FALL 2018

TEXAS A&M ENGINEER

INVESTING IN THE FUTURE

FROM THE DESK OF
M. KATHERINE BANKS

I am pleased to present this edition of *Texas A&M Engineer*, which provides a snapshot of the outstanding research conducted by our faculty and students, and highlights the significant investments Texas A&M Engineering has made in research and educational facilities.

With our current annual research funding of $300 million, our 677 faculty members utilize 1.5 million square feet of research space to address engineering challenges in health care, energy, national security, infrastructure, materials and manufacturing, and information systems.

The year 2018 has been a banner one for Texas A&M Engineering. In April, we opened the Center for Infrastructure Renewal (CIR), a 138,000-square-foot multidisciplinary research and training center. Research in the CIR focuses on critical infrastructure sectors including: advanced materials and manufacturing, smart structures, flexible pavement, concrete infrastructure, autonomous vehicles/connectivity, smart energy, corrosion and materials reliability, and structural and materials testing.

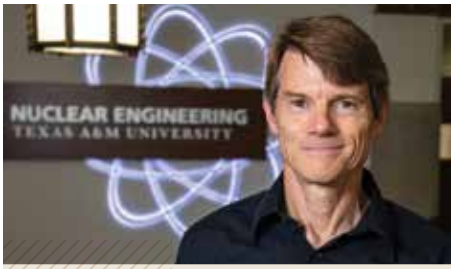
In August, we celebrated the opening of the Zachry Engineering Education Complex, 525,000 square feet of active learning space dedicated to undergraduate engineering education. Its student-focused design, 60,000 square feet of maker space and modern learning technology is revolutionizing the way we deliver engineering education to today's students.

We are also pleased to be part of Triad National Security, LLC, selected by the Department of Energy to manage Los Alamos National Laboratory with our partners, Battelle and the University of California.

The Texas A&M Engineering research and educational programs are thriving in College Station, Texas, but are also impacting the world. We invite you to visit our outstanding new facilities, collaborate with top faculty and contact us to discuss research partnership opportunities.

M. Katherine Banks, Ph.D., P.E.
Vice Chancellor of Engineering and National Laboratories,
The Texas A&M University System
Dean of Engineering, Texas A&M University
Director, Texas A&M Engineering Experiment Station
University Distinguished Professor
Harold J. Haynes Dean's Chair Professor

CONTENT



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ZACHRY DEPARTMENT OF CIVIL ENGINEERING

Impacting infrastructure

Multidisciplinary researchers tackle civil infrastructure issues from the state to global level in the Center for Infrastructure Renewal.

Imagine experts in every aspect of civil infrastructure all working together under one roof to solve the most pressing problems in statewide, national and global infrastructure. That's business as usual in the Center for Infrastructure Renewal (CIR).

"It is a unique facility in many ways. This includes the number and breadth of experts working on the topic of infrastructure," says Dr. Zachary Grasley. "You have folks who are experts in large-scale structures – how they respond to earthquakes or hurricane-force winds. You have experts working on new materials for pavements. You have experts working on the electrical grid and corrosion of offshore gas structures. And the CIR has the physical capabilities to perform any necessary tests to solve all kinds of problems across infrastructure."

A joint effort between the Texas A&M Engineering Experiment Station and Texas A&M Transportation Institute, the CIR is focused on developing new and innovative solutions for rehabilitating infrastructure in the state of Texas and throughout the world, as well as developing technologies for new infrastructure that cost less, last longer and can be built in less time.

The CIR works closely with agencies in Texas, like the Department of Transportation, to develop new technologies that will help make all of the new infrastructure being built throughout Texas better able to support population growth, longer-lasting and more resilient to natural disasters like hurricanes, says Grasley.

"A lot of the technologies we develop are adapted and utilized throughout the United States and the world," he continues. "We partner with all kinds of federal agencies, international agencies and companies in Texas and around the world to help take our innovations and put them into practice."

Featured Researcher: Dr. Zachary Grasley
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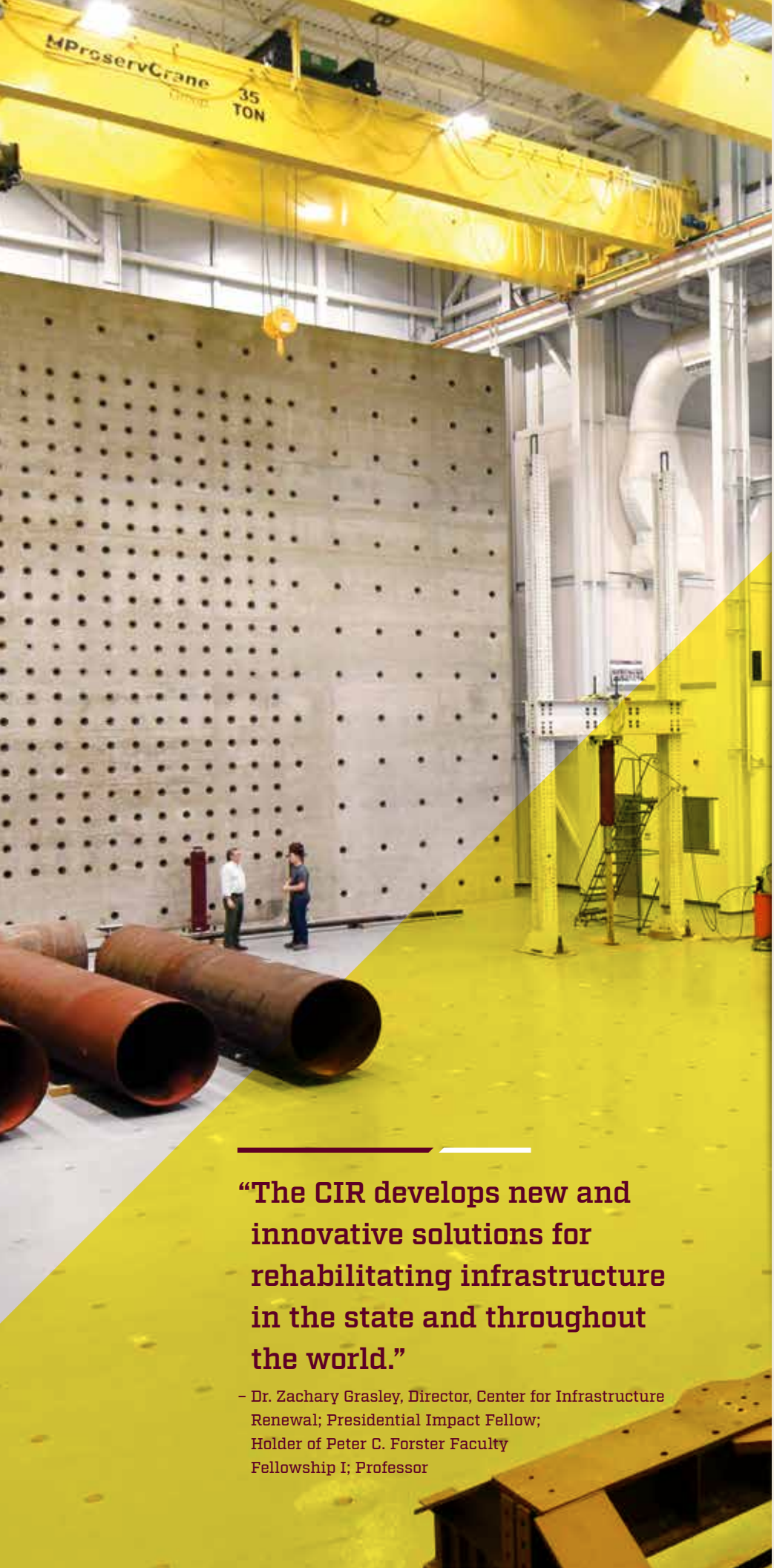
138,000-SQUARE-FOOT MULTIDISCIPLINARY RESEARCH AND TRAINING CENTER



“The CIR develops new and innovative solutions for rehabilitating infrastructure in the state and throughout the world.”

– Dr. Zachary Grasley, Director, Center for Infrastructure Renewal; Presidential Impact Fellow; Holder of Peter C. Forster Faculty Fellowship I; Professor

ZACHRY DEPARTMENT OF CIVIL ENGINEERING

Paving the way for safe, innovative bridges

Prestressed concrete bridge research is innovating the way bridges are built, reports Dr. Mary Beth Hueste in recent studies with the Texas Department of Transportation.

This collaborative research helps further the potential for precast, prestressed concrete bridge systems, which allow bridge components to be fabricated off-site and then constructed on-site. This ensures that the bridges are not only built more quickly, but with greater efficiency and higher quality. The method is also cost-effective for taxpayers.

Hueste’s team first focused on continuous prestressed concrete girder bridges. Most precast girders are limited to 160 feet due to transport weight and length restrictions. With in-span spliced girder technology and continuous prestressing installed at the bridge site, researchers found span length could be nearly doubled.

They also investigated a short span slab beam system. Spreading beams apart, with less expensive precast concrete panels in between, and using a cast-in-place concrete deck produced a viable, cost-effective design.

Featured Researcher: Dr. Mary Beth Hueste
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J. MIKE WALKER '66 DEPARTMENT OF MECHANICAL ENGINEERING

Enhancing campus navigation with self-driving shuttles

Dr. Srikanth Saripalli has been spearheading autonomous vehicle research since he joined the faculty in 2016. A new initiative in the project is to study passengers' emotions while in the vehicle, a project Saripalli is working on with Dr. James E. Hubbard Jr. from the Department of Mechanical Engineering. (Read more about Dr. Hubbard on Page 6.) The goal is to monitor a passenger's stress levels by reading brainwaves and determining how best to communicate in order to help them feel more at ease.

"The shuttle is not just interacting with pedestrians outside the vehicle; it's also interacting with people who are sitting inside the vehicle because there is no driver, and if there is no driver, you need that comfort," Saripalli says.

The team bought a Polaris golf cart, outfitted it with sensors and began running tests in moving the shuttle from point A to point B while teaching the shuttle to stop in between if it sensed pedestrians or any sort of obstacle. Since then, they've also received a donated Yamaha cart, which they fully automated.

Each golf cart is equipped with multiple Lidar sensors, so lasers that work day and night offer 360-degree visibility. There is also a camera and a mapped route fed into the shuttle's code.

The program's goal is for the shuttle to serve as paratransit for people who are mobility challenged.

Featured Researcher: Dr. Srikanth Saripalli
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Dr. Saripalli's team teaches an autonomous shuttle to sense pedestrians and obstacles on Texas A&M's campus.

Center for Infrastructure Renewal (CIR)

A leading source for transformative infrastructure solutions

The CIR is a one-of-a-kind, 138,000-square-foot multidisciplinary research and training center designed to bring together researchers from universities, government and the private sector to tackle infrastructure problems and accelerate knowledge into practice.

- Advanced Characterization of Infrastructure Materials Lab
- Advanced Infrastructure Materials and Manufacturing Lab
- Asphalt Innovation Lab
- Connected Infrastructure Lab
- Concrete Innovation Lab
- Intelligent Infrastructure Assessment Lab
- National Corrosion and Materials Reliability Lab
- Smart Grids Control Center
- Soil/Unbound Materials Innovation Lab
- Structural and Materials Testing Lab

Lower Cost, Less Time, Longer Life.

For research collaborations, contact:

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CIR | CENTER FOR Infrastructure Renewal

TEES TEXAS A&M ENGINEERING EXPERIMENT STATION

Texas A&M Transportation Institute

J. MIKE WALKER '66 DEPARTMENT OF MECHANICAL ENGINEERING

New preeminent scholars bring revolutionary research to Texas A&M

When she joined the department in 2017, Dr. M. Cynthia Hipwell brought a wealth of experience in nanotechnology, tribology, sensors and actuators. She is putting that expertise to use through her INnoVation tools and Entrepreneurial New Technology (INVENT) laboratory.

Hipwell works alongside researchers well-versed in tribology, materials, cognitive ergonomics and human-machine interactions to develop important innovations like high-resolution, flexible tactile sensors and actuators that can be used for haptic feedback applications in communications, hazardous work environments, virtual reality and design. She also seeks to develop improved understanding of the finger-device interface to create optimal performance in haptic devices.

Featured Researcher:
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GURI GOVERNOR'S UNIVERSITY RESEARCH INITIATIVE

NATIONAL ACADEMY OF ENGINEERING

Chancellor's Research Initiative

The department welcomed Dr. James Hubbard Jr. in spring 2018. His state-of-the-art motion-capture studio is already pushing new boundaries in autonomous vehicle technology development.

Hubbard's StarLab, located on the 2,000-acre RELLIS campus, will feature more than 40 high-speed motion-capture cameras, a capture volume of 40 by 40 feet, and a holodeck-like environment well-suited for testing and developing new methods and technologies.

Hubbard's current projects include an autonomous shuttle service for handicapped individuals, which he is working on with Dr. Srikanth Saripalli, and development of smart seats for autonomous vehicles capable of monitoring their riders' conditions.

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NATIONAL ACADEMY OF ENGINEERING

Chancellor's Research Initiative

DEPARTMENT OF INDUSTRIAL & SYSTEMS ENGINEERING

Texas A&M hosts 2018 NAMRC

More than 700 researchers and manufacturers from 28 countries discussed innovations and developments in manufacturing, cyberphysical systems and materials processing in Texas A&M University's Hall of Champions in June. This marked the first time in its 46 years that the North American Manufacturing Research Institution of SME's North American Manufacturing Research Conference was held in Texas. Speakers included:

- Andres Alcantar, chairman and commissioner of the Texas Workforce Commission
- Takeshi Ebisu, president and chief executive officer of Goodman Global Group, Inc.
- Ahmed Mahmoud, chief information officer of General Motors IT
- Mike Molnar, director of the Advanced Manufacturing National Program Office at the National Institute of Standards and Technology
- John Vickers, principal technologist at the Space Technology Mission Directorate for NASA

"A major benefit to Texas A&M is that many people had never been to the campus before, and the conference was a great opportunity to showcase Texas A&M."

– Dr. Zhijian Pei, Professor

namrc46 North American Manufacturing Research Conference

MSEC Manufacturing Science and Engineering Conference

Following the flow

Researchers are measuring velocities of atmospheric high-speed fluids to improve detection of hazardous gases, develop aircraft and more.

Thanks in part to a $5 million grant from the Governor's University Research Initiative (GURI), Dr. Richard Miles is developing the Aerospace Laboratory for Lasers, ElectroMagnetics and Optics (ALLEMO). GURI, enacted in 2015 by Governor Greg Abbott, is aimed at helping public higher education institutions in Texas recruit distinguished researchers.

Within the center, Miles and his research team will study how Femtosecond Laser Electronic Excitation Tagging (FLEET), which they developed, can be used to measure velocities of high-speed fluids in the atmosphere.

FLEET is a special velocimetry tagging technique that, according to an article written by Scientia.global, "takes advantage of unique properties of recombining nitrogen molecules by first dissociating them with a titanium-sapphire laser pulse with tens-to-hundreds of femtosecond duration. This short pulse avoids the formation of bright sparks and enables the writing of lines and patterns of dissociated species into the flow. After dissociation, the nitrogen atoms recombine, forming nitrogen molecules in a high-energy state that emits fluorescent red and infrared light for tens of microseconds (first positive emission)."

These emissions can be captured with a fast-shuttered camera, and aerodynamic flows can be followed in real time, without chemically or electronically altering any molecules. Because the flow is not disrupted with foreign gases or obstructive particles and provides immediate findings, it can potentially lead to unparalleled understandings of high-speed fluid mechanics. Benefits of Miles' research include a better understanding of fluid dynamics processes, resulting in more advanced high-speed aircraft designs.

Work in the center will also focus on developing laser-based stand-off detection technologies that could have practical applications like the remote detection of hazardous gases for pollution monitoring, homeland defense and the detection of explosives. The technology could be extremely useful for many industries, including aerospace, petroleum and homeland security.

In addition, research is planned on plasma-driven and enhanced processes, including plasma-enhanced combustion, the use of plasmas for aerodynamic control, and plasma-enhanced energy conversion. These may lead to new methods to create higher-performance and safer aircraft with active surface-mounted devices, reduce the generation of pollutants in combustion and develop high-efficiency methods for electricity production.

Femtosecond Laser Electronic Excitation Tagging (FLEET), developed by Dr. Richard Miles' research team, measures velocities of high-speed fluids.

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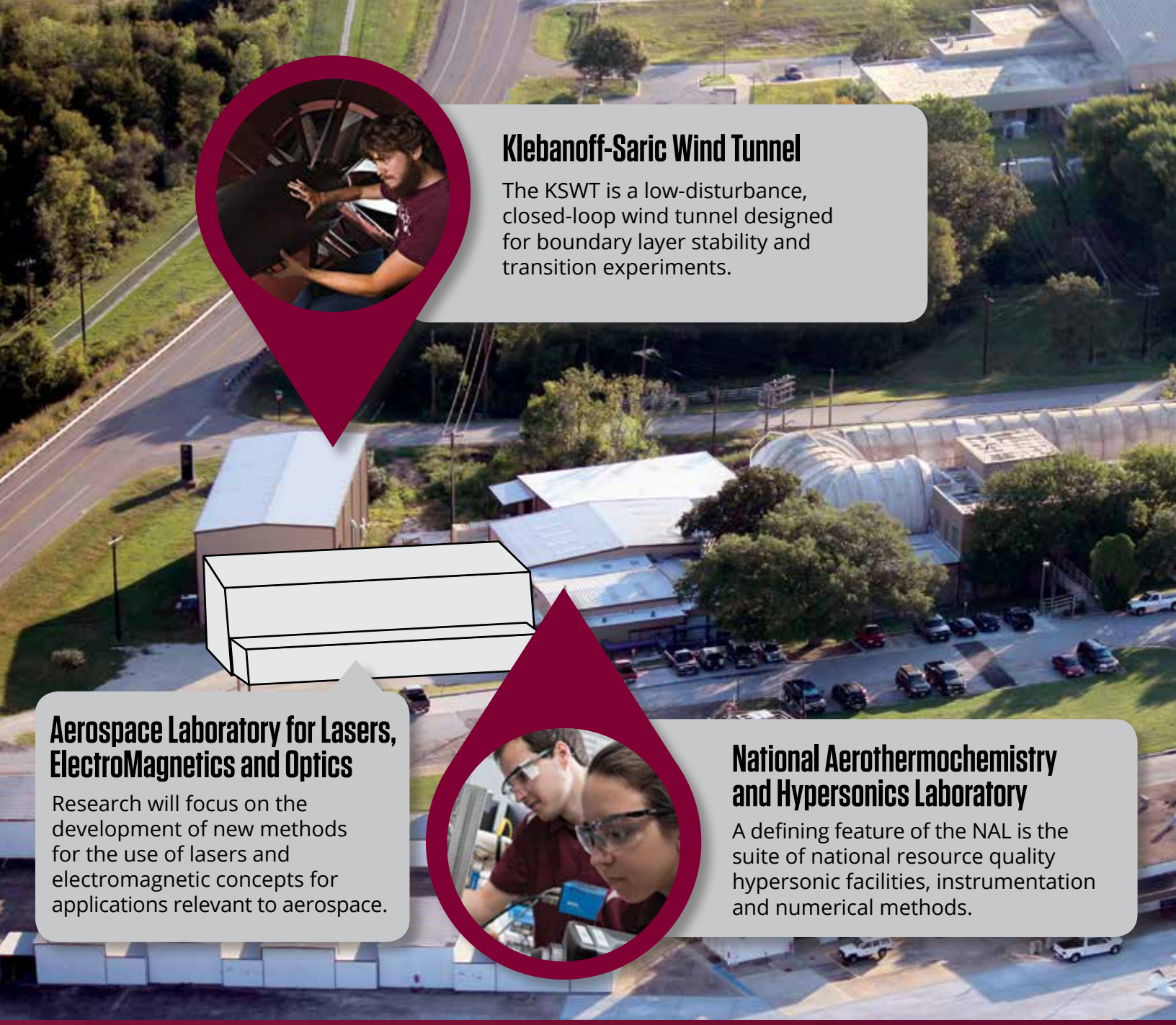
GURI GOVERNOR'S UNIVERSITY RESEARCH INITIATIVE

NATIONAL ACADEMY OF ENGINEERING

Dr. Richard Miles is developing the ALLEMO, which will join the university's existing aerospace engineering research facilities **shown on Pages 8 and 9.**



Klebanoff-Saric Wind Tunnel

The KSWT is a low-disturbance, closed-loop wind tunnel designed for boundary layer stability and transition experiments.

Aerospace Laboratory for Lasers, ElectroMagnetics and Optics

Research will focus on the development of new methods for the use of lasers and electromagnetic concepts for applications relevant to aerospace.

National Aerothermochemistry and Hypersonics Laboratory

A defining feature of the NAL is the suite of national resource quality hypersonic facilities, instrumentation and numerical methods.

Klebanoff-Saric Wind Tunnel

This facility is mainly used to study laminar-turbulent boundary layer transition by means of flat-plate and swept-wing experiments. Measurement techniques used include hotwire anemometry, infrared thermography, and naphthalene flow visualization.

National Aerothermochemistry and Hypersonics Laboratory

The mission of the NAL is to provide a venue for faculty, students, research associates and visiting scientists to improve our knowledge and control of non-equilibrium gaseous flows and their surface interactions. The resulting facility has been supported by the AFOSR, AFRL, ARO, DoD, NASA, NSF, ONR and industry.

Oran W. Nicks Low Speed Wind Tunnel

The LSWT is used extensively for undergraduate education, engineering research and commercial testing. Commercial tests range from one day to several months. Studies have been conducted on everything from bicycles with riders, golf clubs, light pole fixtures, and offshore oil platforms and drill ships to missiles, airplanes and space re-entry vehicles.

Oran W. Nicks Low Speed Wind Tunnel

The LSWT is used extensively for undergraduate education, engineering research and commercial testing.

Land, Air, and Space Robotics Lab

The LASR Lab is a world-class robotics facility that makes use of innovative robotics to emulate relative 6 degree-of-freedom motion of aerospace vehicles.

Aerospace Engineering Research Facilities

Land, Air, and Space Robotics Lab

The indoor robotics arena is the centerpiece of the lab, offering 2000 square feet of flat floor for ground robots. Twelve foot ceilings give aerial vehicles plenty of room to maneuver. Black curtains, floors, walls, and ceiling simulate the outer space environment, where a single strong light source may provide illumination for realistic optical sensing experiments. A fabrication room and electronics workspace adjoin the main arena. The conference room and graduate student offices complete the package that this facility offers for any advanced robotics research program.

Aerospace Laboratory for Lasers, ElectroMagnetics and Optics (Coming Soon)

The ALLEMO is a new laboratory being built adjacent to the National Aerothermodynamics and Hypersonics Laboratory (NAL). Research conducted in it will focus on the development of new methods for the use of lasers and electromagnetic concepts for applications relevant to aerospace. These include new diagnostics for high-speed aerodynamics, long-range detection of trace hazardous gases and pollutants, plasma-based methods for flow control, guiding of electromagnetic and laser radiation, and advanced energy conversion methods. The laboratory and the state-of-the-art equipment to be contained within it are jointly funded through the Chancellor's Research Initiative (CRI) and the Governors University Research Initiative (GURI).

DEPARTMENT OF NUCLEAR ENGINEERING

Ensuring stockpile reliability

The United States has not developed new nuclear weapon designs since it ceased physical testing in 1992. Instead, purely for the sake of deterrence and national security, the nation has kept up its arsenal by refurbishing, repairing and replacing parts in some weapons and retiring many other weapons.

Keeping weapons functional is imperative to the U.S. goals of nuclear deterrence. Predictive computational modeling is an important piece of this puzzle.

"Texas A&M is unquestionably strong in predictive science and engineering in the area of particle transport, meaning neutrons, photons and charged particles," says Dr. Marvin Adams.

He says this strength stems from collaboration within the multidisciplinary predictive computational modeling group. The research group includes Adams; nuclear engineering professors Dr. Jim Morel and Dr. Jean Ragusa; Dr. Lawrence Rauchwerger and Dr. Nancy Amato, professors in the Department of Computer Science and Engineering; Dr. Bani Mallick, Susan M. Arseven '75 Chair in Data Science and Computational Statistics; Dr. Jean-Luc Guermond, professor and Mobil Chair in Computational Science; and Dr. Raytcho Lazarov and Dr. Bojan Popov, professors in the Department of Mathematics.

The researchers develop predictive science and engineering methods that help national laboratory experts calculate the effects of time on nuclear weapons and their probabilities of success as they age. The more time passes from when the devices were originally tested (prior to 1992), the more difficult calculations become. Materials degrade over time and devices change from their tested configurations through refurbishments and repairs. Eventually, each type of nuclear weapon in the U.S. arsenal will have to be refurbished or replaced, so every variable must be carefully calculated.

"Anybody can calculate an answer, but calculating how accurate your answer is and predicting uncertainties is extremely difficult," says Adams.

Partners in National Security

Adams and his fellow researchers are working on several projects in this realm. Each is sponsored by the U.S. Department of Energy's (DOE) National Nuclear Security Administration (NNSA) or one of its laboratories.

The team is currently working on an $11 million project through the Center for Exascale Radiation Transport.

"An important phenomenon in nuclear weapons is thermal radiation transfer," says Adams. "We figure out how to develop and test predictive methods for thermal radiation transfer by using neutron transport as a surrogate. We design complicated neutron-transport experiments, predict the results, predict how close our answers should be to reality, execute the experiments and then compare the experimental results to our predictions."

Lawrence Livermore National Lab (LLNL), one of the DOE facilities, is sponsoring two of the team's current projects.

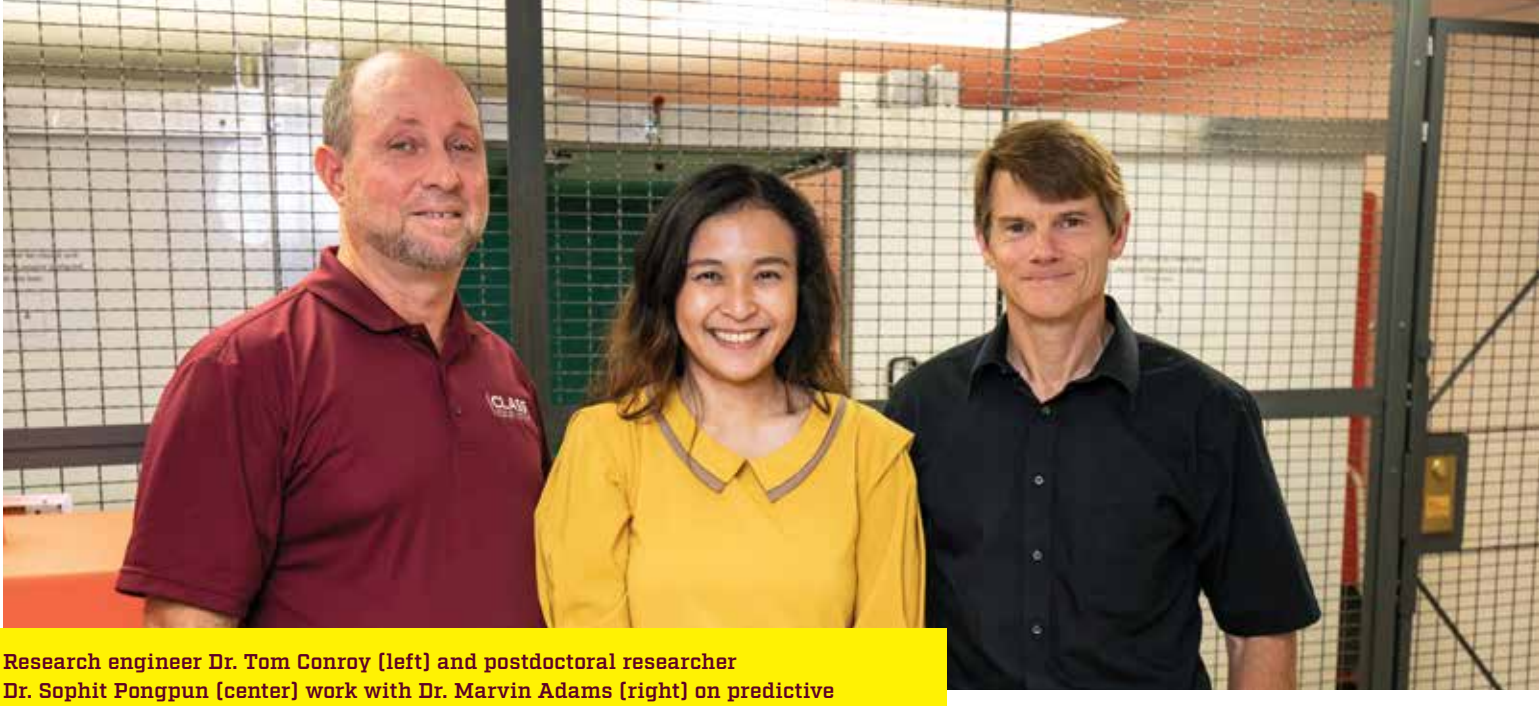
Dr. Adams' research team is developing advanced computational methods and new computational results, supporting the nation's nuclear deterrence.

PROJECTS

$11 million
Center for Exascale Radiation Transport

$1.4 million
"Computational R&D in Support of Stockpile Stewardship"

$1.5 million
"Collaborative R&D in Support of LLNL Missions"



Research engineer Dr. Tom Conroy (left) and postdoctoral researcher Dr. Sophit Pongpun (center) work with Dr. Marvin Adams (right) on predictive methods for thermal radiation transfer.

Through the $1.4 million "Computational R&D in Support of Stockpile Stewardship" project and the $1.5 million "Collaborative R&D in Support of LLNL Missions" project, the team is developing advanced computational methods and new computational results that support the nation's nuclear deterrence and other national security missions. This is the third set of three-year projects from LLNL that Adams and Morel have co-led. The projects grew out of Texas A&M's role as an Affiliate of Lawrence Livermore National Security, LLC, the organization that manages LLNL for the NNSA.

"The expertise we've developed here at Texas A&M is also part of what made us an attractive partner in the competition for the contract to manage and operate the Los Alamos National Laboratory (LANL), another DOE facility," says Adams. The Texas A&M University System, University of California and the Battelle Memorial Institute, united by their shared commitment to national service, formed Triad National Security, LLC, which was awarded the LANL contract in June 2018. The Triad team assumed management of LANL on November 1.

Featured Researcher:
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"The expertise we've developed here at Texas A&M is also part of what made us an attractive partner in the competition for the contract to manage and operate the Los Alamos National Laboratory (LANL), another DOE facility."

– Dr. Marvin Adams, Associate Director, Institute for National Security and Cybersecurity Education and Research; Deputy Director, Center for Exascale Radiation Transport; HTRI Professor

SPONSORS

U.S. Department of Energy's National Nuclear Security Administration

Lawrence Livermore National Lab

PARTNERS

Texas A&M University, the University of California and the Battelle Memorial Institute formed Triad National Security, LLC

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

National cybersecurity expert joins Texas A&M to lead cybersecurity initiative

Dr. Stephen Cambone discusses Texas A&M's role in the evolving cybersecurity field.

Q: What collaborations are helping Texas A&M become a major cybersecurity player?

A: The work we're doing is based in the College of Engineering, but we also collaborate with the Bush School of Government and Public Service. The Bush School has hired professors – a former deputy of United States Cyber Command (USCYBERCOM) and a former chief of staff for the United States Air Force – and they're establishing a center for policy research related to cyber issues.

Q: The Army Futures Command will be located in Austin. What does that mean for the cybersecurity program?

A: It is a terrific opportunity to do basic research in the cyber world and apply that research, leading to actual deployment of physical systems that will enable the Army to perform its mission.

Q: How is Texas A&M expanding efforts to work with government entities?

A: We've developed relationships with USCYBERCOM, the National Security Agency (NSA) and other agencies. There's work in blockchain analysis encryption and secure hardware and software development. The NSA, in cooperation with the Department of Homeland Security, jointly issues certifications to universities for their work in the cyber field relative to cyber education, cyber research and cyber operations. Texas A&M holds all three.

Q: What funding has Texas A&M secured that will benefit students?

A: We've received awards from the Department of Defense, more specifically from the Air Force, and the National Science Foundation awarded the university $4 million to provide scholarships to both undergraduate and graduate students pursuing cybersecurity fields.

Featured Researcher: Dr. Stephen A. Cambone
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CAMBONE SERVED AS THE **FIRST** U.S. UNDERSECRETARY OF DEFENSE FOR INTELLIGENCE.

TEXAS A&M ENGINEERING

is proud to be part of

TRIAD National Security, LLC

recently awarded a $2.5 billion annual contract from the U.S. National Nuclear Security Administration to operate Los Alamos National Laboratory.

"Los Alamos is one of the most important nuclear security assets in the world. We are committed to working with our partners to enhance safety and security at the lab while advancing its world-class science and executing its vital missions."

– John Sharp
Chancellor of The Texas A&M University System

Triad is a nonprofit, public service-focused organization

TRIAD MEMBERS:

BATTELLE

THE TEXAS A&M UNIVERSITY SYSTEM

UNIVERSITY OF CALIFORNIA

TRIAD INTEGRATED SUBCONTRACTORS:
Fluor Federal Services
Huntington Ingalls Industries

TRIAD SMALL BUSINESS SUBCONTRACTORS:
Longenecker & Associates
Merrick-SMSI
TechSource

DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

Helping wounds heal with smart skin grafts

Featured Researcher: Dr. Svetlana Sukhishvili
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Patients need smarter skin grafts that facilitate healing and minimize infection, especially if they have chronic or slow-healing wounds.

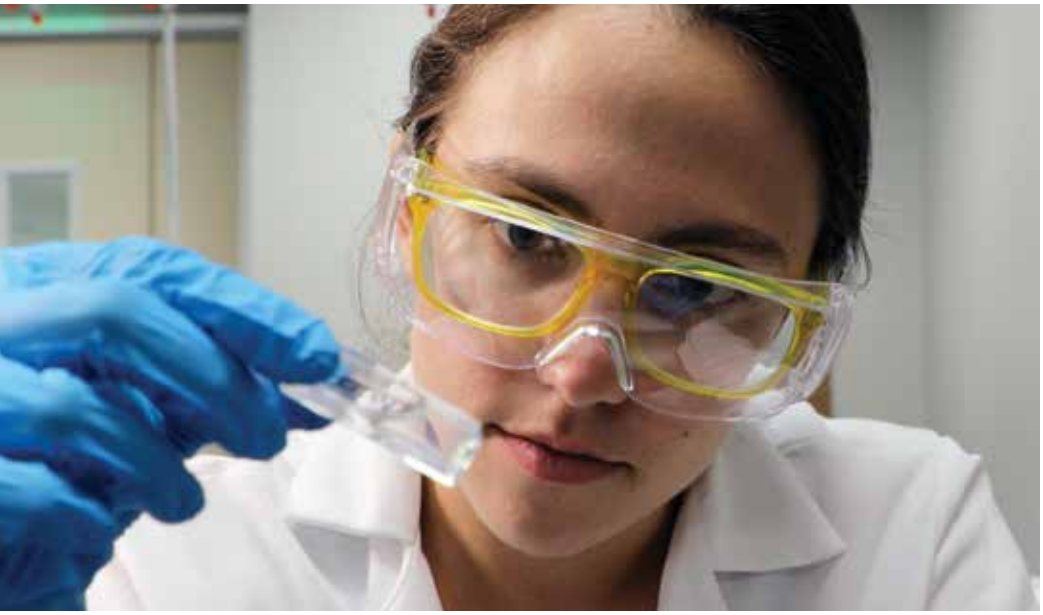
Dr. Svetlana Sukhishvili and her research team, along with Dr. Hongjun Wang, professor and chair of the Department of Biomedical Engineering at Stevens Institute of Technology, set out to develop such a solution.

Sukhishvili's team investigated how to build a stimuli-responsive polymeric material that could absorb and release antibiotics when prompted by a physiologically relevant stimulus. They added functional containers, or micelles, on the surface of biodegradable fiber meshes to enhance surface functionality.

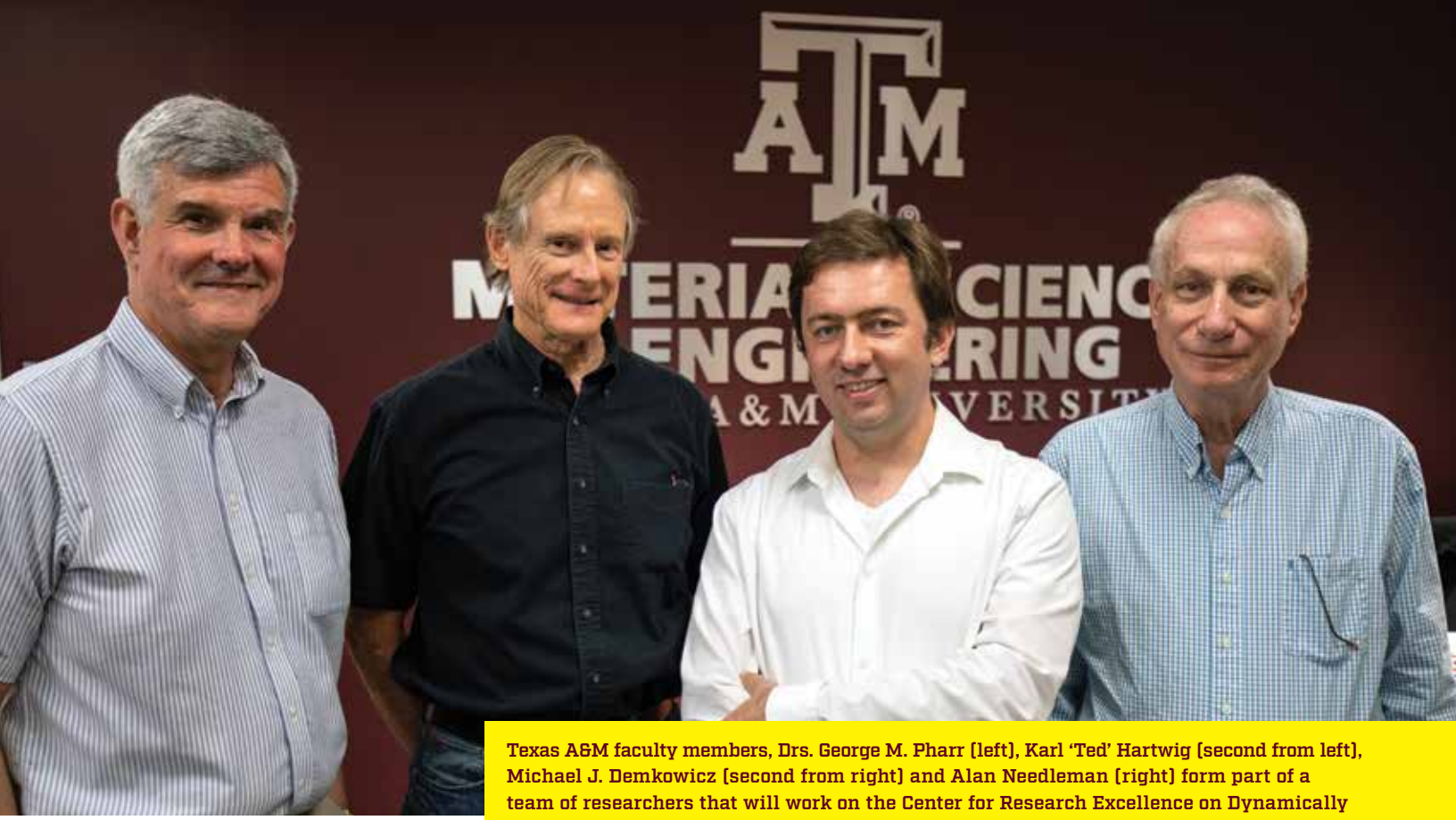
Wang and his team studied the material's interaction with human cells. They found it was not only nontoxic but also enhanced cellular growth and migration due to the surface-bound micelles, which changed the surface topography.

This could be a game-changer for diabetic ulcers and other chronic wounds. The researchers are now working with clinicians to enhance the graft's real-world applicability for different types of wounds.

Dr. Svetlana Sukhishvili's team investigated how to build a stimuli-responsive polymeric material that could absorb and release antibiotics when prompted by a physiologically relevant stimulus.



A "smart" skin graft could be key to healing diabetic ulcers and chronic wounds.



Texas A&M faculty members, Drs. George M. Pharr (left), Karl 'Ted' Hartwig (second from left), Michael J. Demkowicz (second from right) and Alan Needleman (right) form part of a team of researchers that will work on the Center for Research Excellence on Dynamically Deformed Solids project.

DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

Training new scientists to analyze aging weapons

A new, multi-university center led by Texas A&M will contribute to the understanding of materials science fundamental to the maintenance of the United States' nuclear deterrent. Of equal importance, it will also train the next generation of scientists and engineers who will ensure the safety, security and effectiveness of the nuclear weapons stockpile.

"We are honored to be selected as a new National Nuclear Security Administration (NNSA) center," says Dr. Michael J. Demkowicz, who serves as director of the Center for Research Excellence on Dynamically Deformed Solids (CREDDS). "In addition to CREDDS' support of the Nation's Stockpile Stewardship Mission and training of future scientists, I am excited about the new science that will come out of it."

CREDDS will provide a variety of outreach activities, including seminars and a summer school planned for the fourth year of the project. In addition, undergraduates, graduate students and postdoctoral associates affiliated with CREDDS will have the opportunity to visit and spend extended periods of time at the national laboratories involved in stockpile stewardship.

"This is about educating the next generation of scientists and engineers to support stockpile stewardship," says Dr. Andrew L. Ross, Brent Scowcroft Chair of International Policy Studies in the Department of International Affairs at the Bush School of Government & Public Service at Texas A&M and director of the National Security Affairs Program. "We need to have people who can do this, not just now, but 10, 20 years down the road. Given the strength of our engineering program – top ranked, not just in the country but in the world – it's the right place to do this kind of work. I'm not surprised that NNSA chose Texas A&M to take the lead."

Featured Researcher:
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AggieFab researchers deposit thin films of material onto a surface using the Clustex 100sp Multi-Deposition Sputter.

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

HPE donation enables new advanced materials and photonics research

Recognizing that the Texas A&M University College of Engineering has "enormous reach and the ability to shape the future of the IT industry and its workforce," Hewlett Packard Enterprise (HPE) recently donated equipment valued at $18 million and $1.5 million to establish an endowed chair in the Department of Electrical and Computer Engineering.

"We anticipate that this huge jump in our capabilities will attract researchers outside our university to come here to not only use our facility but also collaborate with our faculty," says Dr. Arum Han.

The AggieFab Nanofabrication Facility is a shared nano/microfabrication facility with more than 6,500 square feet of class 100/1000 cleanroom space. It also has a raised access floor and vertical laminar flow, as well as an additional 4,500 square feet of support space. The facility has state-of-the-art equipment for full ranges of micro and nanoscale fabrication on diverse materials.

Among the equipment donated by HPE is a Clustex 100sp Multi-Deposition Sputter, used to deposit different material layers on a wafer; a Titan Themis Transmission Electron Microscope; an FEI Helios NanoLab™ DualBeam™ Focused Ion Beam system; and a Zeiss Orion Plus Helium Ion Microscope/NanoFab.

These nanopatterning and atomic-level film deposition instruments will give Texas A&M researchers the chance to develop next-generation technologies across several disciplines.

"The suite of state-of-the-art nanopatterning and atomic-level thin film deposition instruments just donated by Hewlett Packard Enterprise will provide new capabilities," Han says. "Researchers can now develop next-generation computer chips for more powerful but energy-efficient computing, integrated photonic devices and microsensors for biosensing/medical applications or better autonomous vehicles, or flexible electronic devices and micro/nanofluidic systems for continuous health monitoring or point of care diagnosis in remote settings."

"It typically takes three to four years of intensive effort and institutional support to acquire even one instrument that HPE just donated. Having four such high-end instruments coming to our cleanroom facility simultaneously is just absolutely amazing and is unheard of for any university cleanroom."

– Dr. Arum Han, Director, AggieFab Nanofabrication Facility and Professor

He says departmental researchers are extremely thankful to HPE and to the Texas A&M Engineering Experiment Station leadership who helped make the donation possible.

"It typically takes three to four years of intensive effort and institutional support to acquire even one instrument that HPE just donated," explains Han. "Having four such high-end instruments coming to our cleanroom facility simultaneously is just absolutely amazing and is unheard of for any university cleanroom."

The HPE gift of $1.5 million, combined with a donation of $500,000 by the Office of the President at Texas A&M, will establish the Hewlett Packard Enterprise Chair in the Department of Electrical and Computer Engineering. This endowed chair is designed to attract or retain an engineering faculty member with interests related to advanced materials and photonics.

"We are proud to build on the college's deep capabilities in materials science and physics to extend its expertise into the next generation of materials and computing architectures," says Mark Potter, chief technology officer of HPE and director of Hewlett Packard Labs. "At HPE, innovation is at the heart of our ethos, and we look forward to partnering further with the college on meaningful research that will shape our industry."

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HAROLD VANCE DEPARTMENT OF PETROLEUM ENGINEERING

Unearthing new oil recovery methods

Traditional hydraulic fracturing methods have left large portions of shale reservoirs unstimulated. In many thick reservoirs, there remain large, untouched oil reserves lying above or below the stimulated region. One Texas A&M team's research has the potential to enable operators of thousands of existing fractured horizontal wells to better select re-fracturing candidates and design re-fracture treatments that could increase oil production.

With $8 million from the Department of Energy, and further assistance from WildHorse Resource Development (WRD), Dr. Daniel Hill is leading a research team in developing an innovative field laboratory in the Eagle Ford Shale.

Thanks to organizational efforts from Dr. George Moridis, George and Joan Voneiff Professor in Unconventional Resources, Hill is collaborating with Dr. Jens Birkholzer and his team from the Lawrence Berkeley National Laboratory, Dr. Mark Zoback and his team from Stanford University, and Dr. Matthew Averill from WRD.

"By applying the most advanced monitoring technology ever implemented in the field, we will learn more than ever before about the hydraulic fracture systems created and the subsequent reservoir flow patterns in hydraulically fractured unconventional reservoirs," explains Hill.

WRD is contributing one existing well for re-fracturing and two new-stimulation wells, and also investing funds to drill and complete them while Hill and his team develop methods to improve the effectiveness of shale oil production.

Researchers investigating unconventional reservoirs will have the opportunity to conduct active seismic monitoring using fiber optics in observation wells, providing a real-time view of fracture propagation and stimulated volume for both new stimulations and legacy well re-fracturing. The team will also conduct time-lapse seismic monitoring of reservoir changes during initial production and enhanced oil recovery from a re-fractured well. A gas-injection-enhanced oil recovery pilot test in the re-fractured well will be the project's final phase.

$8M
DOE GRANT

THE EAGLE FORD SHALE LABORATORY: A FIELD STUDY OF THE STIMULATED RESERVOIR.

"The Eagle Ford Shale Laboratory will undoubtedly influence future drilling and well completion practices in shale reservoirs."

– Dr. Daniel Hill, Professor and Noble Chair, Harold Vance Department of Petroleum Engineering

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GROSS SQ. FT. OF RESEARCH SPACE

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GROSS SQ. FT. OF RESEARCH SPACE IN DEVELOPMENT

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ENGINEERING
TEXAS A&M UNIVERSITY

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Dr. Binayak Mohanty and his Vadose Zone Research Group are leading efforts to describe root zone soil water flow mechanisms.

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Dr. Binayak Mohanty records hydraulic measurements in the field at the Texas Water Observatory site in Sargent, Texas.

DEPARTMENT OF BIOLOGICAL & AGRICULTURAL ENGINEERING

Measuring water movement in soil from space

Understanding water movement in soil is critical for many earth science studies on a local to global scale. Traditional ground-based measurement techniques are limited to small-scale studies. Recently, with the deployment of Earth-observing satellites like the Soil Moisture Active Passive (SMAP) and Soil Moisture and Ocean Salinity (SMOS) satellites, researchers have gained opportunities to measure soil water retention and hydraulic properties from space.

Funded by NASA through its Science Utilization of SMAP (SUSMAP) project, Dr. Binayak Mohanty and his Vadose Zone Research Group are leading efforts to describe root zone soil water flow mechanisms. They're also working to estimate effective hydraulic properties at various spatial scales – ranging from field plot, watershed, and river basin regions to the entire continent – using space-borne sensors. SMAP is measuring soil moisture over a three-year period, every two to three days. This permits changes around the world to be observed over time scales ranging from major storms to repeated measurements of changes over seasons.

The team's proposed remote-sensing, modeling and scaling approach will be evaluated in different hydro-climatic regions such as humid Iowa, semi-humid Oklahoma and semi-arid Arizona. Measuring soil hydraulic properties in complex landscapes and multiple scales from remotely sensed soil moisture data will help researchers develop new models. It will also have a tremendous impact on their ability to predict terrestrial hydrology, agriculture, weather, climate change and global circulation of water, energy and chemicals in the environment.

NASA's SUSMAP project is based on Mohanty's group's successful proof-of-concept demonstration over the past decade. The Vadose Zone Research Group carries out research on a wide spectrum of topics related to the unsaturated zone, like numerical modeling of hydrological processes, soil biogeochemistry, scaling issues in hydrology, and field-scale observations and measurements.

Mohanty has also led the establishment of the Texas Water Observatory (http://two.tamu.edu) in the Brazos river corridor as a ground-based observational platform for testing many of these remote-sensing-based science applications.

DEPARTMENT OF INDUSTRIAL & SYSTEMS ENGINEERING

Reusing and repurposing wasted heat energy

A research group led by Dr. Shiren Wang is working to find efficient solutions for reusing and repurposing wasted heat energy.

Wang's research group has invented a new hybrid nanostructure, with good mechanical flexibility and outstanding thermoelectric properties, that can serve as ink for scalable printing. In an iPhone X, printing of Wang's thermoelectric materials onto the battery could extend the battery life five to 10 minutes. Integrated within a vehicle engine, it can improve fuel efficiency by 6 percent in freeway driving.

His research has been selected for publication in the Royal Society of Chemistry's prestigious *Energy & Environmental Science* journal.

Industrial processes consume fuel to implement desired operations. Traditionally, more than half of the energy produced is lost through waste heat. Thermoelectric products are made from special materials that absorb heat and create electricity.

These products often need to have complex geometries that fit in tightly constrained spaces, which makes 3D printing the ideal manufacturing technique. Printable materials that demonstrate flexibility and high thermoelectric performance have been in short supply, but Wang is seeking new innovative solutions.

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DEPARTMENT OF OCEAN ENGINEERING

Improving predictive models and coastal resilience

Information gathered during hurricanes by the Texas COAstal Storm Rapid Response team, composed of researchers from Texas A&M University at College Station and Galveston, and Rice University, could help ensure better predictions of hurricanes' impact and potential damage.

"Our field measurements of hydrodynamics and sedimentation during and after hurricane impact allow us to improve predictive models and tools so they can be used by federal, state and local agencies to issue public notifications, allocate resources and plan appropriate responses based on expected local conditions," says Dr. Jens Figlus.

Figlus and his team seek information to help them understand if storm impacts will erode the beach; cut or wipe out sand dunes; or produce sediment deposits requiring expensive cleanup efforts. Being better prepared for these outcomes can help improve coastal resiliency.

The researchers are specifically interested in infragravity waves, which are surface waves with long periods and low frequencies, produced by hurricanes and how they affect coastal erosion, accretion patterns and storm damage. Similar to how different frequencies of light waves from the sun can create different colors in a rainbow, water waves in certain frequency ranges hitting a coastline can have specific erosion and deposition effects.

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Understanding the backbone of bitcoin

Dr. Juan Garay, author of "The Bitcoin Backbone Protocol: Analysis and Applications" – which was among CoinDesk's top 10 cryptocurrency research papers of 2015 – is focused on understanding the fundamental properties of blockchain data structure and protocol. Blockchain serves as the core of the virtual currency bitcoin.

"It is called a protocol because it is a collection of programs, one for each participant," Garay says. "There are multiple participants that perform so-called 'proofs of work' and exchange messages. My work was the first to formally define this, analyze it and prove the basic properties of the underlying data structure."

Garay's research focuses on the specification and contrast of computational models on which blockchain protocols are run, together with the required trusted setup and computational assumptions and the cryptographic tools that enable their operation.

"My work was the first to formally define this, analyze it and prove the basic properties of the underlying data structure."

– Dr. Juan Garay, Professor

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Using genomic data to understand disease response

Using signal processing and machine learning tools, Dr. Xiaoning Qian and his team are working to decipher which genes are critical to understanding and predicting disease progression and how genetic differences and environmental stress change the living system. These answers would help biologists develop new disease management practices.

As biologists provide Qian with various affected gene data sets, he and his students develop models and algorithms to analyze the data. They seek to identify important genes, decode which are intertwined and understand which trigger system response, like in immune pathways.

Qian's goal is to develop analytic methods that lead to biologically meaningful messages. This could ultimately help create user-friendly software for biologists.

Currently, the team is in the early stage of developing methods to effectively analyze genomic data. They are incorporating Bayesian methods, which integrate the uncertainty inherent in limited data samples, and attempting to reconstruct the dynamic system of cells based on their data analysis.

The methodology Qian is developing relies on big data set analyses and machine learning algorithms, which has application potential that extends well beyond genomics. Following this development, he will seek to have his findings validated across multiple studies.

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DEPARTMENT OF
BIOMEDICAL ENGINEERING

Building a scaffold to heal bone defects

People with cranial bone defects due to injury, birth defects or surgery have traditionally been treated with bone grafts, which cannot be easily manipulated to fit within irregularly shaped defects. Without proper fit and good contact with neighboring bone tissue, defect healing is compromised.

Dr. Melissa Grunlan recently received $1.9 million from the National Institutes of Health (NIH) to continue developing and testing a new shape-shifting foam designed to precisely fill and promote healing of defects.

"Bone defects can cause tremendous functional problems and aesthetic issues for individuals, so it was recognized that a better treatment would make a big impact," says Grunlan.

The new material acts as a scaffold that temporarily supports bone healing and then dissolves, leaving behind a healed defect. It becomes malleable when exposed to warm saline, allowing it to be press-fitted and perfectly conform into the bone defect before it becomes rigid.

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Dr. Melissa Grunlan's shape-shifting foam acts as a scaffold to support bone healing.

DEPARTMENT OF BIOMEDICAL ENGINEERING

Positioned to make regenerative medicine treatments possible

Featured Researcher: Dr. Roland R. Kaunas
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Regenerative therapy research is rapidly growing, but before stem cell-based treatments can move from the lab to clinical use, many more cells are needed.

"Once you scale up to having these treatments readily available for patients, you have to make a ton of high-quality cells," says Dr. Roland Kaunas.

Texas A&M, with its history of expertise in manufacturing, might be key to a successful scale-up.

Serving as regional lead for the Advanced Regenerative Manufacturing Institute, and receiving grants from the National Science Foundation and National Institutes of Health, Texas A&M is already a leader in this emerging field.

Kaunas and fellow researchers are working on validating bioreactors, which can make large amounts of cells. They will turn to Texas A&M's experts in biophotonics and manufacturing processes to help reduce the number of bad lots of cells, a crucial step in bringing treatment prices down.

Kaunas is also developing curricula for graduate students and professionals in the field (even those without advanced degrees) so they can apply statistical methods for manufacturing to this new field and run bioreactors.

ARTIE MCFERRIN DEPARTMENT OF CHEMICAL ENGINEERING

Linking gut microbiota to liver disease

Nonalcoholic fatty liver disease (NAFLD) is the most common liver disease in Western countries and correlates strongly with obesity and metabolic syndrome. It ranges from benign, reversible steatosis to irreversible nonalcoholic steatohepatitis, which can lead to fibrosis and liver cancer.

Dr. Arul Jayaraman, fellow researchers at Texas A&M and Dr. Kyongbum Lee at Tufts University have found a high-fat diet significantly changes the composition and function of a person's intestinal microbiota, specifically three metabolites – tryptamine (TA), indole-3-acetate (I3A) and xanthurenic acid. Two have a direct link to fatty liver disease.

The team found TA and I3A reduce expression of inflammatory molecules in macrophages and fat accumulation in hepatocytes. Depletion of both promotes NAFLD progression.

The researchers have examined the feasibility of adding TA and I3A back to the system to control NAFLD and found I3A is better suited for controlling fat accumulation and inflammation.

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DEPARTMENT OF ENGINEERING TECHNOLOGY & INDUSTRIAL DISTRIBUTION

The future of STEM education

Last summer, an interdisciplinary research team trained 12 Texas teachers in building automation, the internet of things, the engineering design process and additive manufacturing while providing STEM software, a 3D printer and internet of things measurement devices for their classrooms.

The "Connected STEM – Promoting STEM Education through Connected Devices and Building Automation" project, funded by a $1 million National Science Foundation grant, includes Dr. Michael Johnson, Dr. Joseph Morgan, Dr. Jay Porter and Dr. Mathew Kuttolamadom from the Department of Engineering Technology and Industrial Distribution, Dr. Jennifer Whitfield from the Department of Mathematics and Dr. Bugrahan Yalvac from the Department of Teaching, Learning and Culture.

One of the most exciting aspects of this project is the potential for it to become a new standard of teaching STEM in classrooms, not only in Texas, but potentially the rest of the nation and even the world.

"Now that the teachers have this capability and understanding they can incorporate it into their classrooms for a long time," says Johnson.

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U.S. Secretary of Energy Rick Perry tours Texas A&M's new Center for Infrastructure Renewal.

Texas A&M University System Chancellor John Sharp (right) welcomed U.S. Secretary of Energy Rick Perry, who visited the center and toured the labs' capabilities related to President Trump's vision for tackling our country's aging infrastructure.

U.S. Air Force Secretary Heather Wilson visits Texas A&M, host of the Air Force Science and Technology 2030 Forum.

Secretary of the U.S. Air Force Heather Wilson visits with Dr. Rodney Bowersox, Director, Texas A&M National Aerothermochemistry and Hypersonics Laboratory. Wilson visited Texas A&M labs after addressing invited guests from academia and industry at the Air Force Science and Technology 2030 Forum hosted by Texas A&M.

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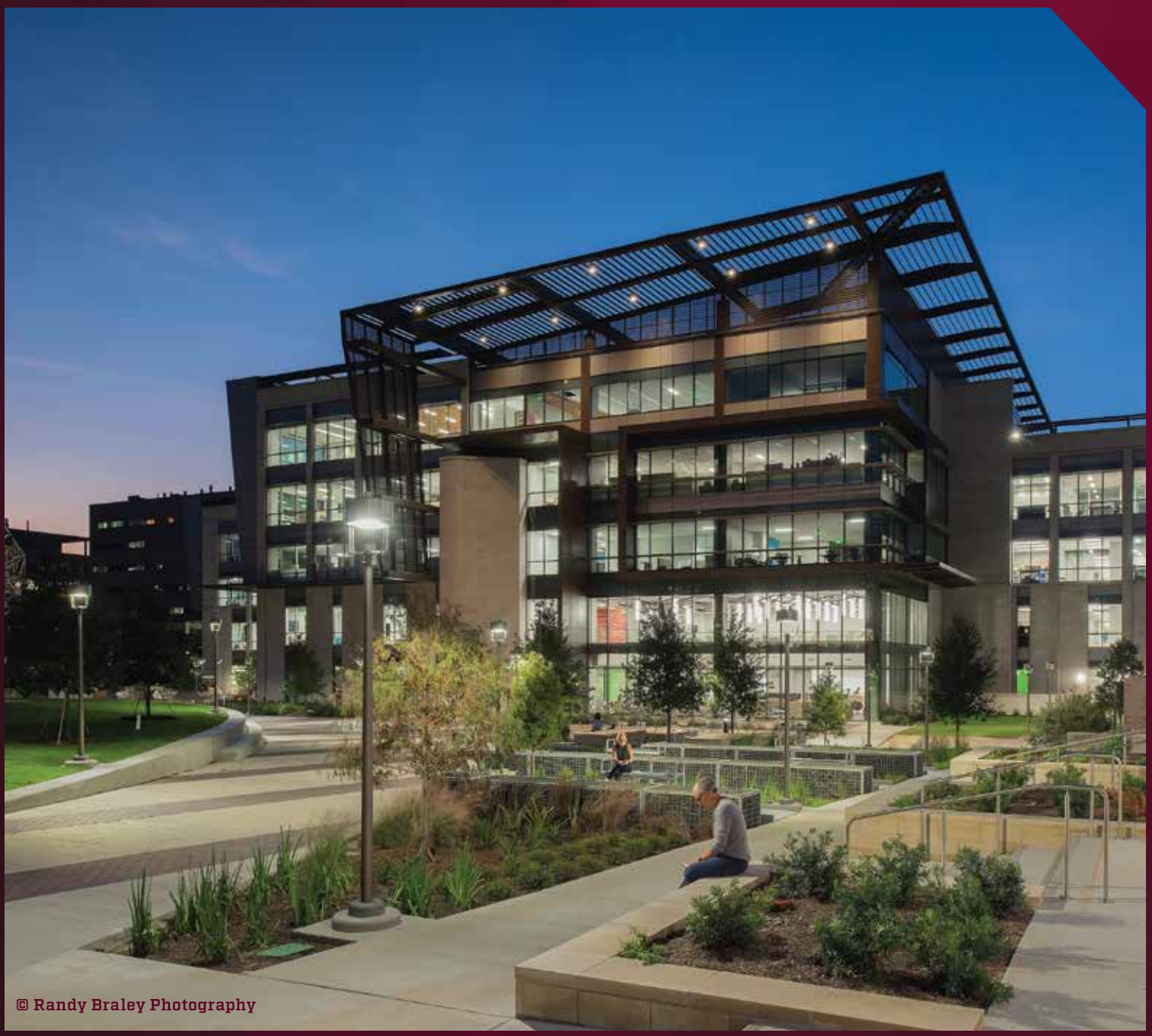

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