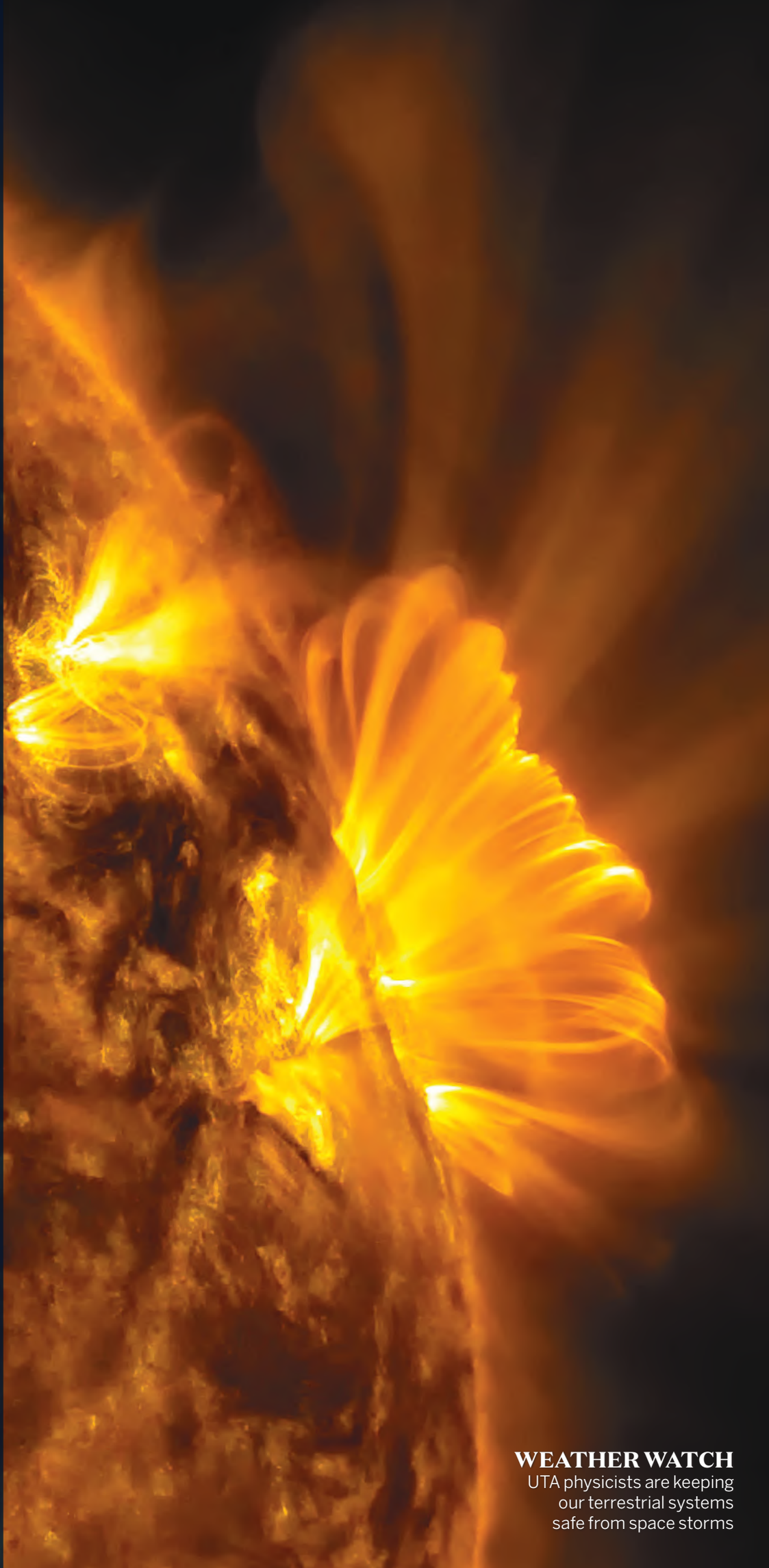
Inquiry

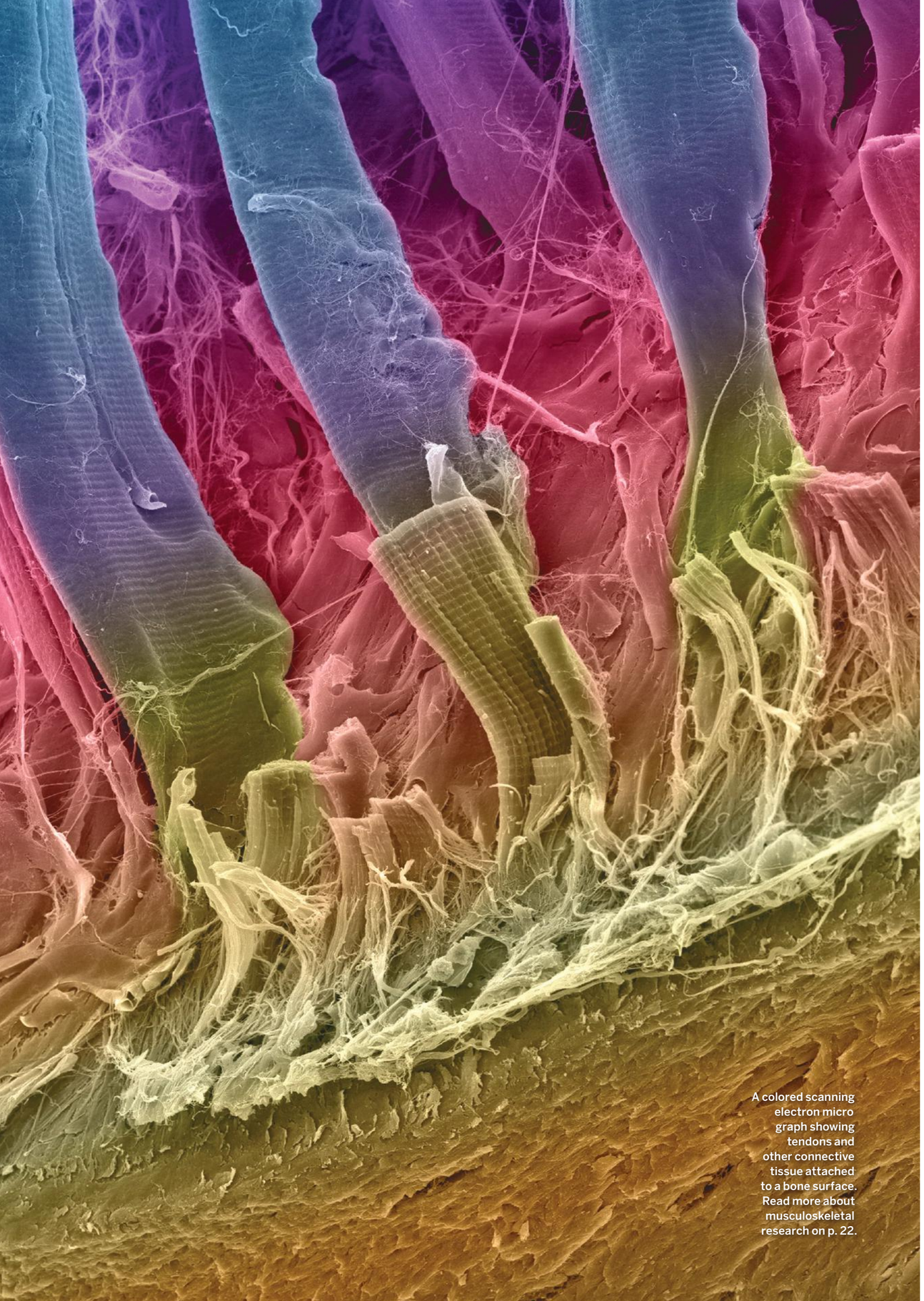


THE UNIVERSITY OF TEXAS AT ARLINGTON

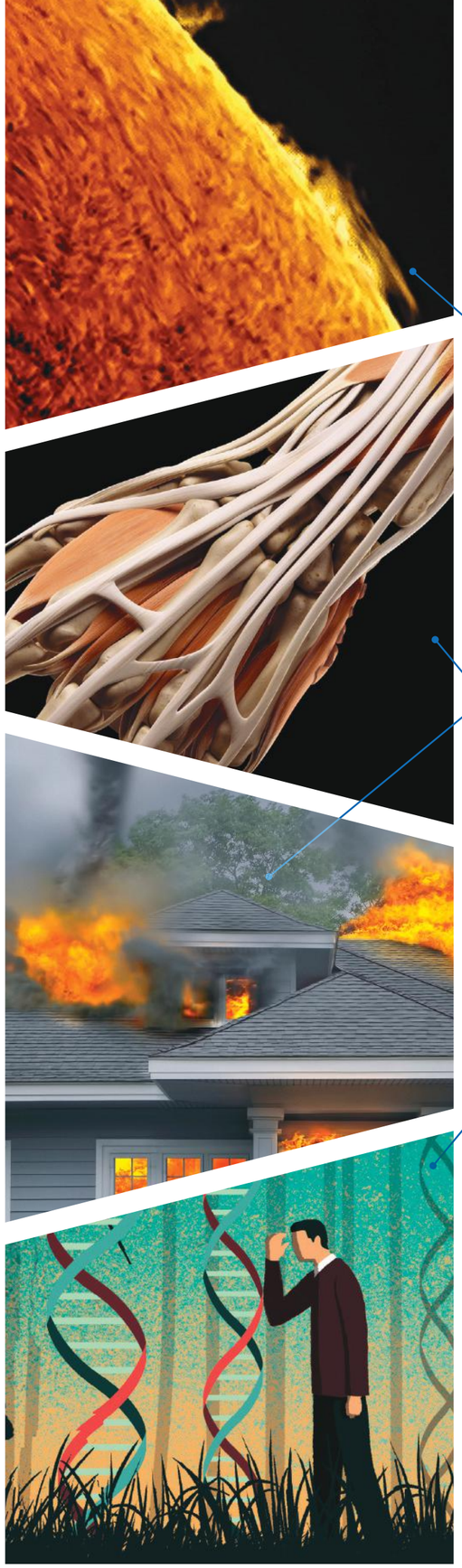
RESEARCH 2020

WEATHER WATCH

UTA physicists are keeping our terrestrial systems safe from space storms



A colored scanning electron micro graph showing tendons and other connective tissue attached to a bone surface. Read more about musculoskeletal research on p. 22.



Inquiry

2020

VP Dispatch

Breaking Barriers

Celebrating a year of growth and excellence

Welcome to *Inquiry*, the research magazine for The University of Texas at Arlington. This edition of *Inquiry* captures the research, growth, and development that placed 2019 among the most transcendent years in UTA's history. We enjoyed marked success thanks to the relentless spirit of discovery that is shared among our faculty, as well as the efforts of our staff and University leadership.

The combined vision and energy of the people at UTA have resulted in groundbreaking discoveries and new projects closely aligned with our strategic plan and its four themes: Health and the Human Condition, Sustainable Urban Communities, Global Environmental Impact, and Data-Driven Discovery. We have forged new ground in solving some of our greatest challenges while elevating the budding researchers and leaders in our student body.

I am perhaps most proud to say that 2019 brought with it a tremendous achievement for UTA: We officially met all criteria to become Texas' next Tier One institution and will be eligible for funding from the National Research University Fund after sustaining the benchmarks for two years. This was made possible by the profound growth and excellence of all who are members of the Maverick family.

While this designation, when official, will present numerous, meaningful opportunities, it will more importantly serve as a signal to the global research community that UTA is a breeding ground for innovation and service through discovery. It demonstrates that we are among the best of the best in our ability to propel people, industries, and communities forward.

Our goals for growth and excellence are fueled by our desire to provide solutions and knowledge that improve the world we live in. Top-tier research universities support prosperity and development for all, and UTA is no exception. Last year was an important one for the University, but there is still much ahead on the horizon for us to pursue. I hope you enjoy this encapsulation of a year of excellence at UTA and stay connected with us as we work to transform the world.

Go Mavericks,

James P. Grover
Vice President ad interim for Research

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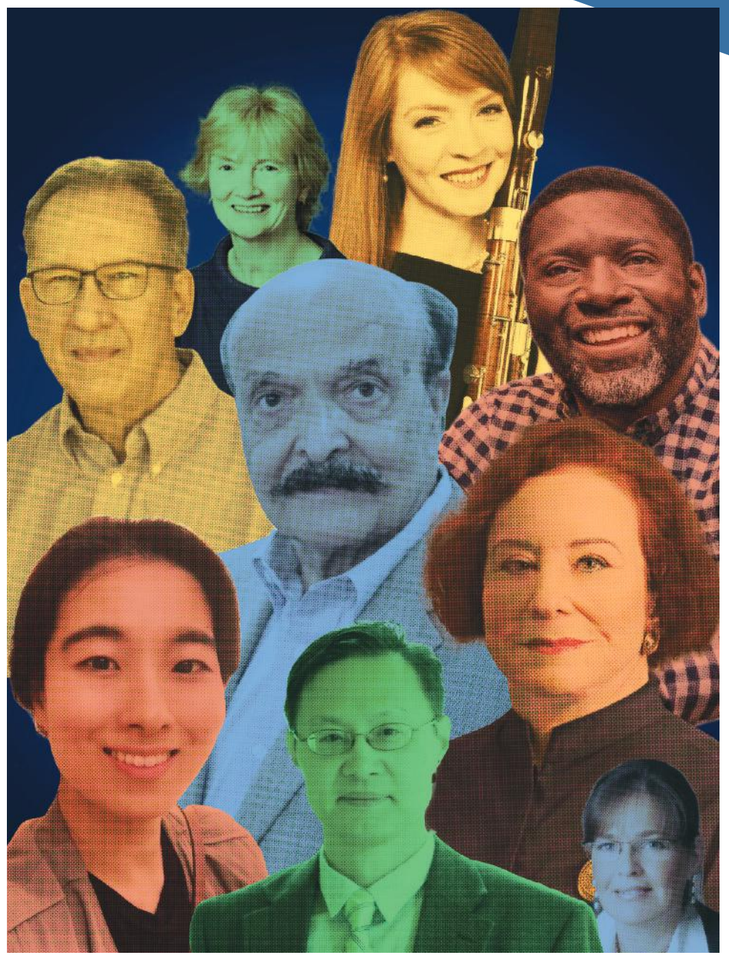
Leading Edge



Research Growth

UTA has bolstered its research portfolio in recent years through a variety of means, such as new infrastructure, new partnerships with industry and academia, and—most importantly—new faculty. More than 100 faculty have joined UTA over the past year, including National Academy members, renowned scientists, and award-winning artists. These educators are filling positions in all eight of the University's degree-granting colleges and schools, where they do important work in line with our four strategic themes. Their collaborative approach to research and instruction will not only help our students receive the education they need to make an impact in the world, but also help support the community through life-changing innovations.

Aiding Older Adults

A trio of UTA researchers is working to improve transportation for older adults in DFW assisted-living communities.

Assistant Professors Caroline Krejci (industrial, manufacturing, and systems engineering), Kate Hyun (civil engineering), and Kathy Lee (social work) are analyzing data from various sources to identify available transportation access and options for older adults. They then plan to survey older adults to better understand their mobility needs, potential barriers, and other issues.

Special Education

Over the next five years, UTA's College of Education and School of Social Work will use a $1.08 million grant from the U.S. Department of Education's Office of Special Education Programs to create an interdisciplinary master's-level personnel preparation cohort. These graduate students will be trained to work with and serve grade-school children with disabilities and high needs.

Assistant Professors Jandel Crutchfield, Ambra Green (principal investigator), and John Romig are involved in the project.

Illustration by Lara Tomlin

Health and the Human Condition

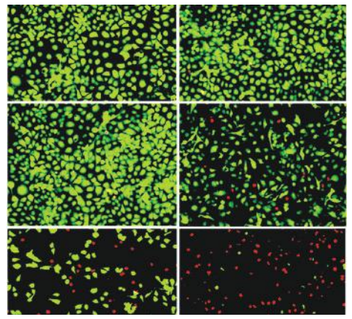
A century ago, the average American lived about 55 years. Today, we are likely to make 80. Unrelenting scientific curiosity and exploration have made this dramatic increase possible and led to life-saving breakthroughs in the diagnosis and treatment of diseases and other ailments. But progress that improves 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 well-being.

QUICK HITS

UTA hosted its first International Symposium on Traumatic Brain Injury Mechanisms and Protections in April. The event, which brought researchers and experts from across the globe, was chaired by Associate Professor **Ashfaq Adnan**.

Social work Senior Associate Dean **Debra Woody** won a $1.3 million grant to train addiction recovery specialists. The award is part of the U.S. Health Resources and Services Administration's Opioid Workforce Expansion Program.

Assistant Professor **Cara Boutte** is creating a comprehensive model of mycobacterial cell wall regulation to better understand how it responds to stress. The project has important implications, as mycobacteria have developed immunity to many antibiotics.



KILLER WAVES

Novel cancer treatment uses microwaves to trigger cell death

Physicist Wei Chen believes he's found a new way to treat cancer cells. He and a team of international collaborators recently published a paper in *Nanomedicine: Nanotechnology, Biology, and Medicine* advancing the idea of using titanium dioxide nanoparticles stimulated by microwaves to cause the death of cancer cells without damaging healthy cells around them.

Called microwave-induced radical therapy, the new method centers on reactive oxygen species (ROS), a natural byproduct of the body's metabolism of oxygen. Using light to activate ROS can be challenging for the treatment of tumors deeply located within the body. In contrast, microwaves have the ability to create deeper penetration that moves through all types of tissues and non-metallic materials.

"This new discovery is exciting because it potentially creates new avenues for treating cancer patients without causing debilitating side effects," Dr. Chen says. "This targeted, localized method allows us to keep healthy cells intact so patients are better equipped to battle the disease."

FRACTURED

Professors studying heart failure

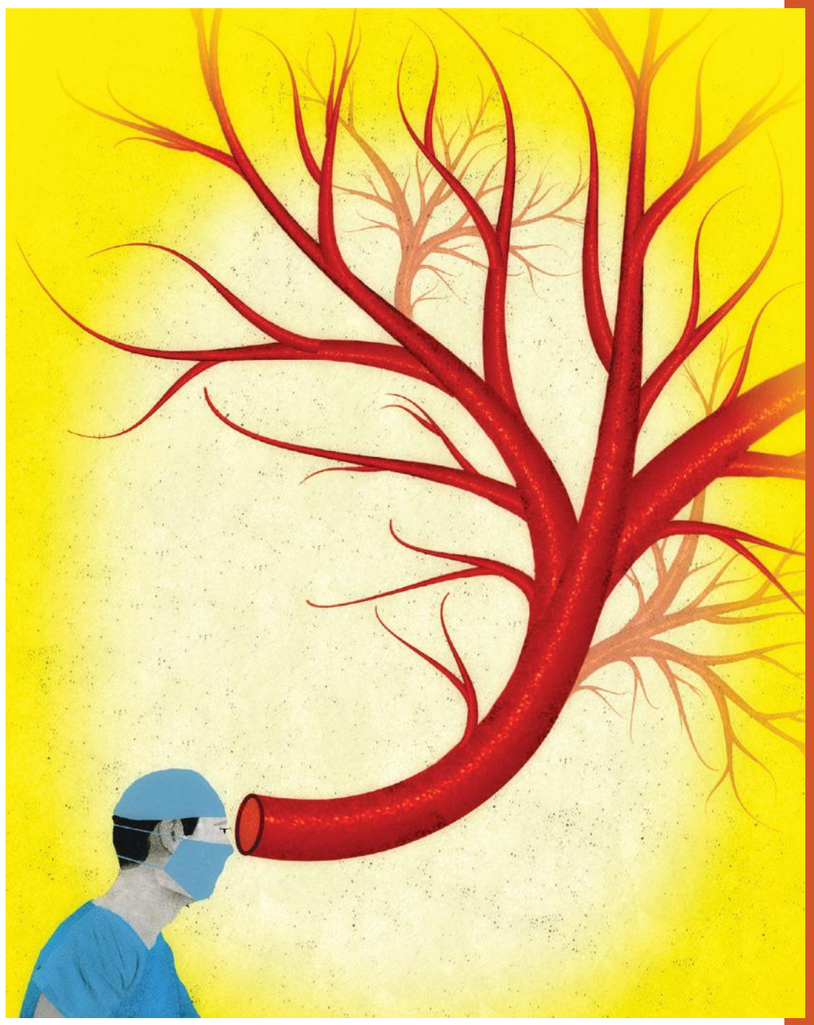
Researchers from UTA and UT Southwestern Medical Center (UTSW) are teaming up to study what has become the fastest-growing type of heart failure.

Kinesiology Associate Professor Michael Nelson and Professor Paul Fadel are part of an $11 million National Institutes of Health project to study the mechanisms of exercise intolerance in heart failure patients with preserved ejection fraction (HFpEF), a condition in which the heart pumps normally but is too stiff to fill properly.

HFpEF is found mostly in older individuals, and its mortality rate is high.

"These patients have reduced quality of life and lowered tolerance for the activities of daily living," says Dr. Nelson. "We are taking a whole-body, interdisciplinary approach to work as a team and address this problem head-on."

Nelson, Dr. Fadel, and their colleagues at UTSW are focusing on identifying common characteristics among HFpEF patients based on cardiac, pulmonary, and skeletal muscle limitations that impede their ability to exercise. The goal is to determine the best therapies for these patients.



RX SUCCESS

"The interventions developed will be tested and evaluated in simulated and actual primary care settings."

Focused on medication safety

Each year in the United States, the unsafe use of medications leads to over 700,000 emergency room visits, according to the National Electronic Injury Surveillance System. But a group of UTA researchers hopes to dramatically reduce that number through novel interventions, especially among patients 65 and older.

The University is leading the Partnership in Resilience for Medication Safety Learning Lab, a consortium funded by a $2.5 million grant from the Agency for Healthcare Research and Quality. Other members include Johns Hopkins University, JPS Health Network, and the University of North Texas Health Science Center.

"The whole focus is on medication safety through a partnership approach," says Professor and patient safety specialist Yan Xiao, who oversees the lab. "The interventions developed will be tested and evaluated in simulated and actual primary care settings."

Co-principal investigators are nursing Associate Professors Kathryn Daniel and Jing Wang, business Professor Kay-Yut Chen, and engineering Assistant Professor Yuan Zhou.

Illustration by Brian Stauffer

WATER WORLD

Fighting coastal flooding

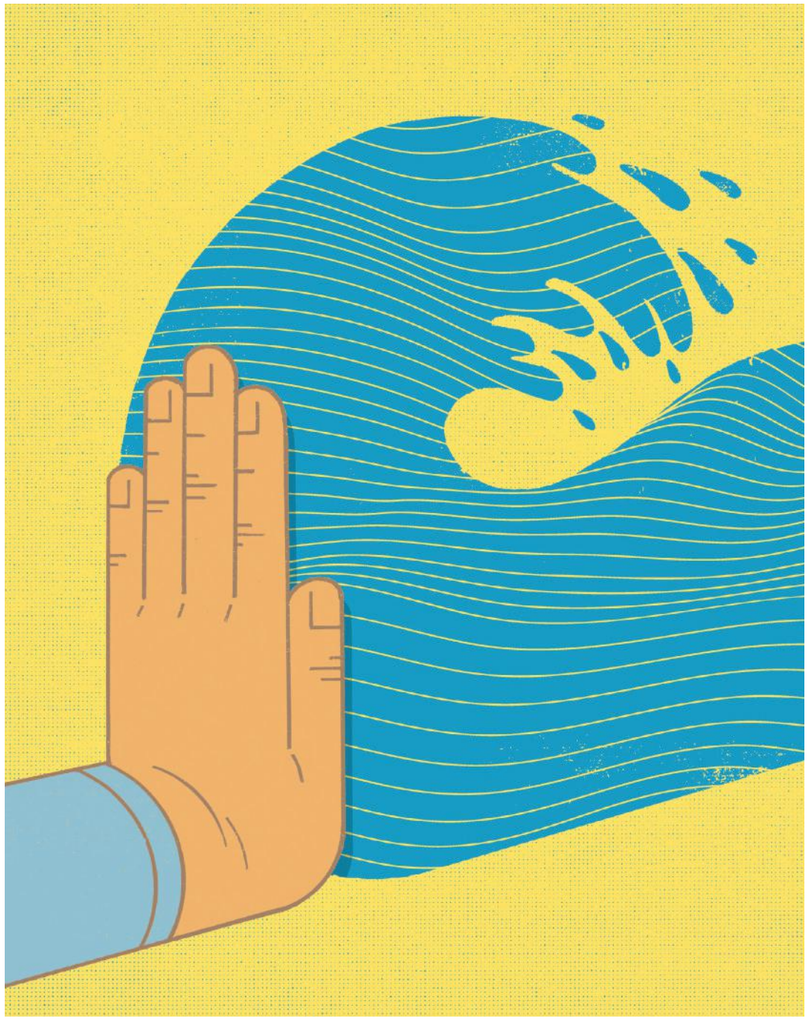
With sea levels rising around the globe, coastal areas are experiencing more frequent flooding and—as a consequence—increased damage to urban infrastructure and natural areas.

Civil engineering Assistant Professor Michelle Hummel and her research partner, Kevin Befus of the University of Wyoming, are looking to nature to find ways to help turn back the tide.

"The critical thing is to understand if nature-based approaches and their benefits are as effective as engineered approaches," Dr. Hummel says. "We're trying to find strategies that will mitigate coastal flooding and be sustainable in the long term as sea levels rise."

She and Dr. Befus are identifying how natural features (e.g., sand dunes, marshes, wetlands), gray infrastructure (seawalls, levees, detention ponds), and nature-based features (man-made structures that mimic natural features) might be used alone or in combination to control local flood hazards in Santa Monica Bay and Humboldt Bay in California.

They will create an integrated modeling framework to determine how different shoreline measures affect the physical processes that control surface and groundwater flooding.



ROAD WARRIORS

Cities and counties will use Romanoschi's results to write construction requirements for contractors.

Recycled asphalt put to the test

Stefan Romanoschi and the Texas Department of Transportation (TxDOT) have teamed up to test the durability of roads made from recycled asphalt.

Several years ago, the civil engineering professor built a portable accelerated pavement testing machine that can run a full-sized truck axle back and forth over a pavement test section every six seconds, or more than 100,000 times in a week. It allows researchers to simulate road stress at full-scale and measure durability more efficiently than current methods.

With funding from a two-year, $1.26 million TxDOT grant, Dr. Romanoschi and researchers from the Texas A&M Transportation Institute will use the machine to determine which mixes of recycled asphalt last longer and work better on the surface layers of Texas roads, as well as how they perform under various truck traffic, temperature, and moisture conditions.

The pavement testing center greatly reduces the amount of time needed to determine which asphalt mixture design is better. Cities and counties will use Romanoschi's results to write construction requirements for contractors that maximize the life of roads.

GROWTH

Helping farmers thrive

For small-scale farmers and ranchers in Texas, it can be a challenge just getting products to the market.

Caroline Krejci, an assistant professor in the Industrial, Manufacturing, and Systems Engineering Department, is using a grant from the USDA Sustainable Agriculture Research & Education program to explore how to solve this problem through collaborative transportation and the creation of virtual logistics communities.

"We want to help family farms and ranches figure out how to efficiently transport their products to customers throughout their respective regions," says Dr. Krejci. "The long-term goal is to connect them and build a network of producers across the state to leverage regional variations in growing seasons and products."

She is working with farmers in three Texas regions who have already begun collaborating with others in their communities to create better ways to transport food. Krejci hopes to help them determine how to make these collaborations more efficient and resilient.

"It's a balance between efficiency and the social aspect of making sure that farmers can thrive and earn a living."

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.

QUICK HITS

The **College of Architecture, Planning, and Public Affairs** held a "Future Cities, Livable Futures: Toward a Sustainable Model for Urban-Watershed Systems" conference in August. Co-sponsors were the National Science Foundation and UNESCO.

Civil engineering Professor and Chair **Ali Abolmaali** and the city of Waxahachie are collaborating on robotic inspections of several miles of the city's sewer pipelines.

Mohammad Najafi, director of the Center for Underground Infrastructure Research and Education, is collaborating with the Indian Society for Trenchless Technology to solve leakage problems in the pipes that channel stormwater to energy plants.

Illustration by Dan Page

SUNK

Uncovering submerged civilizations

To better understand the social organization of caribou hunters who lived 9,000 years ago, Ashley Lemke is looking beneath the surface—literally.

The assistant professor of anthropology received funding from the National Science Foundation to survey and excavate ancient hunting sites in the Great Lakes that she believes could be a travel route for hunters and caribou.

"There's a sunken forest in Lake Huron, so as I'm discovering tools and hunting structures, I'm seeing the landscape as these people saw it 9,000 years ago," says Dr. Lemke.

In separate projects, she is using virtual reality technology to show indigenous people in Alaska what the landscape looked like when their ancestors lived on it and is exploring areas in North Carolina for evidence of prehistoric people in the Atlantic.

"The sites I study are underwater due to changes in our climate, and we're facing similar issues now," Lemke says. "With underwater archaeology, we can study the past and see how people adapted or responded as the land around them changed."

BRIDGED

"Sediment released from bridge construction might ... cause habitat to suffer downstream."

The ecological impact of bridges

A group of UTA civil engineers is studying the impact of bridge construction projects on stream ecology through a grant from the Texas Department of Transportation (TxDOT).

Assistant Professor of Instruction Habib Ahmari, Associate Professor Xinbao Yu, and their team will conduct a baseline study of stream morphology and aquatic habitat before a bridge is built, then what happens during bridge construction and after it is complete.

Their goal is to develop a predictive model for TxDOT that can be used to determine the downstream ecological impacts of bridge construction to support more effective project planning.

"Sediment released from bridge construction might change the sediment loading in receiving streams and cause habitat to suffer downstream of these bridges," Dr. Ahmari says. "We have to determine the impact of bridge construction on freshwater mussels, which are natural filters of the water in rivers and streams. It's a very important species to have in a river or stream because it shapes the ecosystem and clarifies water for other species."

The team is partnering with Texas A&M AgriLife Research for the project.

GOLDEN

Making artisanal mining safer

In small towns in Colombia and Peru, where artisanal and small-scale gold mining (ASGM) is a way of life, workers often use techniques that have been passed down through the generations. But these tried-and-true methods can also be deadly.

In ASGM, ore is often processed with mercury, a substance toxic to both humans and the environment. Past efforts to change this practice have largely failed, most likely because the potential solutions were created by outside engineers and environmentalists without input or insight from the communities that would be using them.

Civil engineering Associate Professor Kate Smits and doctoral students Michelle Schwartz and Jose Valesquez are part of a team of engineers and social scientists working with local researchers and educators to make the mining process safer and more environmentally friendly while allowing the communities to continue their ancestral way of life.

"These are not simply improved technologies and techniques, but new social organizations and networks of people that make ASGM cleaner, safer, and more sustainable," Dr. Smits says.

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.

QUICK HITS

Three recent studies published by Shimadzu Distinguished Professor of Analytical Chemistry **Kevin Schug** and his team indicate that wastewater produced during hydraulic fracturing may be recycled and treated for reuse by forward osmosis.

Majie Fan, associate professor of earth and environmental sciences, is studying the role a mountain range in Mexico plays on the formation of a major weather pattern affecting North America.

Sophia Passy, associate professor of biology, and postdoctoral researcher **Katrina Pound** published an article on the biological consequences of stream acidification in the Adirondack Mountains in *Diversity and Distributions*.

Illustration by Stephan Schmitz

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.

QUICK HITS

Kyungsuk Yum, assistant professor in the Materials Science and Engineering Department, received a five-year, $500,000 National Science Foundation CAREER award to design and develop bioinspired 3D materials with programmed shapes and motions.

David Arditi, an assistant professor of sociology, is working to preserve North Texas' independent music scene through MusicDetour, a digital depository for music created and performed in the Dallas-Fort Worth area.

Electrical engineering Professor **Weidong Zhou** is using a $450,000 Army Research Office grant to determine the minimum amount of energy required to develop high-speed and energy-efficient lasers based on nanophotonic cavities and nanostructured materials.

FACT CHECK

Professor leading program to debunk misinformation

For the past several years, computer science and engineering Professor Chengkai Li has been developing an electronic fact-checking system called ClaimBuster, which monitors news to catch factual claims and find matches with a curated repository of fact-checks from professionals. Now, he is leading a $998,870 National Science Foundation Convergence Accelerator Pilot program to deliver verifiably credible, open-knowledge networks.

"Our goal is to ensure credibility, integrity, completeness, and truthfulness so people accessing the knowledge network can be confident that the information provided is correct," Dr. Li says.

He is working with researchers from a number of other universities on the project, as well as with institutions such as the Pacific Northwest National Lab, Army Research Lab, IBM, and Amazon.

"The Convergence Accelerator initiative is an exciting new approach to discovery," says engineering Dean Peter Crouch. "Dr. Li and his collaborators at UTA and across the country have a unique opportunity to provide an impactful service to the public."

RED FLAG

The ultimate goal is to use the information to describe and predict patterns among offenders.

A database of teacher misconduct

To improve hiring practices for teachers, inform policymakers, and ensure student safety, Catherine Robert is developing a database with information about Texas certified educators who have engaged in sexual misconduct during the last two decades.

The assistant professor of educational leadership and policy studies—in partnership with David Thompson at UT San Antonio—is providing empirical data on educator sexual misconduct that can help policymakers. The goal is to use the information to describe and predict patterns among offenders.

"This data can directly inform how we prepare new and current teachers to ensure the safety and well-being of students," Dr. Robert says.

For example, she and her team have already found that 36% of sanctioned teachers were in their first year of teaching in their school districts, and more than half were coaches, band directors, or extracurricular sponsors.

The grant also entails the development of training programs for staff in maintaining appropriate boundaries with students and identifying so-called "grooming" behaviors.

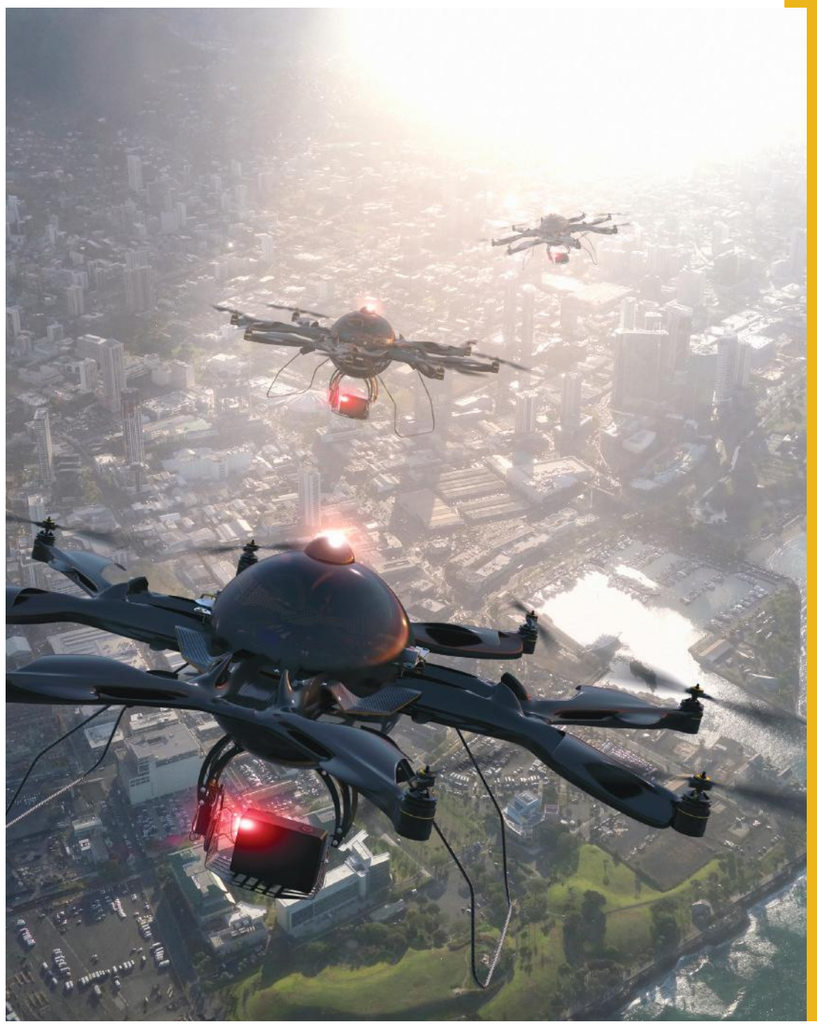
FLIGHT SCHOOL

Making UAVs more efficient

Electrical engineer Yan Wan is teaching drones how to be a team. For her National Science Foundation CAREER award, the associate professor investigated networking solutions to enable multiple unmanned aerial vehicles (UAVs) to accomplish a single goal with limited physical resource constraints. One of the findings was recently published in *IEEE Transactions on Control of Network Systems*.

"We found that layered structures—in which multiple groups of UAVs communicate with one another through group leaders—are very promising to control networked UAVs," Dr. Wan says. "We proved that such structures can significantly reduce communication throughput while still allowing efficient completion of distributed control tasks."

Her research, while still in the theoretical stages, could have an impact on the design of future unmanned vehicle networks—even, potentially, UAVs that work without human controllers. Understanding how to build networks that consider both control and communication needs would increase efficiency, reduce throughput requirements, and improve network management capabilities.



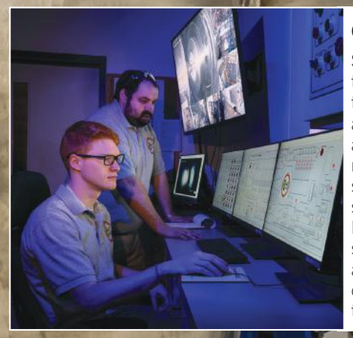
Closer Look

Testing
Test articles are inserted in the high-speed and high-temperature gas and exposed to conditions similar to planetary entry or re-entry.

Collection
The hot and supersonic gas is collected and aerodynamically slowed down to subsonic values. It is then cooled by powerful heat exchangers and processed by a deep-vacuum station.

Input
The plasma (air or carbon dioxide to simulate atmospheric entry on Mars) is accelerated to hypersonic flow conditions, the equivalent of Mach 12.

Pressurized
Capable of reaching near vacuum pressures, the chamber allows researchers to test at conditions equivalent to high-altitude flight.



Control Room
State-of-the-art technology is used to remotely operate the facility from a blast-resistant room. Hundreds of sensors are constantly monitored by the integrated system, and operations are carried out on multiple touch screens.

Instruments
Advanced instrumentation spans from classic calorimeters to cutting-edge femto-second lasers that non-intrusively probe the reacting gas' composition and velocity.

Warm-Up
Up to 1.6 MW of electrical power is used to heat the test gas. Temperatures higher than the surface of the sun can be obtained (10,000 degrees Fahrenheit).

LAST YEAR, UTA brought its new arc-heated, hypersonic wind tunnel online. The only one of its kind in the nation at a university, the tunnel is being used to develop advanced laser-based measurements of plasma flow for the study of heat shields for hypersonic vehicles. The tunnel was entirely designed at the UTA Aerodynamics Research Center by Professor Luca Maddalena and his team, which over the past four years has included postdoctoral researchers Stefano Gulli, Fabrizio Vergine, and Davide Viganò; doctoral students Vijay Gopal and Daniel Palmquist; alumnus David Campbell; undergraduate students Cooper Green, Ian Raybon, Rachel Weeresinghe, and Skyla Westphal; and lab manager David Carter.

FORECAST: SOLAR FLARE

Space weather such as solar wind and geomagnetic storms can rattle power grids and communications systems here on Earth. Scientists at UTA are working to keep our systems running by improving forecasting and increasing our understanding of these powerful events. **BY SARAH BAHARI**

IN MARCH 1989, a powerful explosion rocked the surface of the sun. Moments later, a billion-ton cloud of gas began hurtling toward Earth. When the particles crashed into our magnetic field, they triggered brilliant auroras—also known as northern lights—and one of the most severe geomagnetic storms in modern times.

That solar storm generated electrical currents in the ground beneath much of North America, tripping circuit breakers. Millions of people in northeastern Canada lost power. A blackout blanketed Quebec, shutting down businesses, schools, airports, and subways. Power transformers in New Jersey melted.

If a similarly powerful storm struck today, the consequences likely would be even more damaging. In addition to long lasting power outages, communications satellites could be disabled, telecommunications cables destroyed, and GPS signals tangled.

Yet scientists say it is impossible to predict when the next major storm will strike Earth. We can, however, improve our forecasting, and that's exactly what physicists at The University of Texas at Arlington are doing through their research on strengthening space weather models and boosting our understanding of space weather events.

Space weather forecasting is about 50 years behind terrestrial weather forecasting," says physics Assistant Professor Dan Welling. "Fortunately, we are making enormous strides in building more sophisticated space weather models needed to protect our infrastructure.

Photo by Barcroft Media / Getty Images

With a cadre of renowned space physicists, UTA is forging a leading role in space weather research. Scientists have earned millions of dollars in research grants and important professional accolades, reflecting UTA's commitment to data-driven discovery, one its four strategic pillars.

"UTA has solidified its role as a key player in the field of space physics," says Alex Weiss, professor and chair of the Physics Department. "Our scientists are helping to unravel the mysteries of how extreme space weather events affect the Earth's atmosphere, which is directly related to the safety and security of our communities."

PREDICTING SOLAR FLARES

When a solar flare erupts on the sun, it sends charged particles barreling through the universe. Three days and 100 million miles later, the particles reach Earth, where they rattle the magnetic field.

Physics Professor Yue Deng is leading a national effort to develop a space weather simulator capable of predicting how energy is distributed in the upper atmosphere during such events.

"Space weather is very important to society's infrastructure, but there is still much we do not know," she says. "This is an important opportunity to improve our ability to predict space weather's effects with much higher accuracy and detail."

For the project, Dr. Deng assembled a team of scientists from across the country, including the University of California at Los Angeles, Johns Hopkins University, the Massachusetts Institute of Technology, the University of Colorado at Boulder, the University of New Mexico, and UT Dallas. The team won a $7.3 million grant from the Department of Defense's Multidisciplinary University Research Initiative to fund its work.

The goal is to better predict density, momentum, and energy distributions during space weather events in the upper atmosphere to an accuracy of 1 degree longitude and 1 degree latitude—about 62 miles in each direction.

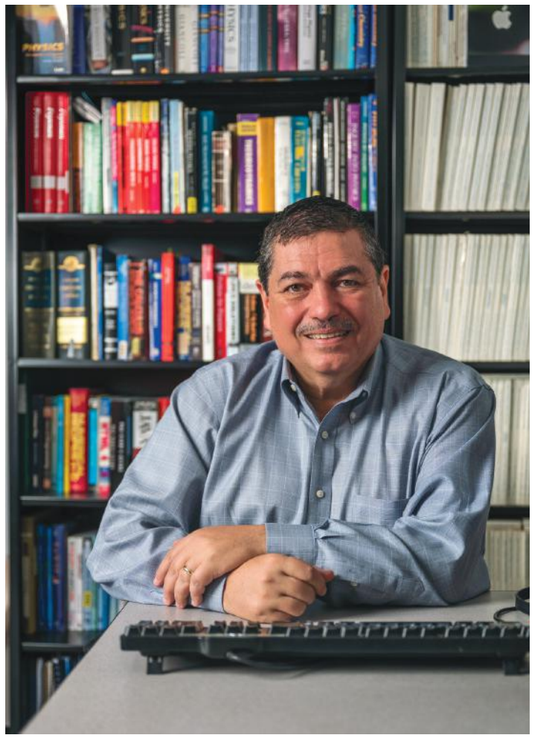
Current estimates of the energy entering the upper atmosphere during times of greatest solar output can be off by 100%. That in turn can throw off the models used to predict trajectories and track neutral density in a specific region by up to 30%, wreaking havoc on GPS and communications systems.

To improve modeling, Deng studies weather events on a smaller scale, both spatially and temporally, while combining new techniques with current knowledge and models. Previously, she helped develop the Global Ionosphere-Thermosphere Model, which yields a 3D look at how electrodynamic energy from solar winds influences the Earth's upper atmosphere.

Ultimately, this work could help operators of satellites, communications systems, air traffic radar, and electricity grids know how to best protect their systems from solar flares or coronal mass injections, in which the sun releases an avalanche of electrons and protons.

"We hope to one day be able to accurately predict solar weather events," Deng says. "If not properly anticipated, solar flares and coronal mass injections can disrupt a number of critical systems worldwide, from our defense satellites to flight programs."

Clockwise from left: **Ramón López, Yue Deng, and Dan Welling are focused on predicting and measuring space weather.**



MEASURING SPACE STORMS

How scientists measure space storms is a critical piece of the puzzle. Physicists have long relied on what is called the disturbance storm time index (Dst) to evaluate the strength of the current around Earth caused by solar wind energy entering the magnetosphere. Now, Professor Ramón López is working to develop a new, more relevant classification system for geomagnetic storms.

"Measuring changes to the geomagnetic field is critical to understanding these storms," Dr. López says. "With our current classification system, we do not have the full picture of what is happening."

Solar winds move from the sun to Earth's upper atmosphere, unleashing a torrent of energy. López is particularly interested in storms where large amounts of energy are dissipated in the ionosphere, because activity there can have significant consequences on space weather. (The ionosphere is the layer of the Earth's atmosphere about 40 miles to 600 miles above the surface.)

Studying past real-life space weather events, he uses computer simulations to create a comprehensive model that illustrates the transfer of energy related to the solar wind.

"Our current models do a fine job of measuring the size of small storms. But there is a disconnect that occurs with large-scale storms, and that is what we are addressing," López says. "A more relevant measure than Dst would help us better understand how these storms affect our technology on Earth."

SIMULATING WEATHER SEQUENCES

In 1972, U.S. military pilots flying in North Vietnam witnessed something unexpected—more than two dozen sea mines suddenly, and without reason, exploded in the water.

Scientists later concluded that the explosions were likely triggered by a solar storm that also caused widespread electrical and communication disturbances throughout North America. Today, using data from that event, Dr. Welling is piecing together a picture of the storm through simulation.

"The big challenge with space weather is observation. In terrestrial weather, we have instruments everywhere to measure rainfall, wind velocity, and temperature," he says. "In space weather, we have some instruments on the ground to measure the effects of the magnetic field and a handful of satellites in space at a time. It's much more difficult to get a clear picture of solar wind conditions."

To overcome the challenge, Welling runs hundreds of simulation sequences, then develops inferences. Further, he studies worst-case scenarios. For example, he is currently completing a project with Los Alamos National Laboratory in New Mexico to determine which regions of the world—and specifically, which power grids—would be the most vulnerable to a major solar storm.

"We essentially study little perturbations that can be big trouble for a power grid," he says. "Working alongside geologists, we use characteristics of electrical conductivity in the ground to determine which areas are most at risk."

"UTA is a true powerhouse for space-related research, helping to drive critical discoveries that will have a lasting impact."

COVERING THE SPACE SPECTRUM

UTA's space-related research doesn't end at weather. Faculty from across campus are studying various issues important to our understanding of the universe.

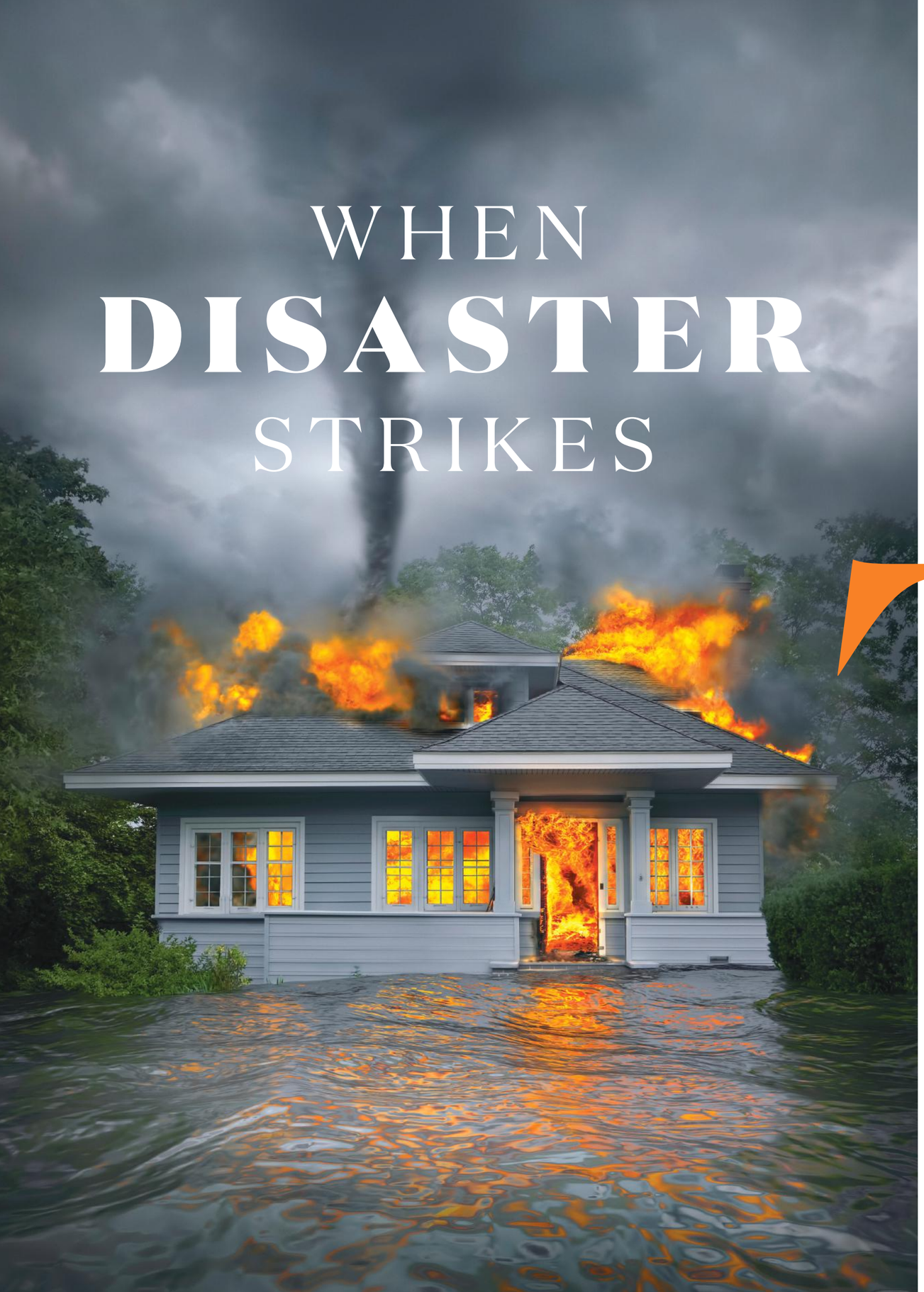
For example, over the past year, Purnendu "Sandy" Dasgupta, the Hamish Small Chair in Ion Analysis, engineered a device that collects drops of liquid as it travels through space and analyzes the content for conditions that support life, while bioengineering Professor Hanli Liu launched a project to improve memory and cognitive function in astronauts during space missions by directing light onto their brains.

More recently, an international team of astrophysicists that includes physics Professor Zdzislaw Musielak found the first verified presence of confined "pseudo-shocks" around a sunspot. The discovery could help explain longstanding questions about the reasons for the vast difference in temperature between the sun's surface and its corona, the outermost part of its atmosphere.

Morteza Khaledi, dean of the College of Science, believes the work of these scientists and engineers demonstrates the University's impressive breadth of expertise in space-related research.

"UTA is a true powerhouse for space-related research, helping to drive critical discoveries that will have a lasting impact," Dr. Khaledi says. "The work of our scientists has the potential to transform not only our understanding of the universe, but also how Earth fits into this incredibly complex picture." i

WHEN DISASTER STRIKES



During natural disasters, cities and their citizens must contend with myriad decisions that affect resilience and survivability. UTA researchers are guiding them along the way.

BY AMBER SCOTT

The day disaster strikes usually starts like any other. Normal routines unfold within cities built to sustain them. People make their way through the actions of daily life, rarely giving even a passing thought to the systems that make it possible.

But then, something changes: The rain is torrential; the tornado drops down from nowhere; the ground rumbles. When disaster strikes, the strengths of our infrastructure—or lack thereof—become readily apparent. Were our social, economic, and physical systems prepared? If they weren't, the consequences can range from severe economic and infrastructural damage to the devastating loss of human life.

While researchers at The University of Texas at Arlington can't prevent disasters from hitting our cities, they can help decision-makers at the local, state, and national levels make the right calls—and ultimately mitigate the damage. Professors from a variety of fields, including political science, civil engineering, and social work, are examining disaster preparation, response, and recovery to ensure citizens and cities are safe.

Risky Business

Every day, we drive on roads and walk on sidewalks that cover a vast and intricate maze of pipes beneath us. In the U.S., there are approximately 1.6 million miles of water and sewer pipes; by 2020, their average age will be 45 years. If an earthquake were to strike, these pipelines would be particularly vulnerable, as they weren't built to modern earthquake-resistant standards.

"Imagine you're a water utility employee and someone comes to you with $2 million so you can rehabilitate your pipelines," says Mohsen Shahandashti, assistant professor of civil engineering. "You know you can get earthquake-resistant pipes, but it will be very expensive—you couldn't do it for the whole city. If you're lucky, you could replace 1% of the pipes you have. So where do you start?"

Dr. Shahandashti hopes to provide a starting point through the development of an algorithm that models the effects of earthquakes on water pipeline infrastructure. His research will aid decision-makers in determining how best to use limited infrastructure funding to make pipelines less prone to earthquake damage.

Borrowing from principles of quantitative finance, Shahandashti and his co-principal investigators—industrial, manufacturing, and systems engineering Professors Jay Rosenberger and Victoria Chen and civil engineering Professor

Simon Chao—are working to minimize the risks associated with choosing which pipes to work on and replace first.

"Turning to finance research was motivated by the problem. Utility managers have a huge responsibility, so they are looking for the best and least risky decision," Shahandashti says. "Is there a way to limit this risk? That is the question I seek to answer."

Water Works

In recent years, the nation has seen an increase in so-called 100-year floods, resulting in major damage to cities.

"A distinct feature of climate change is that you suffer from long-term drought, and rainfall happens in short duration," says Nick Fang, assistant professor of civil engineering. "Average annual rainfall may remain pretty much the same, but it's coming all at once instead of over time. City codes implemented years ago aren't designed for this—they just can't handle it."

Dr. Fang, who has conducted extensive research on flooding and Texas watersheds, recently received a Texas General Land Office grant to analyze regional drainage and propose recommendations for future flood prevention in nine southeast Texas counties. He and his team will collect existing topographic and geographic information system data, build them into a dashboard, then work with the local communities and their leaders to develop water strategies.

"What we are looking for are possible changes to coding or zoning practices that will prevent or lessen regional flooding damage during future natural disasters," says Fang, who is collaborating with UT San Antonio's Hatim Sharif on the project.

"Many times, communities don't have sufficient resources to address these issues," he continues. "Universities like UTA step in and can assist them in an effective way."

While Fang helps communities better manage flood water, another civil engineering professor at UTA, DJ Seo, helps the National Oceanographic and Atmospheric Administration (NOAA) and the National Weather Service (NWS) better predict the amount of water that will arrive during major weather events like hurricanes or flooding.

He is working on a way to take forecasts and metrics from multiple sources and merge them into a single dataset. The aim is to create a forecast that will be more easily understood and useful, thereby helping emergency managers make the best decisions possible based on the most complete information.

"Forecasting water is becoming increasingly more important because manmade changes to the land surface and climate change are making hydrologic prediction more difficult," explains Dr. Seo. "At the same time, the impact is becoming larger due to growth of population and the built environment."

Let it Snow

Adding further complexity to flood forecasting is the impact of snowmelt-driven runoff on water levels. Many variables can affect these predictions, including precipitation type, snowpack attributes such as density and grain size, and the movement of meltwater through soil.

Civil engineering Assistant Professor Yu Zhang is helping forecasters improve predictions and issue more accurate, timely, and effective warnings by combining snowpack and hydrologic modeling capabilities in the NWS.

> *"Disaster is not normal business. The question is how to survive."*

His research could create a paradigm for ingesting remotely sensed snow data from NOAA's Joint Polar Satellite Systems into the National Water Model.

"Snow is the biggest wildcard because there are so many things that can go wrong," Dr. Zhang says. "We want to be able to exploit the information concerning snowpack from NOAA's operational remote sensing platforms. Our work can help communities understand potential mitigation measures and economic cost benefit."

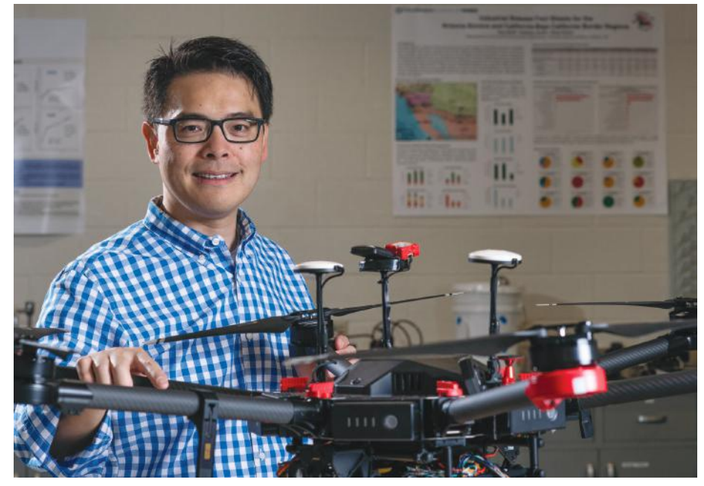
Elder Care

Community resilience is a central driver of research being conducted by Zhen Cong, associate dean for research and faculty affairs and director of the School of Social Work's Ph.D. program. She's focused on one of the most vulnerable groups in our communities: the elderly.

"I'm interested in the social side—how people experience disasters," she says. "In the area of disaster research, we tend to view the elderly as one single population and make recommendations based on that view. But in reality, they're all very different. There's not a lot of research in this realm."

To fill that void, Dr. Cong and her team are collecting data on household emergency plans and looking at how communities affected by natural disasters respond and recover. What they've found is that while older adults are not less likely to have emergency plans, those plans are more likely to be underdeveloped.

"Older adults who have higher levels of social isolation and declined mobility, physical health, and cognitive functioning are more vulnerable to disasters. Having a quality, detailed plan that is easy to follow is an important part of increasing their survivability and resilience," she says. "To best meet their needs, we have to take an individualized approach to emergency preparedness from a multilevel interdisciplinary perspective—looking at family relationships, social networks, community social capital, and our built environment."



From left: **Zhen Cong, Mohsen Shahandashti, and Nick Fang are focusing on different issues related to natural disasters.**

Cong is also creating a new model to guide future disaster-related studies in the presence of aging populations and emerging technologies. This includes how to effectively communicate tornado warnings to older adults and how to best mobilize protective action and mitigation behaviors.

"Being in the community and seeing the effects of these disasters firsthand is what motivates me," she says. "You see people working together, supporting each other—it's very emotional and encouraging."

Surveying Response

Political science Associate Professor Daniel Sledge and Assistant Professor Herschel Thomas are also interested in community response to disaster. They worked on a study assessing how nonprofit and nongovernmental organizations (NGOs) supplemented recovery efforts in communities hit hard by hurricanes and wildfires in recent years.

"When there's a disaster, you tend to hear about the role of the government and its successes or failures," Dr. Sledge says. "We have a very real, complex intergovernmental system for responding to disasters, but it fundamentally assumes that NGOs are going to be there on the ground and that they're capable of responding to disaster."

Dr. Thomas adds: "There is a massive responsibility placed on these organizations and businesses. They're expected to do a lot, but we don't know much about their capacity."

To find out, they traveled extensively, conducting field research in Texas, Florida, Puerto Rico, and northern and southern California. After surveying and interviewing 115 nonprofits and NGOs engaged in disaster response, Sledge and Thomas concluded that voluntary organizations active in disaster (VOADs) are critical to successful post-disaster coordination and recovery. VOADs bring together groups and representatives from local and state government agencies to coordinate actions, share information, and target their efforts during and after disasters.

In their study, which was published in the *American Journal of Public Health*, the researchers noted that the success of these groups depended on a number of factors, including resources, coordination, and whether the organization was active already and in place before the disaster struck.

"A lot of what we found isn't surprising to the people and the groups who are out there working in the communities. There just isn't much research about it," says Sledge. "We're trying to understand the role of the NGOs and shed light on what they're doing, why it's effective or not, and what might be done differently."

Thomas notes that at its heart, their work is really about the people who are directly impacted by and responding to the aftermath of these disasters.

"The sheer number of regular citizens who found themselves in extreme situations and stepped up to the plate—it was amazing," he says. "In conducting our field work, we saw the humanity of this massively complex system."

Paradoxically, that system is both helped and hindered by the humanity that drives it. That's where UTA's researchers come in—to ask the right questions, formulate the right approach, and tackle challenges head-on. It's a way of steering the decision-makers in the right direction and supporting the vulnerable before, during, and after disaster. It's what keeps our infrastructure standing strong and running smoothly. It's what saves lives.

"The problem is that we could have a shock. Disaster is not normal business. The question is how to survive," Shahandashti says. "In order to survive it, you need to make the right decisions before, when, and after it happens. The work of every UTA researcher working in the area of disaster resilience follows at least one of those three. And that's what unifies us: the decision-making." i

Flesh & Bone

College of Nursing and Health Innovation researchers are unlocking the secrets of the musculoskeletal system to promote healthy aging, treat diseases, and increase our quality of life.

BY ELIZABETH COUCH

With 208 bones, 650 muscles, about 1,300 tendons, and a multitude of vessels and nerves, the musculoskeletal system is the largest system in the human body. A group of researchers at The University of Texas at Arlington is dedicated to studying this intricate system and solving its mysteries—especially as they relate to chronic disease and aging.

"We want to understand the musculoskeletal system, answer essential questions about its mechanisms, and discover strategies for improved function during development and aging to determine new strategies for healing," says Marco Brotto, the George W. and Hazel M. Jay Endowed Professor in the College of Nursing and Health Innovation.

He heads the new Bone-Muscle Research Center (BMRC), which features the work of seven researchers with different areas of expertise in bone, muscle, neuronal, and vascular biology.

In addition to Dr. Brotto, the BMRC comprises Rhonda Prisby, head of the Bone Vascular and Microcirculation Laboratory; Dan Trott, whose expertise is integrative immunology; Venu Varanasi, who focuses on bone-muscle regeneration; Zui Pan, an expert in calcium signaling in cancer, muscle aging, and cardiovascular disorders; and Jingsong Zhou, whose recent research covers amyotrophic lateral sclerosis (ALS) and aging muscle disorders. The researchers also have individual labs.

Although they are each driven by different experiences and motivations, their overall goal is the same: to find answers and solutions for better health outcomes.

"We are applied, basic, translational, and clinical scientists working together with chemists, engineers, and computational biologists to find new answers to old and new questions," Brotto says. "We're using highly innovative, integrative, and transdisciplinary approaches to find new cures and promote longer and healthier living."

Growing Older, Not Stronger

As people grow older, the density of their bones lessens. Consequently, bones become more delicate and easier to break.

"We are living longer, but are seeing many chronic problems," says Brotto. "As people age, especially if they lead sedentary lifestyles, they continuously lose mass and function of their musculoskeletal system, which can lead to developing conditions such as atherosclerosis, osteoporosis, and sarcopenia."

Compounding this problem is the projected growth of our older population. In less than two decades—and for the first time in U.S. history—older adults will outnumber children. Helping this demographic stay healthy is thus becoming ever more critical.

"The key focus of our center is to detect aging-related problems in someone's 30s or 40s, not their 60s or 70s," Brotto says. "We want to tackle problems before it's too late."

"It is crucial to seek solutions to further advance the health and quality of life for this rapidly growing population."

Nearly 128 million people in the United States and 2 billion worldwide currently suffer from musculoskeletal conditions. These often-devastating ailments can significantly reduce quality of life and annually cost $1 trillion to treat in the U.S.

To help reduce these numbers, Brotto is using a series of National Institutes of Health (NIH) grants totaling approximately $6.575 million to tackle a variety of musculoskeletal diseases. His projects include determining how bone cells can influence and change the function of muscles by releasing hormone-like molecules, examining the mechanisms that contribute to the loss of strength in muscle during aging, determining if regulating certain proteins can improve the function of aged skeletal muscles, investigating the role of a protein called "numb" in muscle function and weakness with aging, and working to develop protein gene activators to protect skeletal muscles from diabetes.

"The outcome of this work could significantly enhance the quality of life for older adults," says Kathryn Daniel, associate professor of nursing and director of the Adult Gerontology Primary Care Nurse Practitioner program. "It is crucial to seek solutions to further advance the health and quality of life for this rapidly growing population."

Muscle Atrophy and ALS

BMRC Associate Director Jingsong Zhou's research focuses on a different form of musculoskeletal disorder: ALS, more commonly referred to as Lou Gehrig's disease. The majority of research on ALS centers on the spinal cord because of how the disease affects neurological function. But Dr. Zhou is investigating the theory that ALS affects the physiology of the whole body through defective cells in multiple organs.

"In the beginning, we believed the muscle atrophy ALS causes was secondary to the death of the neurons in the spinal cord, but we have evidence that indicates the muscle is not only a victim of the disease, but also it actively contributes to it," says Zhou, who is also a professor of kinesiology. "This is a systemic disorder affecting the whole body."

She recently received a $2.88 million award from the NIH to preserve mitochondria as they function or dysfunction in a diseased cell. This will help clarify the mechanisms behind why multiple organs are involved in ALS deterioration.

"We are ultimately working to find some potential therapeutic means to treat the disease with a new understanding," Zhou says. "Once we understand why the cells are damaged, we can test potential compounds or therapies."

Different Perspectives

Two other bone-muscle researchers are using their unique backgrounds to help inform their work.

Kinesiology Associate Professor Rhonda Prisby earned an undergraduate degree in art, an education that she believes has enabled her to see science from a unique vantage point.

"I have found that art and science share similar traits," she says. "Like art, research allowed me to come up with my own ideas, be creative, and ask *what if?*"

With this honed, artistic eye, she was able to notice something important lurking in the blood vessels within bone marrow.

"By examining seemingly unrelated images and linking the details of them together, I was able to posit the presence of bone-like particles in the blood," Dr. Prisby explains. "In fact, some of the ossified particles are large enough to clog the smallest blood vessels in the vascular tree."

While vascular calcification—mineral deposits on the walls of arteries and veins—is a common characteristic and risk factor for morbidity and mortality, Prisby's bone-like particles are potentially more dangerous because of their sharp edges.

"Some of the ossified particles have sharp tips and edges that could damage the lining of blood vessels," she says. "This damage could initiate events leading to atherosclerosis—or a build-up of plaque—which can restrict blood flow over time."

The discovery of these particles could help physicians detect and treat potentially life-threatening conditions such as heart attack, stroke, and inadequate blood supply to the limbs.

Unlike Prisby, Venu Varanasi's unique perspective comes not from his education, but from his genes. As a child, the associate professor of nursing was diagnosed with a genetic retinal disorder that has slowly deteriorated his vision. Problems with his eyesight first began to affect his career as a postdoctoral fellow at the University of California at San Francisco, leaving him unable to perform the precise microscopic measurements his work demanded.

Although he could have given up or pursued a different path, Dr. Varanasi instead chose to adapt, training his students to handle the micro-level, precise movements his research requires.

"There is an inherently collaborative atmosphere in Dr. Varanasi's lab," says Neelam Ahuja, a doctoral student who works as Varanasi's faculty associate. "He empowers us to be equal players in the research."

Much of this research is focused on severe cranium injuries, which often have difficulty healing due to the large size of the missing bone. While metal or plastic implants are a solution, they can take a long time to be tailored to fit and support bone fixation.

From left: **Marco Brotto, Jingsong Zhou, Rhonda Prisby, and Venu Varanasi are exploring the musculoskeletal system.**

As an alternative, Varanasi and his team developed a method for live 3D printing of bone-forming scaffolds in the cranium that are grafted to bone defects in real-time. This non-invasive approach would lead to shorter healing times and be more in tune with the body's natural healing processes.

"We have the potential to change the way we deliver health care," Varanasi says. "We're moving past current methods of cutting and patching patients and building a transformative method that will heal them without invasive techniques. Our research could have implications for healing fractures in aging adults as well as potential applications for healing muscle loss."

Brotto believes Varanasi's work marks a bold, new approach to the treatment of musculoskeletal maladies.

"Venu's work captures the meaning of translational research and has tremendous commercialization potential," he says. "Implants for cranial defects require continued care and medical attention, which leads to high costs for the patient. Venu's research could bring about a new family of devices that promote self-healing, which not only is the best way for a patient to heal, but also leads to increased accessibility of treatment." i

Investigating the Genome

Whether it comes from a human, coral, or snake, a genome can tell us the secrets behind life, evolution, and the future of health care.

BY DANA JENNINGS

ILLUSTRATIONS BY DAVIDE BONAZZI

SINCE THE LAUNCH of direct-to-consumer genetic testing services like 23andMe and AncestryDNA, tens of millions of customers have unlocked the geographic origins of their ancestors and gained insight into their health—all through a small sample of saliva mailed to a laboratory.

Comprising 3.2 billion DNA bases, the human genome determines what we look like, who we are, and how we interact with the environment around us. But while at-home genetic testing can provide users with information about their roots, their results represent only about 1% of the human genome.

Imagine what could be discovered by diving in to the remaining 99%. That's what many researchers at The University of Texas at Arlington are doing through their diverse projects on everything from immunology to snake intestines and through their work in the North Texas Genome Center on campus.

Exploring the Human Genome

Over the past several years, UTA has expanded its research enterprise, leveraging its expertise in engineering and science to build its portfolio in the life sciences.

Associate Vice President for Research Jon Weidanz arrived on campus in January 2016 to guide this effort and spearhead new investments. An internationally recognized leader in cancer immunotherapy, Dr. Weidanz was tasked with building out the foundational pieces and programs needed to elevate the problem-solving research already taking place on campus. He and UTA leadership also set their eyes on the future of health care: precision, personalized medicine.

"We want to harness the whole genome and use the information to help health care providers conduct better, more strategic medicine," Weidanz says. "There are a number of DNA-sequencing facilities in the region and state, but there was an opportunity to take the lead in North Texas and establish an institute dedicated to a new chapter of health care."

That opportunity came in the form of the North Texas Genome Center (NTGC), which opened in March 2018. A research and medical linchpin in the Science & Engineering Innovation & Research building, the NTGC features two NovaSeq6000 gene-sequencing systems, making it one of only a few centers in the central United States with such technology, the most powerful line of sequencers available from leading manufacturer Illumina. With these machines, the NTGC has the capacity to sequence more than 10,000 whole genomes annually.

Whole genome sequencing is becoming the foundation for precision health, a growing field that examines differences in people's genetic makeup to provide more personalized and effective health care solutions. Ultra-high throughput genomic sequencing has the potential to help enable more meaningful diagnoses and positive treatment outcomes.

After opening, the NTGC began offering academic and corporate researchers the opportunity to access its human whole genome sequencing technology at lower costs. Administrators also began the integral work of developing partnerships with industry leaders to advance a unified mission of delivering genomics-based tools to local communities, all while working toward clinical accreditation under the Clinical Laboratory Improvement Amendments of the College of American Pathologists.

"There's a growing demand, academically and commercially, for this latest technology," Weidanz says. "On the research side, we can already start to see things that we were never able to see before this technology, and that ultimately can lead to new insights. We want to be the go-to place for investigators and companies—and eventually for hospitals and health care providers—to send their samples."

In addition to Illumina, the NTGC has partnerships with researchers at UT Southwestern Medical Center and Texas A&M University (TAMU). The latter collaboration brings together the expertise and resources of TAMU's Institute for Genome Sciences and Society in large-scale genomic sample preparation with the NTGC's massive sequencing capacity. Samples now go to College Station, Texas, for preparation before coming to Arlington for sequencing and analysis reporting.

"This alliance reduces costs and speeds up the process, so we can make sequencing into a commodity and enhance innovation across the biotech, biomedical, and industrial sectors," Weidanz explains.

Once it receives accreditation, the NTGC will begin to provide sequencing of human genomes for clinical and diagnostic purposes—for example, helping discover why some patients respond positively to medical therapies when others don't, or identifying patterns in patient genomes to enable physicians to deliver care more efficiently.

"Partnering with clinicians to conduct genomics sequencing can help us answer some of our greatest questions and challenges in health care," Weidanz

says. "Creating what would essentially be a database of the genome of whole populations would break through the basics of a diverse population to allow us to understand demographics in relation to common diagnoses and positive treatment outcomes. The NTGC is a perfect vehicle for meaningful collaborations such as these, where we can solve problems together."

Snakes and Parasites

Inside and outside the NTGC, researchers at UTA are making advancements with both human and non-human genomes. Todd Castoe, associate professor of biology, is a large part of this effort. In 2019, he received a $1.2 million grant from the National Institutes of Health to explore why the devastating parasitic disease schistosomiasis persists in areas where extensive control measures against it have been implemented.

Schistosomiasis is an acute and chronic disease caused by parasitic worms. It affects over 200 million people worldwide, mostly in tropical and subtropical areas and in communities without access to safe drinking water and adequate sanitation.

"It's important to get rid of schistosomiasis, but the scope of the project is much larger than learning how to eliminate this disease in any one area of the world," Dr. Castoe says. "We want to use the knowledge we gain to help guide eradication campaigns for this and other parasitic diseases elsewhere."

He and his team are using new sequencing technologies to map the ancestry of parasites in an effort to identify human or animal hosts that may be acting as sources of new infection. They are following human and animal populations over time, testing them for infection, and measuring risk factors.

"Using genomic sequencing, this project will provide unprecedented insight into the detailed patterns of transmission across hosts, across geographic areas, and through time," Castoe says. "This will help us to understand how to prevent infections and advance efforts to achieve permanent reductions in schistosomiasis and other worm infections."

He has two other major genome-related projects underway, both involving snakes. In the first, he and biology Associate Professor Matthew Fujita are looking into the roles of selection and gene flow in speciation in the Western Rattlesnake. Their goals are to develop a new system for understanding and appropriately recognizing rattlesnake species, to provide new insight into the process of species formation, to develop new methods for identifying species, and to refine the appropriate medical treatment of snakebites in North America.

For the second project, he and Saiful Chowdhury, associate professor of chemistry and biochemistry, are studying the regulation of intestinal form, function, and regeneration in snakes in an effort to understand why some vertebrates experience rapid changes in intestinal form and function when feeding.

"We want to understand how vertebrates control, at the molecular level, shifts in intestinal form and function, and test if the regenerative capacities seen in some extreme vertebrate examples could be translated to other vertebrates, such as humans," Castoe says. "With both of these National Science Foundation-funded projects, we're using genomics to answer fundamental questions about biology."

From left: Todd Castoe, Jon Weidanz, Laura Mydlarz, and Subhrangsu Mandal are unlocking genomic insights.

Coral Crisis

Instead of diseases and reptiles, Laura Mydlarz, associate professor and interim associate dean of the College of Science, turned to coral for her genomic research. Working with Lauren Fuess and Whitney Mann, both recent UTA doctoral graduates, and undergraduate Lea Jinks, she discovered a correlation between a strong immune response in diseased corals and a lower expression of genes associated with growth and reproduction.

This result indicates that the resilience of species and coral communities may be affected if corals reduce cell growth and reproduction when actively fighting disease. Such a discovery is especially relevant today, as coral disease has become increasingly prevalent due to the changing climate.

In a separate project, Dr. Mydlarz teamed with Bradford Dimos, a second-year graduate student, and Mark Pellegrino, assistant professor of biology, to identify a previously unknown mitochondrial unfolded response in an endangered coral species. The cellular stress response promotes free radical detoxification and innate immunity.

According to Dimos, who is credited as first author on the team's publication in the journal *Proceedings of the Royal Society*, the gene the group discovered acts as a "master regulator" that unlocks hundreds of other genes. Mydlarz credits his vision and previous work on mitochondrial research with bringing together the strengths of her and Dr. Pellegrino's labs to pursue this project.

"There has been a lot of well-done work in the past that has identified various genes that could be important for immunity in coral, but our gene potentially regulates a lot of those," Dimos says. "We've uncovered a single target that has a broad scope of impact. This is a huge step forward in making any interventions to preserve coral more efficiently."

Coral reefs not only create vibrant underwater landscapes, but they also support 25% of all marine species on the planet. In recent years, however, they have experienced massive declines driven by disease and thermally induced mass coral bleaching in the face of increased environmental disturbances.

"Corals build the reef and are the base of the ecosystem. Without live coral, the reef doesn't have the structure it needs to support the life that relies on it," Mydlarz says. "It's ecologically important, but also has great socioeconomic significance. Understanding the existence of this gene means that there is now the potential to identify if corals are experiencing stress before they appear dead or bleached."

Immune Responses

A number of other projects related to genomics are also underway on campus. Chemistry Professor Subhrangsu Mandal, for example, recently found that the long non-coding RNA molecule HOTAIR present in white blood cells has the capacity to signal them to activate immune response in the presence of bacteria.

"We need to know what turns on inflammatory response to bacterial infection to be able to modulate the process," he explains. "If we can do so, we can control inflammatory diseases of the central nervous system that have been hard to treat up to now, such as sepsis and meningitis, as well as cancer and muscular dystrophy, which can also be seen as a kind of inflammation."

Jose Maldonado, a third-year doctoral student in biology, is also tackling the important topic. He received a prestigious National Science Foundation Graduate Research Fellowship in 2019 to fund his research on why sexual—rather than asexual—reproduction emerged as the dominant form. How sexually reproducing organisms evolved from asexually reproducing ancestors is a question that has long puzzled scientists. In recent years, the increasing availability of genomic data has made it possible to use natural populations of asexual non-model taxa to address long-standing hypotheses regarding the evolution of sex. For his work, Maldonado is using the gecko as a model species.

WEIDANZ RECOGNIZES IT might seem unusual for a university without a medical school or health science center to insist on leading the charge into the next generation of health care. But he believes it makes sense when you look at the existing expertise at UTA and its position not only in the Dallas-Fort Worth Metroplex, but the state as well.

"The rapid expansion of our research enterprise at UTA mirrors the rapid expansion of our state and its ventures into biotech," he says. "We're positioned right at the center of a hub for life science research and poised with the resources to tackle genomics in a new way." i

Invention Index

Promoting innovation and the commercialization of research

Healing Glove

A revolutionary bioengineered healing glove created at UTA is one step closer to commercialization. The REHEAL Glove applies negative pressure and delivers medicine to injured hands, controlling the wound environment for better and faster healing while also allowing for motion therapy to restore hand functions.

Last year, project leader Muthu Wijesundara and his team successfully developed a manufacturing process for the technology, through which 100 flexible polymeric gloves were created for early-stage clinical trials.

"The manufacturing process gives us more reliability and reproducibility in the REHEAL Glove production," Dr. Wijesundara says. "Having this process reduces the risk of variants among the gloves interfering with any future clinical trial work."

Cold electron transistor

A new cold electron transistor patented by engineering Professor Seong Jin Koh drastically reduces the amount of energy required for it to operate. For consumer products like cellphones and tablets, this could mean a much smaller power dissipation by a factor of 100 on transistors inside. It could also yield huge energy savings dollars to companies like Google or Amazon that need large amounts of transistor operations in their data centers.

"This novel transistor reduces power consumption, runs the devices cooler, and allows smaller battery packs to operate the component," says Dr. Koh.

Nanophotonic devices

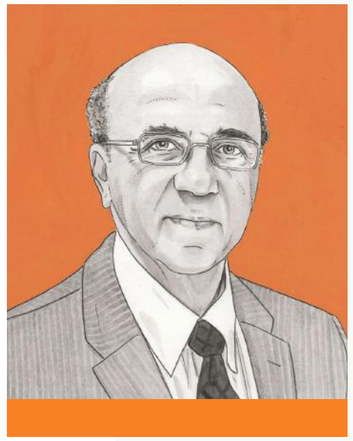
Robert Magnusson, electrical engineering professor and the Texas Instruments Distinguished University Chair in Nanoelectronics, is working on a $1.2 million collaborative agreement with the Army Research Laboratory to develop nanophotonic devices that could have applications in thermal imaging and resonant filtering.

Nanophotonic devices are used to shape the spectrum of light via photonic lattices and resonance, but their application generally has been limited to short wavelengths. Dr. Magnusson and his team are developing devices that will work in the longwave infrared spectral region, making them useful for thermal imaging technology and for sensors in medical diagnostics, chemical analyses, and environmental monitoring.

FACULTY NEWS

GRANT | FELLOWSHIP | APPOINTMENT | AWARD | PAPER

Professor elected to National Academy of Engineering



Last February, **Dereje Agonafer**, Jenkins Garrett Professor in the Department of Mechanical and Aerospace Engineering, received one of the highest professional achievements for engineers: election to the prestigious National Academy of Engineering (NAE).

The NAE honors professionals who have made outstanding and innovative contributions to the research, practice, education, or advancement of engineering. Dr. Agonafer's election highlights his distinguished leadership in engineering, including his focus on computer-aided electro/thermo/mechanical design and modeling of electronic equipment. He is one of 86 members and 18 foreign members in the 2019 class. Agonafer joined UTA in 1999 after a stellar career at IBM, and his continued collaboration with industry leaders has furthered the impact of his work.

"For nearly 20 years, the UTA community, including more than 200 alumni, have benefited from Dr. Agonafer's invaluable mentorship," says UTA President Vistasp Karbhari. "His commitment to the success of our students further cements an already remarkable career full of significant contributions to the industry."

Zhen Cong, associate dean for research and faculty affairs in the School of Social Work, was named a fellow of the Gerontological Society of America.

Biology Associate Professor **Todd Castoe**, Professor **Esther Betrán**, Associate Professor **Jeffery Demuth**, and graduate student **Balan Ramesh** published a paper in *Genome Research* that provides the first chromosome-level assembly of a reptile genome.

Mechanical and aerospace engineering Professor **Endel Iarve**, Professor **Andrew Makeev**, Assistant Professor **Rassel Raihan**, and Professor **Kenneth Reifsnider** received a $2.3 million grant from the Air Force Research Lab to continue working to develop better modeling methods for affordable, sustainable testing of composite materials.

Tamara Eades, a clinical assistant professor of nursing, was named president-elect of the Texas Nurses Association's Board of Directors.

Rachel Voth Schrag, assistant professor in the School of Social Work, published a study in *Violence Against Women* on educational sabotage, an overlooked form of psychological abuse.

The National Institutes of Health awarded biology Assistant Professor **Sen Xu** a five-year, $1.89 million grant to use genomic approaches to understand the genetic mechanisms of parthenogenesis, a form of asexual reproduction.

Florence Haseltine, Presidential Distinguished Professor in the College of Nursing and Health Innovation, received the PCOS Challenge Lifetime Achievement Award from the National Polycystic Ovary Syndrome Association.

Civil engineering Assistant Professor **Nick Fang** will use unmanned aerial vehicles to perform reconnaissance after natural disasters and

Illustration by Lara Tomlin

more accurately and quickly assess damage to buildings, thus accelerating the conventional insurance adjustment process.

Diane Jones Allen, associate professor and director of the Landscape Architecture program, was elected to the American Society of Landscape Architects' Council of Fellows.

Krishnan Rajeshwar, Distinguished Professor of Chemistry and Biochemistry, received the Electrochemical Society's 2019 Electrodeposition Research Award for his outstanding research contributions to the field of electrodeposition.

In a paper published in *Nature Ecology & Evolution*, biology Assistant Professor **Luke Frishkoff** explored how human land use expedites biodiversity loss.

Rassel Raihan, a research scientist at the Institute for Predictive Performance Methodologies at the UTA Research Institute, won the Young Professionals Emerging Leadership Award from the Society for the Advancement of Materials and Process Engineering.

Kytai Nguyen, bioengineering professor, was elected a fellow of the Biomedical Engineering Society.

Biology Chair and Professor **Clay Clark** received a four-year, $1.17 million grant from the National Institutes of Health to investigate the regulation of proteins responsible for programmed cell death.

A project led by civil engineering Assistant Professor **Mohsen Shahandashti** and Professor **Sahadat Hossain** was named to the American Association of State Highway and Transportation Officials' 2019 "Sweet Sixteen" high-value research projects list.

Physics Professor **Ramón López** was named to the UT System Academy of Distinguished Teachers for his excellence in teaching and mentoring students.

Nursing Associate Professor **Kathryn Daniel** was inducted into the American Academy of Nursing's 2019 Class of Fellows. Dr. Daniel is also the director of the College of Nursing and Health Innovation's Adult Gerontology Primary Care Nurse Practitioner Program.

Presidential Distinguished Professor of Physics **David Nygren** and Assistant Professor **Ben Jones** won a $1 million grant from the U.S. Department of Energy to build a detector that may offer key insights into the lingering mystery of the universe's matter-antimatter imbalance.

Matthew Walsh, associate professor of biology, was named a recipient of the Presidential Early Career Award for Scientists and Engineers by President Donald Trump.

Sharareh "Sherri" Kermanshachi, assistant professor in the Department of Civil Engineering, is working with both the Texas Department of Transportation and the Louisiana Department of Transportation and Development to identify and formulate best practices for transportation projects.

A study by **Narayanan Janakiraman**, assistant professor of marketing, published in the *Journal of Marketing* shows that marketers of relatively high-priced products should consider keeping prices high, as many consumers associate high price with high quality.

The journal *Mexican Studies/Estudios Mexicanos* named **Christian Zlolniski** its new editor. He is an associate professor of sociology and anthropology and director of the Center for Mexican American Studies.

Haiying Huang, professor of mechanical and aerospace engineering, earned a pair of grants worth nearly $900,000 from the Department of Defense and the Office of Naval Research to monitor structural health in ship hulls and detect when and where damage happens.

Arne Winguth, associate professor and chair of the Department of Earth and Environmental Sciences, and **Cornelia Winguth**, assistant professor of instruction, co-authored a study for *Nature Communications* that used multiple forms of analysis to provide new insights into the largest mass extinction in the geological record, the end-Permian extinction.

The American Society of Mechanical Engineers awarded **Dereje Agonafer**, Jenkins Garrett Professor in the Department of Mechanical and Aerospace Engineering, its prestigious Heat Transfer Memorial Award.

The first album released by UTA Records was named to Audiophile's Best of 2018 Classical Releases list. *In the Loop* features the compositions and performances of UTA clarinet lecturer **Cheyenne Cruz** and flautist **Hannah Leffler**. **Dan Cavanagh**, chair of the Department of Music, produced the album.

Presidential Distinguished Professor **Surendra Shah** was named a fellow of the National Academy of Inventors.

Daniel Armstrong, Robert A. Welch Distinguished Professor; **Purnendu "Sandy" Dasgupta**, the Hamish Small Chair in Ion Analysis; and **Kevin Schug**, Shimadzu Distinguished Professor of Analytical Chemistry, were named to the 2019 "Power List" compiled by *The Analytical Scientist* magazine.

Civil engineering Assistant Professor **Mohsen Shahandashti** and Professor **Sahadat Hossain** received two, two-year projects worth $518,245 to help TxDOT more effectively conduct underground geophysical explorations and develop action plans to mitigate soil failures.

Fillia Makedon, the Jenkins Garrett Professor in the Computer Science and Engineering Department, was among the winners of the *Dallas Business Journal*'s Women in Technology Award.

Gautam Das, the associate dean for research in the College of Engineering, was named a fellow of the Institute of Electrical and Electronics Engineers.

UTA President **Vistasp Karbhari** was elected as a member of the European Academy of Sciences and Arts.

Ard Anjomani, professor in the College of Architecture, Planning, and Public Affairs, and **Saad AlQuhtani**, a recent alumnus, published a study of transit-oriented developments across the Dallas-Fort Worth Metroplex in the *Journal of Transport Geography*.

Edmund Prater is the first person from UTA to be appointed a Jefferson Science Fellow by the National Academy of Sciences. The professor of information systems and operations management will spend one year on assignment at the U.S. State Department or USAID.

The National Institutes of Health awarded **Jody Greaney**, assistant professor of kinesiology, a $248,000 grant to study the effect depression has on the human brain's control of blood pressure and how it can cause long-term detrimental changes to a person's cardiovascular system.

Matthew Brothers, associate professor of kinesiology, was elected president of the Texas chapter of the American College of Sports Medicine, an organization that represents more than 70 occupations in the sports medicine field.

The UT System Board of Regents recognized **Amy Austin** and **Holly Hungerford-Kresser** with Outstanding Teaching Awards. Dr. Austin is an assistant professor of instruction in the Department of Modern Languages; Dr. Hungerford-Kresser is an associate professor in the Department of Curriculum and Instruction.

A study published by economics Professor **Michael Ward** found no link between violent video games and acts of violence. It was published in the journal *Contemporary Economic Policy*.

Associate Vice President for Research **Jon Weidanz** is one of 66 faculty, scientists, and administrators elected to the inaugural class of Senior Members of the National Academy of Inventors.

Teresa Doughty, dean of the College of Education, was recognized for her special education research and advocacy with the 2020 Burton-Blatt Humanitarian Award from the Division on Autism and Development Disabilities.

Electrical Engineering Professor **Michael Vasilyev** is one of 72 newly elected fellows of the International Society for Optics and Photonics.

UTA's first Carnegie Fellow

John Garrigus is the first person from UTA to be named an Andrew Carnegie Fellow. The professor of history was one of 32 scholars elected to the 2019 class and the only one from a Texas university.

A leading scholar of Atlantic and Caribbean history, Dr. Garrigus plans to continue his lifelong work on slave life in the Caribbean during his fellowship. Much of his research has centered on Francois Macandal, a Haitian burned at the stake by French planters who believed he had fatally poisoned thousands of slaves, hundreds of colonists, and countless livestock. His book project proves that a generation before Haiti's successful slave revolution, the French colony was decimated not by rebel slaves wielding poison, but by anthrax spores transported from France in a shipment of mules.

"I think everyone who lives in a democracy owes a debt of gratitude to the Haitian revolutionaries," Garrigus says. "Twenty years ago, we didn't understand that. But we're learning more and more. With this award, I'll have the time to write a general audience book about this fascinating episode."

Illustration by Lara Tomlin

Early Insight

undergraduate level

Making history

In 2019, Sara Peper became the first undergraduate to ever win the President's Cup, a coveted award for poster presentations given by the American College of Sports Medicine. The exercise science major's poster was titled "Silicon Ions Enhance Myogenic Differentiation in C2C12 Skeletal Muscle Cells."

Peper works in the laboratory of Venu Varanasi, associate professor in the Bone and Muscle Research Center. Her research interest is tissue regeneration using silicon-based biomaterials.

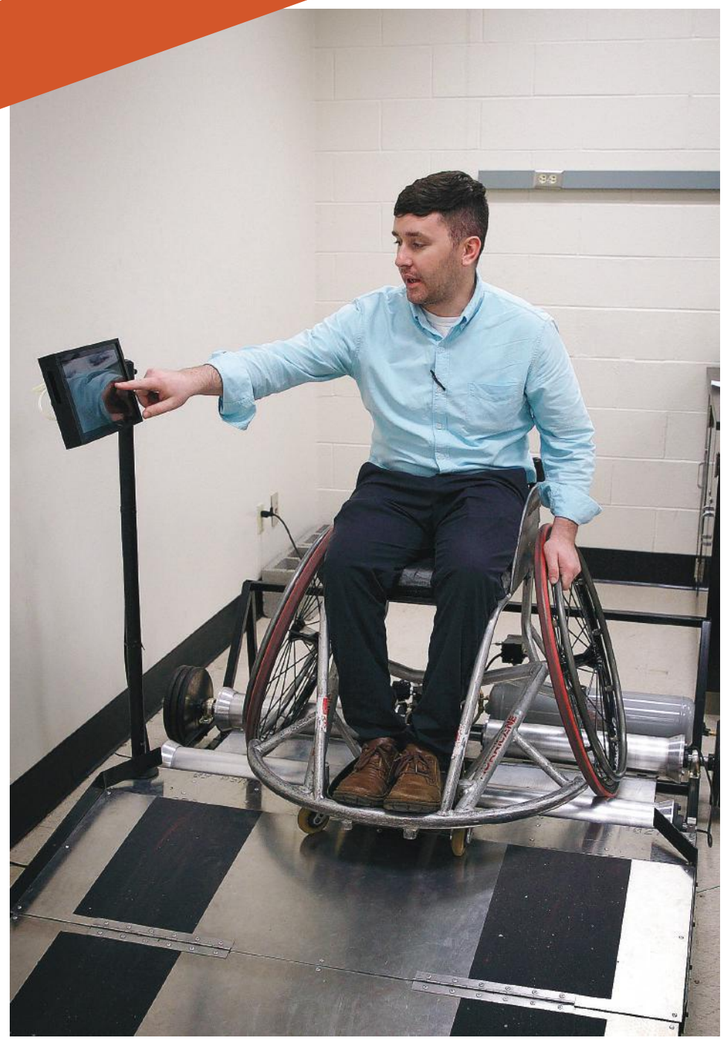
After graduation, Peper will begin work on a master's in biomedical engineering at UTA and eventually pursue a joint MD/PhD degree.

Research awarded

Chemistry student Melissa Orr was honored this year with a Sigma Xi Grants in Aid of Research award.

A fourth-year student in the Department of Chemistry and Biochemistry's B.S. to M.S. fast-track program, Orr is studying how changing the crystal chemistry of rare-earth, solid-state materials can lead to control of physical behavior.

"I was stunned to learn I had received the award," she says. "I am honored and excited to continue my research efforts with the support of Sigma Xi. I'm interested in the unique chemistry that only rare-earth elements can provide, as they exhibit a diverse array of intriguing physical phenomena that translate into optical, magnetic, and semiconducting applications."



Wheelchair Treadmill

UTA's national champion Movin' Mavs and Lady Movin' Mavs wheelchair basketball teams might be getting even better soon, thanks to some ingenuity from their fellow students.

During their senior year, engineering majors must complete a Capstone Project, for which they design, implement, test, and present a final demonstration of a prototype solution to a real-world engineering problem. In 2019, a group of mechanical engineering students built a treadmill that can be used by athletes in wheelchairs.

"I'm excited that something we did has the potential to help others in a practical, real-life way," says Brandon Griffin (pictured above), who led a team comprising Antonio Araujo, Matthew McCormick, Matthew Niestroy, Jason Gulledge, and Chad Goodlow. "It shows us how important even senior design projects are."

The State of RESEARCH *at* THE UNIVERSITY OF TEXAS AT ARLINGTON

THE STATE OF RESEARCH

LAST YEAR PROVED to be a landmark one for The University of Texas at Arlington, as it achieved all criteria required to receive Texas Tier One designation and funding from the state's National Research University Fund (NRUF). As part of this effort, UTA had to reach a series of milestones, including surpassing $45 million in restricted research expenditures, which it did in 2018 and 2019.

Other requirements include awarding more than 200 Ph.D.s each year, which UTA has done for five years in a row; being designated as a member of the Phi Kappa Phi Honor Society; and demonstrating the ability to recruit a freshman class of high academic achievement, a criterion for which UTA consistently ranks the highest among universities in the running for NRUF designation.

With the addition of several new National Academy members to the faculty in 2019, UTA achieved the final NRUF requirement, as it secured the metrics set for high-quality faculty. The University must now maintain these for another year.

"Receiving allocations from NRUF as a Texas Tier One university will not only empower continued expansion of the first-class research enterprise at UTA, but will also allow us to provide meaningful solutions to the industries, government, and partners that choose to invest in UTA," Interim Vice President for Research James Grover says.

INNOVATION & COMMERCIALIZATION

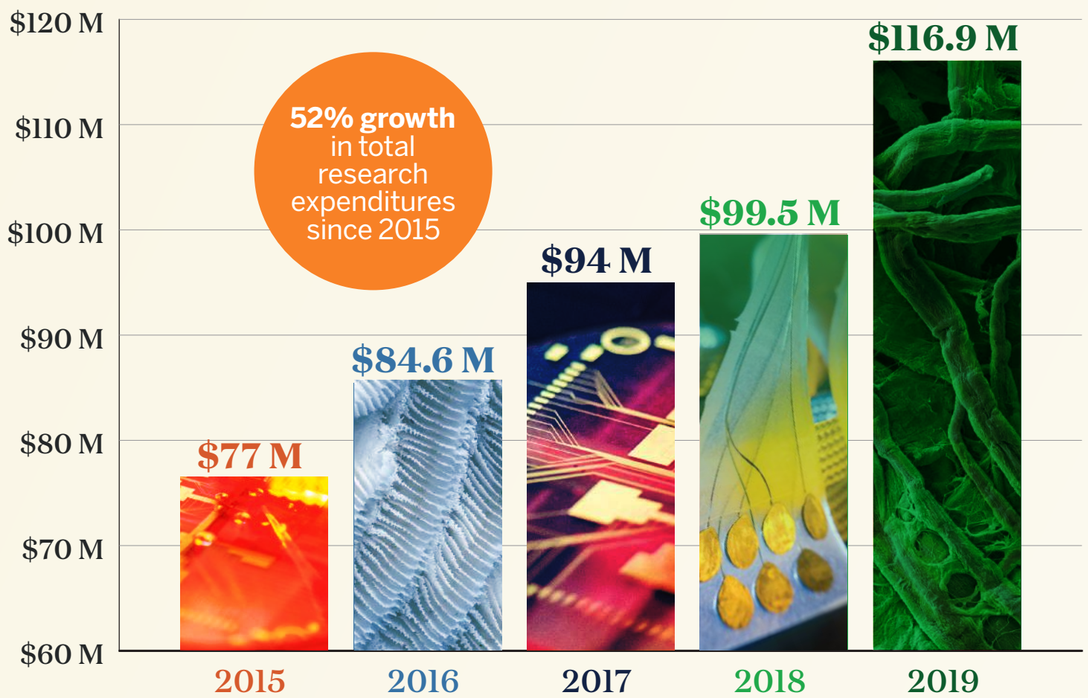
122
EpICMavs entrepreneurial seminar attendees in 2019

22+
Startup companies launched in 2019

105
Patents issued in FY 2015-19

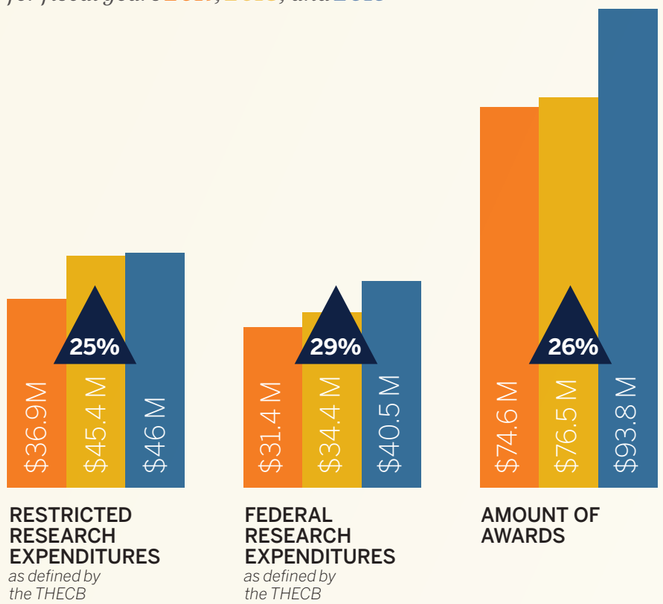
UTA TOTAL RESEARCH EXPENDITURES

by fiscal year, as reported in the THECB RD Expenditure Survey



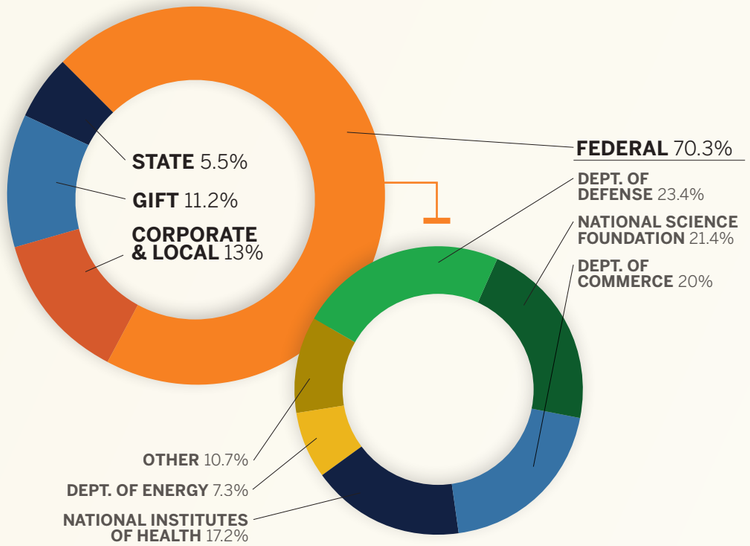
RESTRICTED AND FEDERAL RESEARCH EXPENDITURES

for fiscal years 2017, 2018, and 2019



EXTERNAL RESEARCH EXPENDITURES BY SOURCE

for fiscal year 2019



THE FUTURE OF RESEARCH

UTA is dedicated to bolstering the work of students and young faculty pursuing their greatest questions with research through collaborative opportunities and unparalleled mentorship and partnership.

In the last five years, UTA has been awarded

13 NSF CAREER awards

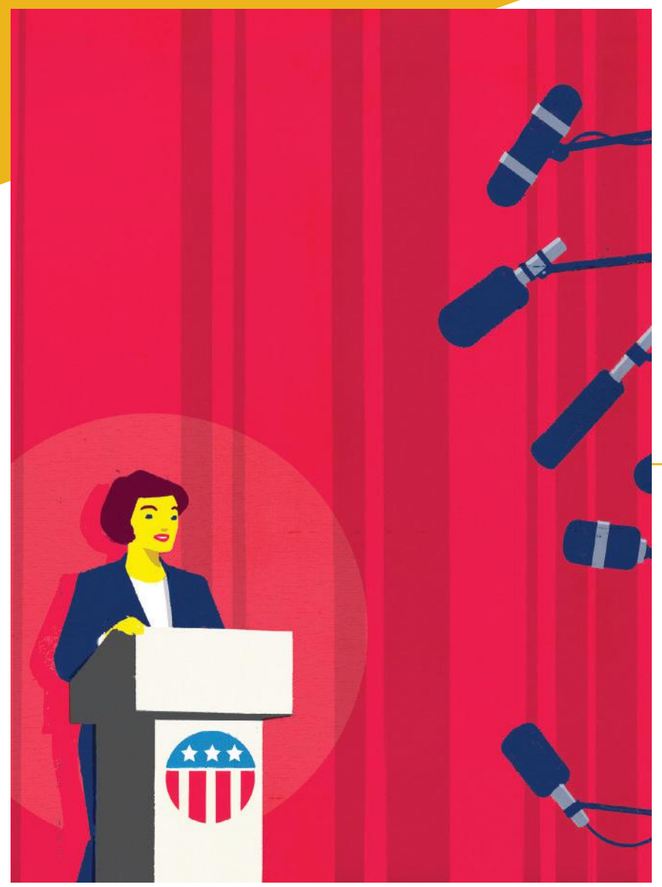
8 major equipment awards (DURIP and MRI)

3 NIH early-stage investigator awards

3 Dept. of Transportation University Transportation Centers

2 CPRIT faculty recruiting awards

2 AHA Development awards



Gender and the Presidency

In her new book, Dustin Harp—associate professor and director of the Women's and Gender Studies Program—explores how traditional and feminist ideas of gender played out during the 2016 presidential campaign.

Excerpted from *Gender in the 2016 U.S. Presidential Election: Trump, Clinton, and Media Discourse* (Routledge, 2019)

What started during the 2016 presidential campaign as an insult hurled at Hillary Clinton—that she was playing the woman's card—became both an enduring critique for her detractors and a rallying cry for supporters of the first woman to win the popular vote in a U.S. presidential election. Donald Trump, at the time the front-runner in the Republican Party's primary race and presumptive party nominee for the general presidential election, said, "I think the only card she has is the woman's card. She's got nothing else going. And frankly: If Hillary Clinton were a man, I don't think she'd get 5% of the vote. The only thing she's got going is the woman's card. And the beautiful thing is, women don't like her."

… This declaration against Clinton resonated across the media sphere quickly. As *The Washington Post* noted, "Donald Trump's accusation that Hillary Clinton is playing the 'woman's card' and would be a failed candidate if she were a man touched off a contentious debate about gender politics and sexism that seems likely to define the presidential election as much as any issue."

Trump's indictment of Clinton indeed marked a significant gender moment early in the 2016 election, a moment when Clinton's gender became central within the political discourse. And like it or not, gender politics and sexism continued to play a major role throughout the election.

Clinton responded immediately to the "woman card" accusation during a speech Tuesday night, April 26, and then posted a video to her campaign Twitter feed later that same night with the hashtag #WomanCard. She embraced the allegation, saying, "Mr. Trump accused me of playing the woman card. Well, if fighting for women's health care and paid family leave and equal pay is 'playing the woman card,' then deal me in.'"

Just a couple of days later, on April 29, Clinton's official campaign Twitter account tweeted an image of a bright pink card resembling a credit card with the message "Lower wages! No paid family leave! Limited access to health care! Just some of the perks of your #WomanCard." Along with the image was the tagline "This is what an Official Hillary for America 'Woman Card' gets you" and a link to hillaryclinton.com, her official campaign website. On the website, a box advertising "Get your free Woman Card!" asked for email addresses and zip codes.

The campaign had turned Trump's accusation into a strategy to build a database of Clinton supporters and possible campaign contributors—a means for fundraising. For better or for worse, the Clinton campaign's reaction brought even more attention to Clinton's gender. ℹ

Illustration by Chris Gash

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