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ARIZONA ENGINEER

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THE RESEARCH ISSUE

INSIDE THIS EDITION

THE UNIVERSITY OF ARIZONA

Keeping the Focus on Research

Dear alumni and friends,

I hope you are enjoying the fall; the weather has turned, and it's beautiful here on campus. It was wonderful to see so many of you at Homecoming. What a long two years it has been.

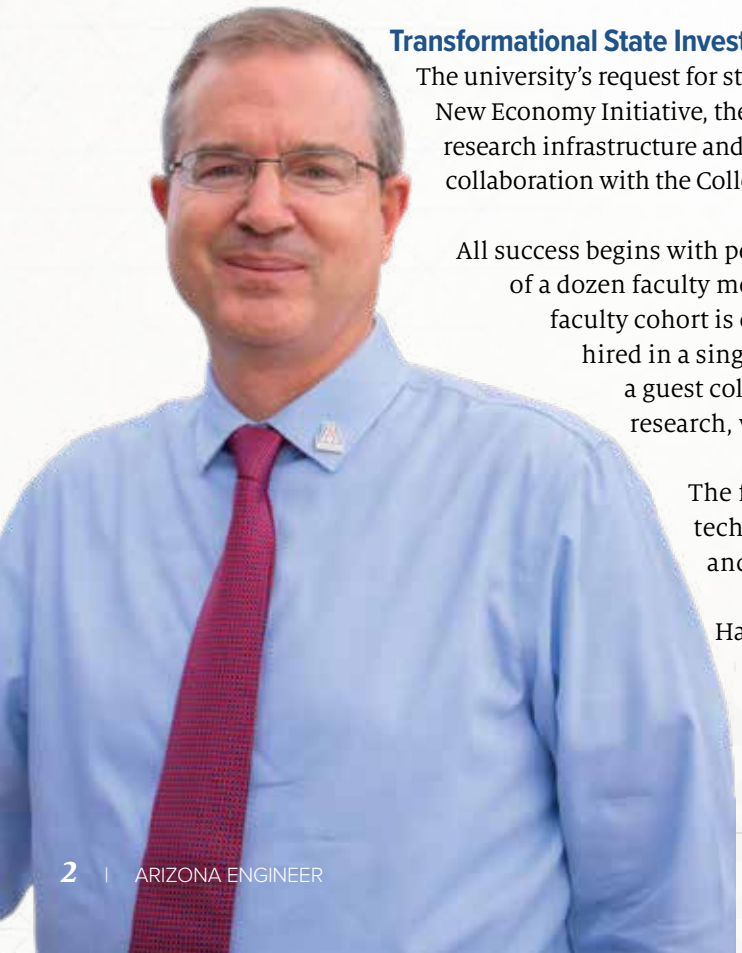
Heading into the fall semester, the four words that characterized the campus spirit were, "Our students are back!" With strong leadership from President Robbins and Provost Folks, college faculty and staff members worked together to bring students safely back to campus and into classrooms and labs. The importance of experiential learning, the theme of the last issue of this magazine, was validated hundreds of times over as we welcomed students into first-year design, reinvigorated design-build clubs, and kicked off the 2021-2022 Interdisciplinary Capstone projects.

I often talk about our three missions of teaching, research and service. With this issue, I want to focus on the college's research enterprise.

Moving at Speeds of Light and Sound

You will read about breakthroughs in quantum communication – where Zheshen Zhang and his colleagues are placing the university among the nation's leaders – laser work in the Center for Directed Energy, and the college's prominence in hypersonic flight. Erica Corral, who is on the Technical Advisory Board for the DOD University Consortium for Applied Hypersonics, is providing national leadership.

University of Arizona engineers are tackling the big societal problems of food and water, energy, health care and security. This issue covers work in line with the university's worldwide reputation in water resources, additive manufacturing, and health care solutions – including an exciting new center for wireless sensing and wearable devices.



Transformational State Investment

The university's request for strategic investment resonated up in Phoenix. Through the state's New Economy Initiative, the College of Engineering received considerable funding for growth, research infrastructure and, an interdisciplinary School of Mining and Mineral Resources in collaboration with the College of Science.

All success begins with people. Thus, the state's investment has helped support the hiring of a dozen faculty members, profiled in this issue, and even more staff. This incoming faculty cohort is one of the largest and most diverse ensembles the college has hired in a single year. Associate dean of research Mark Van Dyke, who has a guest column on Page 4, is leading the college's strategic planning for research, which will guide additional investment in coming years.

The future is bright as the college contributes more and more to technological advancement and economic prosperity, in Arizona and beyond.

Have a great holiday season, and Bear Down!

David W. Hahn
Craig M. Berge Dean, College of Engineering

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COLLEGE OF ENGINEERING ▸ VOLUME 44 ▸ NUMBER 2 ▸ FALL 2021

The Laser-based Diagnostics Laboratory is led by Craig M. Berge Dean David W. Hahn and assistant research professor Daniel Diaz.

CONTENTS

FEATURED STORY

IN EVERY ISSUE

IN THIS ISSUE

5

$4M in Mining School Funding — State's annual allocation supports education for future workforce in mineral resources.

11

Illuminating Neuron Activity — The Gutruf Lab is developing new devices for optogenetics, in hopes of ultimately treating neurodegenerative diseases.

14

Homecoming 2021 — Friends of the college come together to celebrate alumni awardees, the return of in-person events and Wildcat Engineering spirit.

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GUEST COLUMN

by **Mark Van Dyke**
Associate Dean of Research

An Era of Unprecedented Growth Is Upon Us

The college is making the most of extraordinary opportunities to improve lives and chart the course of our state, country and the world.

High Expectations & Lofty Aspirations

Fueled by increases in the number of students, dozens of new faculty, and investments in facilities and capabilities, the University of Arizona engineering research enterprise is contributing significantly to our collective future and poised for growth. The college is immersed in a strategic planning process that spans all departments, crosses research areas from acoustics to water, and involves almost every faculty member. We project that research and development expenditures – presently at $53M annually – will double in the next five years.

These ambitious goals are supported not only by the research roadmap arising from strategic planning and the addition of new faculty, but also by two other initiatives – a faculty onboarding program and research centers of excellence.

Onboarding Faculty for a Fast Start

The faculty onboarding program, developed collaboratively with Kathleen Melde, associate dean of faculty affairs and inclusion, gives newly hired faculty a fast start with best practices for research and teaching. The program also helps established faculty members build on their research accomplishments. It is essential for faculty leaders seeking to grow their research efforts and establish national and international prominence in their fields.

Making a Home for Centers of Excellence

The college has launched three centers in the last year and partnered with optical sciences on another. Two are funded by the National Science Foundation and two are internally funded. The Center for Quantum Networks (CQN) and the Center to Stream Healthcare in Place (C2SHIP) are the latest NSF-funded centers. The Center for Applied Transportation Sciences (CATS) and the Center for Directed Energy (CDE) were started with support from the university's Office of Research, Innovation and Impact. State and national investment in a fifth center, the Arizona Research Center for Hypersonics (ARCH), is expanding wind tunnel facilities and advancing flight research.

Additional centers are slated to start up in 2022 to bolster the college's research strengths. These centers are the front door to the engineering research enterprise. Each one is a hub for collaboration across the college and university and with government and industry.

Opportunities Beget Change

The goal is faculty participation across the college, more research projects involving undergraduates and graduate students, equity and access by all who share our aspirations, and – perhaps most importantly – even greater contributions to economic growth and technological advancement.

These are unprecedented times with extraordinary opportunities to improve lives and help chart the course of our state, country and the world. The college is committed to making the most of it.

State Approves $4M Annually for School of Mining and Mineral Resources

ABOUT 45,000 JOBS in Arizona are connected to mining. Many top industries – including aerospace, manufacturing, technology, health care and renewable energy – rely on Arizona's minerals, particularly copper. That makes Arizona, which produces three-fourths of the nation's copper and is the fifth-largest producer in the world, a key player in the global economy.

The Department of Mining and Geological Engineering has an ongoing relationship with Groundprobe, a global mining company with an office in Tucson, Arizona.

It also makes the University of Arizona a major pipeline to employment in the state's mining sector and associated industries. That's one big reason the College of Engineering and College of Science established the School of Mining and Mineral Resources in 2021. The school is poised to advance sustainable practices, safety and automation, while also boosting Arizona's economy. The 2022 Arizona state budget allocates $4 million yearly in ongoing funding for the school.

> "This funding is critical to fulfilling our vision of establishing southern Arizona as the Silicon Valley of mining."
>
> **DAVID W. HAHN**
> *Craig M. Berge Dean of the College of Engineering*

"This investment was one of the most important issues to me this session," said David Gowan, senate appropriations chair and sponsor of the school's appropriation bill. "Mining is one of Arizona's main industries that contributes to our state's and country's rapid population growth and economic prosperity. Mined resources are required to create roads, hospitals, vehicles, houses and computers; to generate power; and to offer the many other goods and services that consumers need in today's technological world."

Holistic Approach Changes Landscape

Just as demand for minerals stretches across many sectors, the knowledge required to do mining comes from a number of areas. Thus, the school will take an interdisciplinary approach, drawing from expertise not just in engineering and science, but also in law, business, social sciences, public health and other disciplines.

"This funding is critical to fulfilling our vision of establishing southern Arizona as the Silicon Valley of mining," said David W. Hahn, the Craig M. Berge Dean of the College of Engineering. "With its globally recognized teaching and research enterprise, and through close collaboration with government and industry, the University of Arizona will be leading the way on a school that impacts every facet of the mining industry. It was very satisfying to see the close cooperation between legislators, UA leadership, and the state's mining industry to make this support a reality."

UA's mining engineering program is one of only 13 in the nation sanctioned by the Accreditation Board for Engineering and Technology Inc., and U.S. News & World Report ranks the university's geosciences graduate program third in the United States among geology graduate programs. The university is also home to the Lowell Institute for Mineral Resources, which advances scientific, technological and educational aspects of mineral discovery, extraction and processing.

"We are very grateful to Gov. Ducey and the Arizona legislature for their support of this school, and ultimately for one of the top industries in Arizona," said University of Arizona President Robert C. Robbins. "The University of Arizona's combination of faculty expertise, highly regarded programs, motivated students and geographic location mean it is perfectly positioned to educate a workforce for the mining industry of the future."

Mining and geological engineering alumna **Danielle Taran** works as a plant engineer at Granite Construction.

$10M Elevates Hypersonic Facilities to National Prominence

Aerospace and mechanical engineering faculty members **Alex Craig** and **Jesse Little** conduct experiments in the Boundary-Layer Stability and Transition Laboratory.

WITH $3.5 MILLION from the state of Arizona's investment in the New Economy Initiative and $6.5 million in federal support through the Department of Defense's Test Resource Management Center, aerospace and mechanical engineering researchers are upgrading the university's hypersonic facilities and research infrastructure.

The funding positions the UA as a leading educational institution in the hypersonics field.

"We're moving our wind tunnel complex into a more capable realm that you typically don't see at universities, because it's usually reserved for government facilities like NASA," said Alex Craig, assistant professor of aerospace and mechanical engineering.

"With these upgrades, we'll be able to provide impactful ground testing services to DOD and its contractors, NASA, and emerging private ventures supporting space and commercial travel, while still fulfilling our educational mission."

High-Speed Wind Tunnel Expansions

Wind tunnels blast air at high speeds past fixed objects, helping researchers better understand how similarly shaped objects, such as aircraft and missiles, behave in flight. Wind tunnel speed is represented by Mach number, with Mach 1 being equal to the speed of sound – about 761 mph at sea level.

> "The end result is a nationally unique pair of Mach 5 wind tunnels at the UA offering both quiet and conventional testing at an industry-relevant scale."
>
> **JESSE LITTLE**, *associate professor of aerospace and mechanical engineering*

The University of Arizona is home to two hypersonic facilities and additional wind tunnels equipped for testing from Mach 0 to Mach 5.

The Boundary-Layer Stability and Transition Laboratory, led by Craig, houses a 15-inch-diameter Mach 5 Ludwieg tube, also known as LT5. The Turbulence and Flow Control Laboratory is led by aerospace and mechanical engineering associate professor Jesse Little. Its newest addition is the Arizona Supersonic Wind Tunnel (ASWT), which operates at speeds ranging from Mach 1.75 to Mach 4.

The Mach number is changed by adding different nozzle blocks – 12 in total – weighing about 1,800 pounds each.

The funding will support upgrades for both facilities.

"These upgrades will enable us to expand our relationship with the University of Arizona to include not only accelerated product development, but also to grow the next generation of aerodynamicists through early, hands-on test experience," said Roy Donelson, executive director and product area director of Strategic Engagement Systems, Strategic Missile Defense for Raytheon Missiles and Defense.

The upgrades include a Mach 5 nozzle that extends the capacity of ASWT and a system to increase air generation by a factor of 10 and air storage capacity by a factor of three. Additionally, it supports the installation of a new nozzle for the tunnel to create quiet flow, more closely imitating what flight is like in the Earth's atmosphere. The team also will install an automation system to increase the testing capacity of LT5, from about five tests a day to 70 tests per day.

"The end result is a nationally unique pair of Mach 5 wind tunnels at the UA offering both quiet and conventional testing at an industry-relevant scale," Little said.

Polyglot Student Lands Astronaut Scholarship

Roberto Peralta plans to design low-cost prosthetic limbs for the global community.

ROBERTO PERALTA has known since he was a Lego-loving kid that he would one day work with prosthetics – particularly robotic arms.

Roberto Peralta (right) accepts his Astronaut Scholar certificate from former space shuttle astronaut **Curtis "Curt" Brown.**

The mechanical engineering senior and National Hispanic Scholar is an undergraduate researcher who has worked on projects ranging from flexible biomedical devices to Mars-exploring robots. He also happens to speak four languages. Among his most recent accomplishments is being named an Astronaut Scholar. The Astronaut Scholarship Foundation supports top scholars in science, technology, engineering and mathematics to commemorate the legacy of America's pioneering astronauts. The 2021 Astronaut Scholar Class includes 60 students from across the nation.

"Roberto is a superstar young engineer with a great future ahead of him," said Danielle Barefoot, program administrator for internal grants at the University of Arizona and former assistant director of the office of nationally competitive scholarships. "His never-quit spirit truly sets him apart from his peers."

A Cultural Connection

Peralta grew up in a family of engineers, so STEM was a natural choice. A high school mission trip to Haiti, where he met several amputees, reinforced his interest in prosthetics.

"I saw that these people were so capable, even though they were missing arms," he said. "They didn't let that stop them. At the same time, I knew that if they did have arms, they would be able to do more and provide for their families much more easily."

> "I saw that these people were so capable, even though they were missing arms. I knew that if they did have arms, they would be able to do more and provide for their families much more easily."
>
> **ROBERTO PERALTA**, *mechanical engineering senior*

Peralta's interest in serving a global community ties in with his enthusiasm for languages. As the child of immigrants – his dad is from Mexico and mom from Canada – he grew up speaking English and Spanish. He picked up French in high school and fell in love with the culture. In college, he became the president of Club Voilà, the university's French club, and started teaching himself German. He also studied abroad and worked as a camp counselor at an international school during high school. Now some of his closest friends live in other countries.

"Language has always been a way for me to connect with my family, but also with international people who are like family to me," said Peralta, a member of the Society of Hispanic Professional Engineers and Tau Beta Pi, the National Engineering Honors Society.

From Space Exploration to Biomedical Devices

Peralta has researched integrated nanomanufacturing at Boston University through the National Science Foundation's Research Experience for Undergraduates, and he has designed robots to explore Mars in the UA ASTEROIDS Lab. But his research journey started in his first year of college, with biomedical engineering assistant professor Philipp Gutruf. The Gutruf Lab creates devices that integrate intimately with biological systems.

Peralta plans to earn a PhD in biomedical engineering then start a robotic prosthetic company.

"I just hope I can help a lot of people," he said. "Not just in my local community, but in my global community."

$3M Center Advances At-Home Health Care Technology

THE LAST TWO decades have seen an uptick in the use of wearable technologies, such as Fitbits and Apple Watches, to monitor health.

Electrical and computer engineering professor Janet Roveda is lead on a multiuniversity team developing clinically validated wearables, which continuously gather data about metrics like heart rate and blood pressure. The devices enable clinicians to gather patient data remotely and provide care in place so patients don't have to leave their homes. The Center to Stream Healthcare in Place, or C2SHIP, formed as a National Science Foundation Industry-University Cooperative Research Center, or IUCRC, in 2018.

> "Wearable technologies have become an integral part of so many people's lives, and these types of devices have tremendous potential to enhance the way health care is provided."
>
> **ROBERT C. ROBBINS, M.D.**
> *University of Arizona president*

C2SHIP recently received a continuing NSF grant of $3 million, with $1.125 million earmarked for the University of Arizona.

"Wearable technologies have become an integral part of so many people's lives, and these types of devices have tremendous potential to enhance the way health care is provided," said university President Robert C. Robbins, M.D. "Our researchers are leading efforts to maximize the power of these technologies."

Some clinics are already working toward providing health care in place, said Roveda, citing an example of her father using a high-end blood pressure cuff for a few months after being put on a new medication for a heart condition.

"They wanted to make sure the new medication was regulating his blood pressure, so the device was continuously sending data to the clinic," she said. "There were a couple of days that he didn't want to wear it, and he got a call from the doctor checking on him. I see huge potential in a device like that. Our vision is that, someday, you could go to CVS and pick up not just a medication, but also a home care-based instrument to gather data about your health."

Janet Roveda showcases an early chip design for a wearable device being developed in her laboratory.

The center's partner institutions are Baylor College of Medicine, the University of Southern California and the California Institute of Technology. Co-investigators at the University of Arizona are Ao Li, research assistant professor in electrical and computer engineering; Kathleen Melde, associate dean of faculty affairs and inclusion for the College of Engineering; and Hao Xin, professor of electrical and computer engineering.

"Dr. Roveda's primary research has been in digital circuit design, but she has transformed her research into new areas that include cross-cutting solutions spanning electrical engineering, biomedical engineering and health technologies," Melde said.

COVID-19 temporarily stalled funding for the center. But it also highlighted the importance of care in place, especially for medically fragile patients advised not to attend in-person appointments during the pandemic.

"The C2SHIP IUCRC is a perfect example of research that bridges across multiple engineering disciplines and into medicine to tackle important societal challenges," said Mark Van Dyke, associate dean of research in the College of Engineering. "Digital health and the Internet of Things are major components of our strategic plan, and the awarding of this project speaks to the critical mass we have already developed."

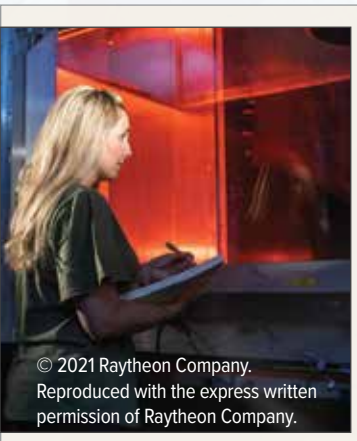
> "Our vision is that, someday, you could go to a pharmacy and pick up not just a medication, but also a home care-based instrument to gather data about your health."
>
> **JANET ROVEDA**
> *professor of electrical and computer engineering*

College Launches Centers on the Leading Edge

THE COLLEGE OF Engineering is launching a number of research centers that bring together faculty expertise, industry partners and government agencies to develop some of the world's top technologies. First out of the gate are hypersonic flight, high-powered lasers and transportation.

"These centers not only put us out in front with technology development, they also reinforce our commitment to doing collaborative research across campus, partnering with private companies and government, supporting entrepreneurialism and providing the very best experience for our students."

MARK VAN DYKE, *associate dean of research*



ARIZONA RESEARCH CENTER FOR HYPERSONICS

Hypersonic vehicles, which move at five times the speed of sound and faster, are a strategic priority for the U.S. military and companies like Raytheon. Ideally situated in the heart of the aerospace and defense industry, the university is a global leader in hypersonic flight.

ARCH includes researchers in aerospace and mechanical engineering, systems and industrial engineering, materials science and engineering, electrical and computer engineering, and applied mathematics. Among its facilities are wind tunnels with capabilities up to Mach 5, computation field dynamics laboratories, CyVerse data centers and a lab for manufacturing materials for extreme environments.

The University of Arizona is also a leadership institution in the University Consortium for Applied Hypersonics, a group of universities working with government, industry, national laboratories, and research centers to advance the field.

CENTER FOR DIRECTED ENERGY

The Center for Directed Energy is co-directed by David W. Hahn, the Craig M. Berge Dean of the College of Engineering and professor of aerospace and mechanical engineering; and Nasser Peyghambarian, professor of optical sciences and materials science and engineering, chair of photonics and lasers, and director of the National Science Foundation Engineering Research Center for Integrated Access Networks.

Directed energy technology uses a highly focused stream of energy – in forms such as light or microwaves – to affect a target with high precision and minimal collateral damage. While directed energy systems come in several types, this center focuses on lasers. The center, one of only two of its kind nationally in academia, is collaborating with five industry partners and the U.S. Navy.

CDE researchers plan to work closely with ARCH and the Center for Quantum Networks, which is housed in the James C. Wyant College of Optical Sciences.

CENTER FOR APPLIED TRANSPORTATION SCIENCES

Transportation researchers investigate mechanisms to reduce freeway traffic, optimize traffic signals, advance public transportation, ensure safety and improve sustainability. More recent transportation research investigates the effects of introducing new technologies, such electric scooters, uncrewed aerial systems, artificial intelligence and smart cities.

CATS is a research, training and capacity-building resource for regional governments, educational institutions and private companies. The center concentrates on smart cities, particularly transportation system management and mobility on demand.

Yao-Jan Wu, associate professor of civil and architectural engineering and mechanics and director of the Smart Transportation Lab, leads the center, with partners in engineering and the College of Landscape Architecture and Planning. Faculty members and students work with academia, industry and government to improve local, regional and national transportation systems.

Little Droplets With a Big Punch

Army Young Investigator Award winner develops a water test that uses oil droplets, rather than a solid sensor, to immediately detect contaminants.

IDENTIFYING ENVIRONMENTAL contaminants like lead and per-and polyfluoroalkyl substances, or PFAS, in water sources is critical to maintaining public health. Suchol Savagatrup received a three-year, $360,000 Young Investigator award from the Army Research Office to develop a quicker, more portable method of detecting contaminants.

Suchol Savagatrup works on testing equipment.

"Lab testing requires time and dedicated equipment, and what we're developing could be really useful for someone who wants an actionable item right away, rather than having to wait for samples to be transported back to the lab," said the assistant professor of chemical and environmental engineering.

Portable sensors in use today are dipped into liquid, and if the liquid is contaminated, the contaminants bind to or interact with the sensor. However, this method is prone to instability. Savagatrup's solution is liquid sensors, in the form of reconfigurable oil droplets that change color when they encounter contaminants.

"These oil droplets are fully submerged in water," he said. "So the boundary between each droplet and water is its own interface and provides an independent reading. If you have multiple of these droplets, you end up with a network of connected information, like neurons in the brain, or like pixels on a computer screen."

The constellation of color-changing droplets paints a picture of the types of contaminants present. Savagatrup and his team aim to establish what color combinations occur in the presence of specific chemicals – starting with PFAS. Then, they plan to train a computer program to recognize these correlations on its own.

"If successful, these signals can be used to generate fingerprints for a suite of toxic or environmentally damaging chemicals, rendering highly selective, sensitive and robust chemical sensors that the Army can use for ultra-trace detection, decontamination and source partitioning," said Elizabeth King-Doonan, program manager, Army Research Office.

Reducing Mud Accumulation

Civil engineer is combating sediment in reservoirs at the source: erosion.

JENNIFER DUAN, professor in civil and architectural engineering and mechanics, has received $90,000 from the Salt River Project to investigate – and ultimately help mitigate – the effect of erosion on water supply.

With reduced vegetation, partly brought on by climate change, comes increased erosion. This muddies water sources, and when the water makes its way down rivers into reservoirs, where it is stored for drinking and agricultural purposes, it carries the sediment with it. This sediment is left behind as the water leaves the reservoir. Increased sediment deposits are accumulating in reservoirs, taking up space that should be filled with water.

"The concern is that without these reservoirs, we don't have a water supply to our cities, to populated areas, to agriculture," Duan said. "How can we prevent more sediment from coming into reservoirs?"

Her work aims to answer that question. She is creating a model for erosion in the Munds Draw Watershed, part of the Verde River Watershed. She and a team will use the model to quantify how much soil reduction occurs through planned erosion control measures. They're starting by gathering field data about the different types of soil and distribution and density of vegetation in the watershed. She is collaborating with the Salt River Project, the Forest Service and Friends of the Verde River.

"This project is a pilot, and we want to look at the whole Salt River watershed in the future," she said.

Jennifer Duan conducts field work in the Munds Draw watershed.

Tiny Wireless Device Illuminates Neuron Activity in the Brain

An optogenetic device developed in the Gutruf Lab is as thin as a sheet of paper and about half the diameter of a dime.

EVERYTHING THAT HAPPENS in the brain is a result of neurons sending and receiving signals in complex networks that are not completely understood by scientists. These networks enable us to pick up a cup of coffee, laugh at a joke, or stand up from a chair. When some neurons do not send and receive signals properly, it can lead to problems such as epilepsy, depression, addiction and chronic pain.

University of Arizona engineering researchers, led by biomedical engineering assistant professor and Craig M. Berge Faculty Fellow Philipp Gutruf, are creating new tools for optogenetics, a process that involves shining light at specific neurons in the brain to excite or suppress activity. Experiments are aimed at increasing understanding of how the brain works so scientists can develop and test cures for illnesses such as neurodegenerative diseases.

UA researchers collaborated with researchers at Northwestern University to demonstrate an untethered light delivery tool that enables seamless optogenetics in the brain.

"This technique means we can use optogenetics without having to penetrate the skull or brain tissue, making it much less invasive," said Jokubas Ausra, a biomedical engineering doctoral student in the Gutruf Lab and first author of the paper.

> "We have a precursor technology that could someday help manage conditions like epilepsy or chronic pain without invasive surgery and chronic use of drugs."
>
> **PHILIPP GUTRUF**, *assistant professor of biomedical engineering & Craig M. Berge Faculty Fellow*

Tiny Device, Big Results

Optogenetic experiments, done in animal models, rely on a light-sensitive protein that attaches to specific neurons in the brain. Scientists then use a small device to send pulses of light to only these neurons and modulate their activity. For how powerful the tool is, the basic concept is straightforward: It's almost like using a tiny, high-tech flashlight.

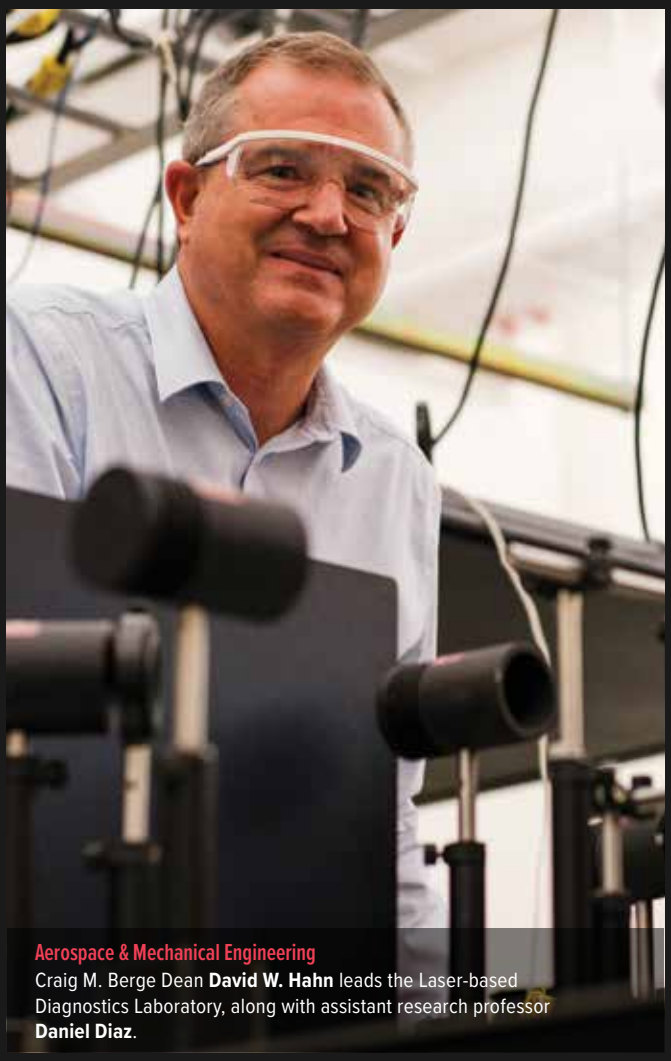
Gutruf and his team reported on the first wireless transcranial optogenetic simulation device that can send light through the skull rather than physically penetrating the blood-brain barrier. The transcranial technique is done using a wireless and battery-free device, as thin as a sheet of paper and about half the diameter of a dime, implanted just under the skin.

"This is significant because when optogenetics become available for humans, we have technology that enables seamless light delivery to neurons in the brain or spine," said Gutruf, who is also a member of the university's BIO5 Institute. "This means we have a precursor technology that could someday help manage conditions like epilepsy or chronic pain without invasive surgery and chronic use of drugs."

Speeding Up Future Progress

There is still a long way to go before the technology is available for humans. In particular, progress must be made on methods for introducing light-sensitive proteins into the human brain and periphery.

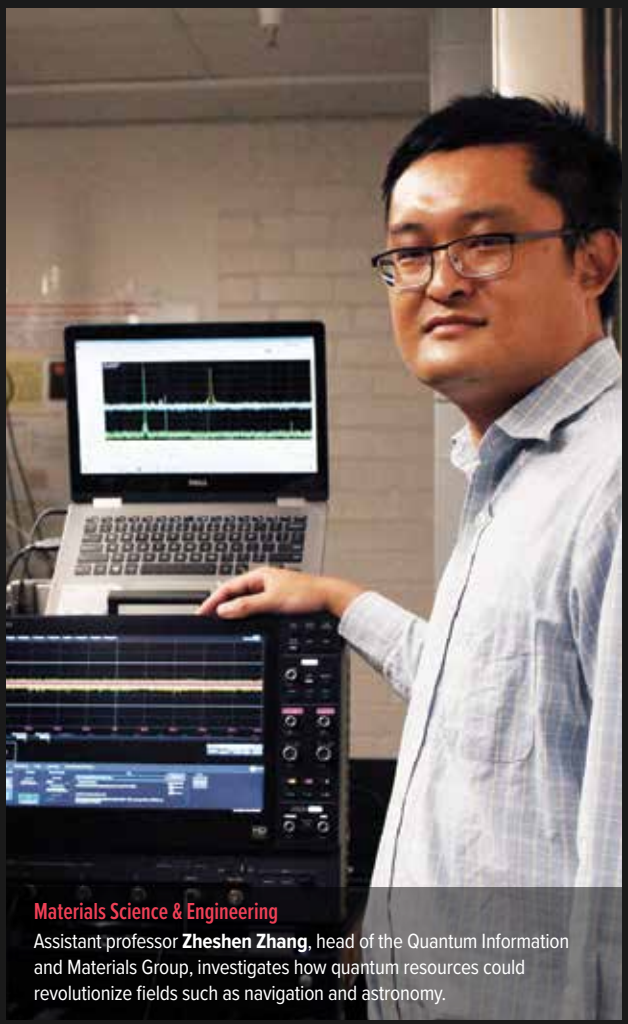
In the meantime, the breakthrough of a more powerful light delivery method improves scientists' ability to study subjects under more natural conditions. Because it doesn't require invasive probes, it also makes optogenetic research more accessible. Now, even labs without sophisticated surgical equipment could help advance the field.



Aerospace & Mechanical Engineering
Craig M. Berge Dean **David W. Hahn** leads the Laser-based Diagnostics Laboratory, along with assistant research professor **Daniel Diaz**.

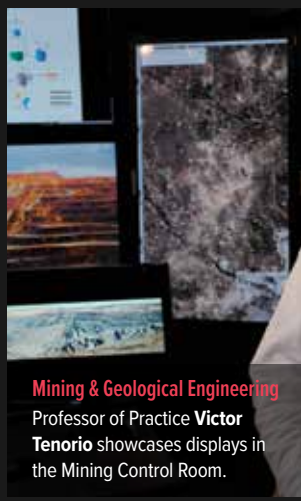
Biomedical Engineering
Assistant professor **Philipp Gutruf** and graduate student **Jokubas Ausra** hold an optogenetic device they developed, which could ultimately help treat neurodegenerative diseases.

Electrical & Computer Engineering
Graduate student **Jude Larbi Kwesi Coompson** works in the Millimeter Wave Circuits and Antennas Laboratory, led by professor **Hao Xin**.



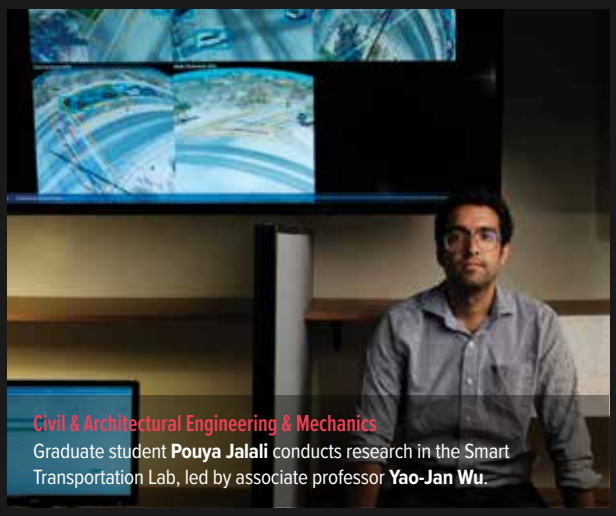
Materials Science & Engineering
Assistant professor **Zheshen Zhang**, head of the Quantum Information and Materials Group, investigates how quantum resources could revolutionize fields such as navigation and astronomy.

Engineering



Mining & Geological Engineering
Professor of Practice **Victor Tenorio** showcases displays in the Mining Control Room.

Biosystems Engineering
Graduate student **KC Shasteen** researches ways to improve efficiency in the Mars Lunar Greenhouse.



Civil & Architectural Engineering & Mechanics
Graduate student **Pouya Jalali** conducts research in the Smart Transportation Lab, led by associate professor **Yao-Jan Wu**.

Chemical & Environmental Engineering
Graduate student **Marisa Gonzalez** helps provide wastewater treatment education to Diné College students on the Navajo Nation.

DEPARTMENT RESEARCH

Engineering proudly holds 10 talented departments. Eight are housed solely in the College of Engineering. Two are jointly administered – optical sciences and engineering with the James C. Wyant College of Optical Sciences, and biosystems engineering in the College of Agriculture and Life Sciences. Researchers often collaborate across departments and colleges throughout the university. Here, the snapshots represent some of each department's work.

Optical Sciences & Engineering
Assistant professor **Dongkyun (DK) Kang** is developing a handheld smartphone microsope for cancer detection in rural settings.

Systems & Industrial Engineering
Graduate student **Yijie Chen** demonstrates a VR program for surgical training.

Students, faculty and staff show off their Wildcat spirit at the Homecoming tailgate party. Back row, from left to right: Engineering Ambassadors **Lucas Hawley**, **Miguel Gastelum**, **Zachary Schawelson** and **Collin Preszler**. Front row, from left to right: Associate dean for academic affairs **Jim Baygents**, associate director of strategic recruitment and outreach **Kelly Ratliff** and senior coordinator of recruitment and admissions **Leslie Grignon**.

Homecoming 2021: It Takes All Kinds in Engineering

SUSAN GRAY, president and CEO of Tucson Electric Power/UNS Energy Corp., welcomed alumni, students, faculty, staff and friends of the college to the Engineers Breakfast on Nov. 5, 2021.

"Don't tell the great folks at Eller," said Gray, who earned her BS in electrical engineering in 1996 and her MBA in 2001. "But I'll always be an engineer at heart, so I'm thrilled to be here this morning, celebrating with the best college at the University of Arizona."


Susan Gray

Gray's keynote speech was about the similarities between her experiences as a triathlete and a corporate leader. Both require persistence, hard work, the support of a diverse team, and a commitment to lifelong learning. She also commended the college for its strengthened commitment to diversity and inclusion.

David W. Hahn, Craig M. Berge Dean, highlighted the role of engineering in the state of Arizona's New Economy Initiative investment of $36 million in the University of Arizona.

"One-third of those dollars went to this college, to invest in the future," he said. "I'm really grateful that the university leadership and state government leadership see us as a college on the rise."

He also announced the college's four alumni award winners.

Young Alumni Professional Achievement Award

Makko DeFilippo

(BS geological engineering, 2009)

After graduation, DeFilippo earned an M.Sc. in metallurgical engineering from the Colorado School of Mines and worked in technical, corporate and mining-focused private equity roles. He is now president of Ero Copper, a mining company primarily operating in Brazil. He has kept in touch with many members of his graduating class.


Makko DeFilippo

"No matter where you are in the world, you end up meeting great people," he said. "That kind of extends to the department, which is full of great people who tend to be pretty tight knit because it's a small industry."

Alumnus of the Year

Tom Peterson

(MS, chemical engineering, 1973)

Peterson grew up going to football games at the University of Arizona, and when he started his master's degree in the College of Engineering, he realized he wanted to stay in academia.

"I ended up basically getting my dream job, which was to be a university professor at the UA," he said.

Peterson went on to become dean of the college, lead the Engineering Directorate at the National Science Foundation, and work as provost and executive vice chancellor at the University of California, Merced.

"I'm just unbelievably humbled to be included in this group of amazing alums we've selected over the years," he said.


Tom Peterson


Carole Haig

Professional Achievement Award

Carole Haig

(BS mining engineering, 1985)

Haig has known she wanted to be an engineer most of her life. In her career, she has overseen planning, design and construction for transit systems, buildings, highways and tunnels. She serves as vice president of commercial projects at global engineering firm WSP USA.

"The world of engineers is so vast, and you need those people who are quintessential engineers, who look at a problem and immediately know what to do," she advised young engineers. "But you're also going to find people like myself, who understand how to take all those pieces and put them together. It takes all kinds to serve the world of engineering."

Outstanding Young Alumni Volunteer Award

Maira Garcia

(BS aerospace engineering, 2014)

A first-generation student, Garcia is now a senior advanced systems engineer at Honeywell Aerospace, as well as the program manager for the company's Society of Hispanic Professional Engineers recruiting team. Read more on Page 22 about the SHPE fundraiser she established.


Maira Garcia

"Receiving this award is such a sweet feeling, because I think back on my days as a first-year engineering student, when I was very curious but quite honestly had no idea what I was doing," she said. "The college gave me the support I needed back then, and it means a lot to me that I can now support current students."


Sehrish Choudhary

A Sense of Belonging

Sehrish Choudhary, president of the Engineering Student Council, brought the ceremony to a close with comments about her experience as a first-generation American and college student. She spent her childhood dreaming of bringing technologies from "Iron Man" to life. When she started studying at the UA, she knew she was right where she belonged.

"I was inspired," she said. "I sat next to my peers, thinking 'I can do this. I want to do this.' I chose engineering because I was captivated and inspired by every aspect of it."

Freeport-McMoRan CEO Speaks on Making Good in Mining

The 16th Annual W. C. Lacy Distinguished Lecture featured Richard Adkerson, the chairman of the board and chief executive officer of Freeport-McMoRan. He spoke to friends of the Department of Mining and Geological Engineering about how much the world has changed over the course of his career.

"Weather patterns, forest fires, storms in the Gulf of Mexico," he said. "You can see it. You can smell it. It's changing, and when it changes, we're going to move away from fossil fuels to electrical forms of energy, and that requires more copper."


Moe Momayez, interim Mining and Geological Engineering Department head and David and Edith Lowell Chair for Mining and Geological Engineering (right), presents the Lacy Lecture plaque to Freeport-McMoRan CEO **Richard Adkerson.**

In addition to an increased focus on sustainability, he said, the mining industry has developed a greater emphasis on safety and diversity. Women are taking on more leadership roles, and Freeport-McMoRan works to train and hire employees from the communities where it does business.

"That's the great thing about this industry," he said. You can do so much good for people. Give them jobs, help them with their health, their education. It's a great feeling."

2021-2022: NEW FACULTY MEMBERS

New faculty members **Marat Latypov**, **Alejandro Salado**, **Erfan Yazdandoost Hamedani**, **Sammy Tin**, **Hossein Rastgoftar**, **Hee-Jeong Kim** and **Kavan Hazeli** stand outside the Aerospace and Mechanical Engineering building.

Angelina Anani

Associate Professor in Mining and Geological Engineering

Anani earned her PhD from Missouri S&T in 2016, then served as assistant professor at the Pontifical Catholic University of Chile. She researches mine system optimization and the development of tools for sustainable decision making, using operations research and artificial intelligence tools in mine design, safety and production scheduling.

Kavan Hazeli

Associate Professor in Aerospace and Mechanical Engineering

Hazeli earned a PhD at Drexel University in 2014, then completed a postdoctoral fellowship at Johns Hopkins University in 2016. His research focuses on mechanical properties of engineering materials, particularly for advanced manufacturing. Applications for his work include hypersonic flight, space exploration and biomedical implants.

Hee-Jeong Kim

Assistant Professor in Civil and Architectural Engineering and Engineering Mechanics

Kim received her PhD from the Korea Advanced Institute of Science and Technology in 2018, then completed a postdoctoral research position at MIT. She researches cement hydration mechanisms, ultimately for development of sustainable and carbon-neutral construction materials of the future.

Marat Latypov

Assistant Professor in Materials Science and Engineering and the Graduate Program in Applied Mathematics

Latypov earned a PhD in 2014 from Pohang University of Science and Technology in South Korea. He continued research at the Georgia Tech/CNRS Laboratory in Metz, France and at the University of California, Santa Barbara. His work involves artificial intelligence, materials physics and data sciences for sustainable manufacturing.

Hossein Rastgoftar

Assistant Professor in Aerospace and Mechanical Engineering

Rastgoftar earned a PhD in 2015 from Drexel University. Since then, he has served on the faculty at the University of Michigan, Ann Arbor, and Villanova University. His work centers on cyberphysical system optimization and decision making under uncertainty, specifically for managing uncrewed aircraft traffic.

Nathalie Risso

Assistant Professor in Mining and Geological Engineering

Risso earned a PhD and an MS at the University of Arizona, in 2019 and 2021, respectively. She has worked as an assistant professor at the University of Bío-Bío in Chile, while also acting as a mentor for the university's IEEE Women in Engineering Affinity Group.

Alyssa Ryan

Assistant Professor in Civil and Architectural Engineering and Engineering Mechanics

Ryan earned her PhD from the University of Massachusetts, Amherst, then spent 2020-2021 as a visiting scholar at Technical University of Munich. She investigates smart technologies to make transportation systems safe and equitable for cyclists and pedestrians, which extends to smart cities and sustainable transportation.

Alejandro Salado

Associate Professor of Systems Engineering

Salado earned a PhD in 2014 from the Stevens Institute of Technology. He has worked as an assistant professor at Virginia Tech since 2015. Model-based approaches are an essential part of his work with large-scale systems. His theories apply to numerous systems, from airplanes and satellites to submarines.

Shang Song

Assistant Professor in Biomedical Engineering

Song earned her PhD jointly through UC Berkeley and UC San Francisco. She then studied manipulating stem cell functions for tissue regeneration and translational medicine at Stanford University. She has worked on implantable artificial organs, such as a pancreas to treat Type 1 diabetes and a device that mimics biological organs for drug screening.

Sylvia Sullivan

Assistant Professor in Chemical and Environmental Engineering

After earning a PhD at Georgia Tech in 2017, Sullivan continued at Columbia University and the Karlsruhe Institute of Technology in Germany. She studies tropical storms and ice clouds, examining both the larger-scale structure, dynamics and propagations of storms, and the small-scale formation, growth and aggregation of ice crystals in storm outflows.

Sammy Tin

Inaugural Patrick R. Taylor Endowed Department Leadership Chair in Materials Science and Engineering

Tin earned a PhD in 2001 from the University of Michigan. Most recently, he served as the Charles and Lee Finkl Chair of Materials Engineering at Illinois Institute of Technology. He also worked at IIT for 15 years. As department head, he is dedicated to increasing undergraduate enrollment and aligning the department's research priorities with that of the college.

Erfan Yazdandoost Hamedani

Assistant Professor in Systems and Industrial Engineering

After starting as a research professor in 2020, Yazdandoost Hamedani now has a tenure-track position. His work focuses on large-scale and distributed optimization for machine learning, signal processing and statistical data analysis. These techniques are useful for solving problems with large numbers of variables.

Engineer Awarded **$5M** to Build Quantum-Powered Navigation Tools

Zheshen Zhang received $5 million from the National Science Foundation's Convergence Accelerator Program to develop ultra-sensitive, quantum-enhanced sensors.

ZHESHEN ZHANG, an assistant professor of materials science and engineering, is leading the $5 million Quantum Sensors project to advance navigation for autonomous vehicles and spacecraft, as well as measurement of dark matter and gravitational waves.

The National Science Foundation's Convergence Accelerator Program, which fast-tracks multidisciplinary efforts to solve real-world problems, is funding the project.

The objects with which we interact in our daily lives adhere to classic laws of physics, like gravity and thermodynamics. Quantum physics, however, has different rules, and objects in quantum states can exhibit strange but useful properties. For example, when two particles are linked by quantum entanglement, anything that happens to one particle affects the other, no matter how far apart they are. This means probes in two locations can share information, allowing for more precise measurements. Or as another example, classical light emits photons at random intervals. But scientists can induce a quantum state called squeezed light to make photon emission more regular and reduce uncertainty – or noise – in measurements.

The Quantum Sensors project will take advantage of quantum states to create ultrasensitive gyroscopes, accelerometers and other sensors. Gyroscopes are used in navigation of aircraft and other vehicles to maintain balance as orientation shifts. In tandem, accelerometers measure vibration or acceleration of motion. These navigation-grade gyroscopes and accelerometers are light-based and can be extremely precise, but current models are bulky and expensive.

Many electronics, including cellphones, are equipped with tiny gyroscopes and accelerometers that enable features like automatic screen rotation and directional pointers for GPS apps. At this scale, gyroscopes are made up of micromechanical parts, rather than lasers or other light sources, rendering them far less precise. Zhang and his team aim to develop chip-scale light-based gyroscopes and accelerometers to outperform current mechanical methods.

Gaining an Edge on Earth and Beyond

The benefits of this extreme sensitivity are numerous. If a self-driving car could determine its exact location and speed using only a compact, quantum-enhanced onboard gyroscope and accelerometer, it wouldn't need to rely on GPS to navigate. A self-contained navigation system would protect the car from hackers and provide more stability. The same goes for navigation of spacecraft and terrestrial vehicles sent to other planets.

"In both space-based and terrestrial technologies, there are a lot of fluctuations. In an urban environment, you might lose GPS signal driving through a tunnel," said Zhang, director of the Quantum Information and Materials Group. "This method could capture information not provided by a GPS. GPS tells you where you are, but it doesn't tell you your altitude, the direction your vehicle is driving or the angle of the road. With all of this information, the safety of the passengers would be ensured."

Guaranteeing Accuracy in 3D-Printed Jet Engine Parts

IN ADDITIVE MANUFACTURING, a 3D printer deposits material onto a surface or mold, letting it solidify one layer at a time until a 3D object – as simple as a plastic cube or as complex as a metal jet engine component – takes shape. Also known as 3D printing, the cost-effective method is especially useful for prototyping and creating parts with complex shapes.

Precision is key in additive manufacturing, especially when it is being used to create heat-resistant metal parts for applications such as jet engines, rockets or other high temperature environments. A team of two University of Arizona engineers is using machine learning methods and $750,000 in NASA funding to monitor and mitigate defects that occur in additive manufacturing. Mohammed Shafae of systems and industrial engineering and Andrew Wessman of materials science and engineering are collaborating with Lockheed Martin Space, Open Additive LLC and CompuTherm LLC.

"Advanced manufacturing is one of the college's research focus areas, and this is a great example of an interdisciplinary effort to advance the field and keep the UA at the forefront," said David W. Hahn, Craig M. Berge Dean of the College of Engineering.

Different Defects, Different Problems

There are two broad categories of defects that can occur in additively manufactured products.

Process defects are physically visible aberrations that occur when something goes wrong in the printing process. For example, two layers may not stick together properly, or there could be a hole or crack in the material.

Material defects are variations in chemistry or the arrangement of atoms that are not visible except with high resolution microscopes. Material defects may happen if one layer is still cooling, and another hot layer is placed on top of it. The temperature of the first layer could rise, and the change in the cooling process might alter the part's properties. For example, the metal could become brittle or less able to endure strain.

"You can think how dangerous that would be if the part were used in a jet engine or a rocket," Shafae said.

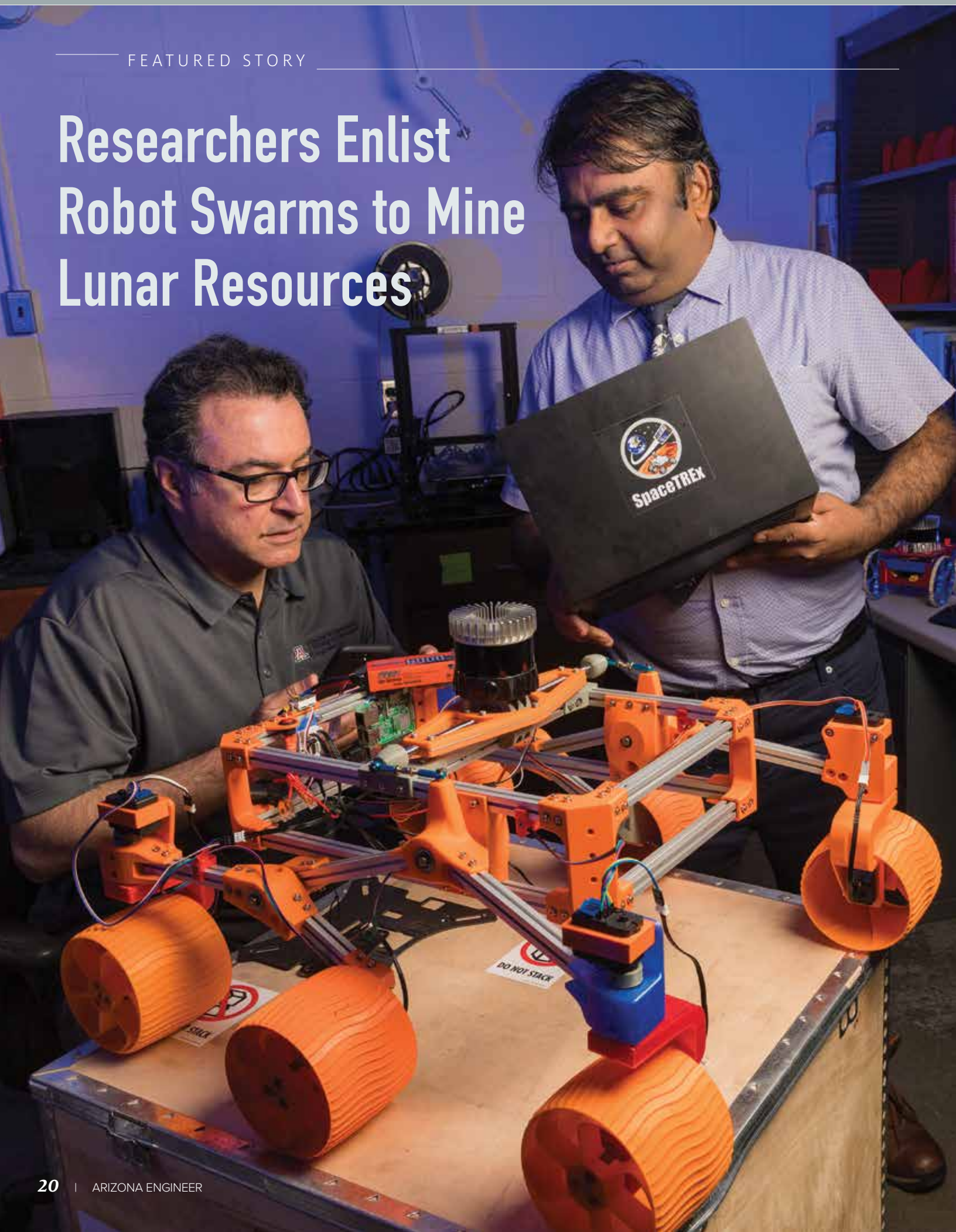
Fourth Industrial Revolution

Shafae and Wessman will be using a sophisticated sensor system, combined with thermal imaging cameras and high-speed localized cameras, to monitor the 3D printing process and identify when and where defects occur. They will apply machine learning methods to the data and develop a model that can predict defects. This will allow scientists to take corrective action to prevent the defects or terminate a process before wasting more time and materials. Research in this area typically uses a single type of sensor to detect specific categories of defects, but this work takes the concept a step further.

"This is truly an example of what people need to be doing to get to Industry 4.0, which is basically the use of data to improve processes, and ensure they are performing as you want them to," Wessman said.

Andrew Wessman and **Mohammed Shafae** stand next to a 3D printer – the first on campus that can be used to create metal objects.

Researchers Enlist Robot Swarms to Mine Lunar Resources



WITH SCIENTISTS BEGINNING to seriously consider constructing bases on celestial bodies such as the moon, the idea of space mining is growing in popularity.

After all, if someone from Los Angeles were moving to New York to build a house, it would be much easier to buy the building materials in New York rather than buy them in Los Angeles and lug them 2,800 miles. Considering the distance between Earth and the moon is about 85 times greater, and that getting there requires defying gravity, using the moon's existing resources is an appealing idea.

An engineering team has received $500,000 in NASA funding for a new project to advance space mining methods using swarms of autonomous robots. As a Hispanic-Serving Institution, the university was eligible to receive funding through NASA's Minority University Research and Education Project Space Technology Artemis Research Initiative.

"It's really exciting to be at the forefront of a new field," said Moe Momayez, interim head of the Department of Mining and Geological Engineering and the David & Edith Lowell Chair in Mining and Geological Engineering. "I remember watching TV shows as a kid, like 'Space: 1999,' which is all about bases on the moon. Here we are in 2021, and we're talking about colonizing the moon."

Blast Off!

According to the giant impact hypothesis, Earth and the moon came from a common parent body, so scientists expect their chemical compositions to be relatively similar. Mining on the moon's surface could turn up rare earth metals needed for technologies such as smartphones and medical equipment, along with titanium, precious metals, and helium-3 – a stable isotope that could fuel nuclear power plants but is extremely rare on Earth.

To mine for ore embedded in rock on Earth, miners need to drill through the rock. This is one of Momayez's specialties, but lunar mining presents a new challenge.

"Here on Earth, we have an unlimited amount of energy to throw at breaking rocks," he said. "On the moon, you have to be a lot more conservative. For example, to break rocks, we use a lot of water, and that's something we won't have on the moon. So, we need new processes, new techniques. The most efficient way to break rocks on Earth is through blasting, and nobody has ever set off a blast on the moon."

> "The idea is to have the robots build, set things up and do all the dirty, boring, dangerous stuff, so the astronauts can do the more interesting stuff,"
>
> **JEKAN THANGA**
> *associate professor of aerospace & mechanical engineering*

Robot Swarms, Powered by HEART

Figuring out these processes is a tall order for humans. That's where autonomous robot swarms come in.

Jekan Thanga, an associate professor of aerospace and mechanical engineering, is adapting a neuromorphic learning architecture technique he developed called the Human and Explainable Autonomous Robotic SysTem, or HEART. The system not only will train robots to work together on mining, excavation and building tasks, but also it will allow the robots to improve their collaboration skills over time.

The team plans to build and train the robots here on Earth, so they can practice. Ultimately, the researchers envision a fully autonomous swarm of robots that doesn't need to receive instructions from Earth to mine materials and construct simple structures. The team still considers humans a critical part of space exploration, but these robot swarms could free up astronauts to focus on other critical mission elements.

"The idea is to have the robots build, set things up and do all the dirty, boring, dangerous stuff, so the astronauts can do the more interesting stuff," Thanga said.

Students Play a Key Role

Momayez and Thanga plan to involve students in the work.

Thanga's ASTEROIDS Laboratory runs the NASA-funded Undergraduate Research and Education Program, in which students spend a year leading their own research projects. With the new funding, Momayez and Thanga intend to add a module to the program focused on space mining. Students will learn about autonomous robot swarms and excavation techniques – in the classroom, in the laboratory and even in the university's student-run San Xavier Mine.

"They can test their robots at the mine, they can excavate, they can drill, they can blast," Momayez said. "And with the establishment of the new School of Mining and Mineral Resources, we hope to get more students from all over the world involved in mining."

Engineering Student Named 2021 Udall Scholar

Biomedical engineering student Sebastian (Sebo) Diaz is among 55 students from 42 colleges and universities selected as 2021 Udall Scholars. Udall Scholars are selected based on leadership potential; record of public service; academic achievement; and commitment to careers in the environment, tribal public policy or native health care.

Diaz's undergraduate work is focused on biomedical imaging and optics, and he has worked on developing endoscopes for early ovarian cancer detection and on creating new methods to diagnose lung disease. A member of the Pascua Yaqui Tribe, he has served as president of the American Indian & Indigenous Health Alliance since his first year at the university. In addition, he is an honors student and the current vice president of the Alpha Omicron Chapter of Zeta Beta Tau.

Sebo Diaz

Alumna **Maira Garcia** attended the SHPE national conference as part of her college bucket list. Follow her post-college bucket list adventures in her blog, Enthusastic About Life.

SHPE Alumna Gives Back

WHEN FIRST-GENERATION college student Maira Garcia started college, she dove into campus life, joining groups like the Society of Women Engineers and the American Institute of Aeronautics and Astronautics. When she joined the Society of Hispanic Professional Engineers, life got even better.

"Right when I got to my first meeting, I felt like I was home with my family," said the College of Engineering's 2021 Young Alumni Volunteer Award winner. "I went for the friendship aspect, but I stayed because they did a lot of professional development and outreach. I realized that if I stayed in SHPE, I was going to become a better engineer."

Attending the SHPE National Convention on a scholarship her senior year changed her life, and she vowed that she'd help others attend in the future. After graduating and joining Honeywell, she started a fundraising campaign in 2015 that raised $1,250. It's grown every year and sent dozens of students to the conference on scholarships. The 2021 fundraiser brought in $7,000.

"I probably wouldn't have gone to the conference if I hadn't won that scholarship because I'm a first-generation student. Sometimes money can be hard when you're trying to pay for the bare minimum of school essentials," said Nayleth Ramirez, a three-time recipient of the scholarship. "But attending really opened my opportunities. Now that I'm an alumna, I definitely want to help support SHPE for the rest of my life."

Maira Garcia, who now works as a senior advanced systems engineer at Honeywell, is shown visiting the Museum of Flight in Tukwila, Washington.

FACULTY AWARDS

Paul Blowers Wins Gerald J. Swanson Prize for Teaching Excellence

Paul Blowers is one of five University of Arizona faculty members to receive the 2021 Gerald J. Swanson Prize for Teaching Excellence. The recognition is one of the university's annual Awards of Distinction.

Blowers, a Distinguished Professor of chemical and environmental engineering, joined the faculty in 1999. One nominator recalled Blowers putting a poor exam performance in perspective. "He showed me exams he had kept from his undergraduate years in which he did comparatively worse on his first exam and then maintained a positive trajectory by applying a growth mindset through well-proven learning techniques," he wrote.

Jennifer Barton Elected Into SPIE Presidential Chain

Jennifer Kehlet Barton, the Thomas R. Brown Distinguished Professor of Biomedical Engineering, professor of optical sciences, and director of the BIO5 Institute, has been elected to serve as the 2022 vice president of SPIE, the international society for optics and photonics. With her election, Barton joins the SPIE presidential chain, and will serve as president-elect in 2023 and as the society's president in 2024.

Barton is known for her development of miniature endoscopes that combine multiple optical imaging techniques. Her research into light-tissue interaction and dynamic optical properties of blood laid the groundwork for a novel therapeutic laser to treat disorders of the skin's blood vessels. She has published over 120 peer-reviewed journal papers in these research areas.

Karanikola Top Candidate for U.S. ASPIRE Prize

The Annual Asia-Pacific Economic Cooperation Science Prize for Innovation, Research and Education (ASPIRE) award recognizes young scientists with a demonstrated history of excellence in research and cooperation with scientists from other APEC member economies. The 2021 theme was "diverse knowledge for a sustainable future."

The Department of State holds the U.S. ASPIRE Competition to determine the nation's nominee to compete for the final, international APEC prize. This year, Vicky Karanikola, an assistant professor in the Department of Chemical and Environmental Engineering, is the runner up for this prestigious recognition. Karanikola specializes in water purification research, particularly in the context of Indigenous nations.

Fink on Finalist Team for E-ROBOT Prize

Associate professor of electrical and computer engineering Wolfgang Fink and assistant professor of architecture Jonathan Bean are one of 10 finalist teams for the U.S. Department of Energy's Envelope Retrofit Opportunities for Building Optimization Technologies (E-ROBOT) Prize. Each finalist team was awarded $200,000.

The pair created the wall Exterior Insulation and Finish System, or wall-EIFs, for building envelope retrofits which are applied with a robotic sprayer.

"By creating a new skilled trade of robotic building retrofit operators, the system will facilitate the retrofit of buildings at scale in a safe manner while significantly reducing cost, as well as the energy footprint of the nation," Fink said.

Alumnus Endows $1M Chair in Materials Science and Engineering

DYLAN TAYLOR grew up spending time in his father's laboratories at the University of Idaho. When he was ready to attend college for materials science and engineering, his dad, Patrick R. Taylor, made a few recommendations. Among them, the University of Arizona.

In honor of his father, and his alma mater, Dylan Taylor and his wife, Gabrielle, made a $1 million gift to create the Patrick R. Taylor Endowed Department Leadership Chair in Materials Science and Engineering.

"MSE is the department I graduated from, so that's near and dear to my heart," said Dylan Taylor, an Honors College student who earned his bachelor's degree as a Tau Beta Pi in 1993. "The education was first class, and the overall experience was fantastic. I feel a deep sense of gratitude to the university."

Dylan Taylor speaks at the Engineers Breakfast as the 2018 Alumnus of the Year.

Patrick Taylor has had an illustrious career in mining and materials engineering. He currently is the George S. Ansell Distinguished Professor of Chemical Metallurgy, Metallurgical and Materials Engineering and the director of the Kroll Institute for Extractive Metallurgy at the Colorado School of Mines. Dylan Taylor said his father has been a source of inspiration for many.

Sammy Tin, who came to the University of Arizona after 15 years at the Illinois Institute of Technology, was named the inaugural chair in fall 2021.

"What brought me to the University of Arizona was basically the people. The leaders in the college have a great vision for the future, and there's tremendous potential here in the College of Engineering," Tin said. "Patrick R. Taylor is one of the pioneers of extractive metallurgy, and I hope I can honor the legacy of both Patrick Taylor and his son, Dylan Taylor."

Construction Begins on Applied Research Building

CONSTRUCTION OF THE University of Arizona's $85 million, three-story Applied Research Building began in June 2021, as crews broke ground on the 89,000-square-foot facility. Located at the southeast corner of East Helen Street and North Highland Avenue, the ARB will house research that advances applied physical sciences and engineering. Construction is expected to be completed in January 2023.

The building will provide new research capabilities with state-of-the-art equipment and technology, and it will bring together several interdisciplinary university programs in one location. It connects faculty across the College of Engineering, the College of Science, the James C. Wyant College of Optical Sciences and the College of Medicine – Tucson.

The ARB will be dedicated specifically to research programs related to the "Grand Challenges" pillar of the university's strategic plan. Those grand challenges fall under areas such as space exploration, artificial intelligence, the environment and disease prevention. Students will be able to conduct research in the building's facilities as well.

"The ARB will focus on expanding several areas of research that have resulted in the university being ranked among the top 100 research institutions in the world," said University of Arizona President Robert C. Robbins.

Guests at the ARB groundbreaking ceremony included **Dean David W. Hahn** (center), Senior Vice President for Research and Innovation **Betsy Cantwell** (fifth from right) and UA President **Robert C. Robbins** (fourth from right).


Susana Mar

2020s

After a yearlong electrical engineering internship at Raytheon Missiles & Defense, **Susana Mar** (BS/ECE 2021) accepted a full-time position as an electrical engineer with the company.

Daniel Zuniga (PhD/SIE 2021) earned his BS and MS engineering degrees from the University of Sonora, then spent several years working in industry before coming to the UA. During his PhD studies, he completed a co-op and worked as a research assistant at Argonne National Laboratory. He began working as a software developer at Hexagon Mining in summer 2021.

2010s


Iesha Batts

Iesha Batts (BS/ChE 2016), was active on campus during her time as a Wildcat, including as a member of the Pride of Arizona Marching Band, Women in Science and Engineering, the Japan Karate Federation and the National Society of Black Engineers. She was recently hired as an associate district representative for Nalco Water.

As an undergraduate, **Wilson Kong** (BS/MSE 2015) co-founded the UA chapter of the Society of Asian Scientists and Engineers. He went on to earn his MS and PhD in MSE at Arizona State University, and he recently won the National Research Council Postdoctoral Fellowship Award. He will work as a postdoctoral associate at the Air Force Research Laboratory.


Wilson Kong

Huy Le (BS/ECE 2015) joined the Interdisciplinary Capstone program as a mentor, after several years sponsoring projects through Raytheon Missiles & Defense. Le says he's benefited hugely from the mentors in his life and is enjoying giving back.


Rosa Maria Rojas

Rosa Maria Rojas (MS/MGE 2013), was nominated and selected to serve a three-year term on the Society for Mining, Metallurgy and Exploration's Structure and Governance Standing Committee. The group focuses on reviewing and reshaping the society's infrastructure.

2000s

Angela Watt (BS/MinEng, 2007) received a medal of merit for young professionals from the American Mining Hall of Fame. Watt serves as the manager of underground engineering for South32 on the Hermosa Mine Project. She previously worked at Rio Tinto.

Otakuye Conroy-Ben (MS/EnvE 2004 and PhD/EnvE 2006) is an assistant professor of environmental engineering at Arizona State University. She is the first in her family to receive a college degree, and her research interests include Tribal water quality and wastewater treatment. She recently delivered a virtual talk through New Mexico State University's Chicano Programs.

1990s

Salman Asadullah (BS/ECE 1995) is the co-founder and chief technical officer at Netnology, a systems and software integrator. Prior to co-founding the company, he worked at Cisco for more than 20 years, in roles ranging from support engineer to CTO.

1980s

As the founder and CEO of PageDip, **Sherisse Hawkins** (BS/ChE 1986) has appeared on ABC's Shark Tank and Vanity Fair. She also worked as an Imagineer at Walt Disney and was VP of engineering at Time Warner Cable. In 2021, she was named to the Colorado Public Radio's board of directors.

Kaman Corp., an aerospace and defense company, appointed **Michelle J. Lohmeier** (BS/SE 1985 and MS/SE 1989) to its board of directors. The board also appointed her to serve on its audit and finance committees.


Otakuye Conroy-Ben (photo by David Cournoyer, courtesy of AISES Winds of Change magazine)

Rafael Quintero (courtesy of Arizona Athletics)

SIE Alumni Compete in Tokyo Olympics

Two systems and industrial engineering alumni competed in the 2021 Tokyo Olympics. They were among 23 current and former Wildcats who participated in the games.

Rafael Quintero (BS/IE, 2018) was a four-time All-American platform diver for the Wildcats from 2013-2016 and was named the Pac-12 Newcomer of the Year during his first college season. He represented Puerto Rico in Tokyo, and placed 14th in the 10-meter platform competition.

Edgar Rivera-Morales (BS/IE 2013) was an All-American high jumper for the Wildcats in 2011 and 2012, and he qualified for three all-conference teams in his career. He represented Mexico, and placed 8th in high jump.

Edgar Rivera-Morales (courtesy of Arizona Athletics)

CLASS NOTES

1970s

Lyle Margulies (BS/EE 1976) earned an MS in biomedical engineering from UT Austin. He has since worked at Samaritan Health System, Seattle Community College, Pro-Tech Services and Microsoft. For the past seven years, he has been designing electromagnetic flow meters for Seametrics. He looks forward to retiring soon and pursuing consulting, traveling and hobbies.

Lyle Margulies stands in front of a flow "test bench" at Seametrics.

During his PhD studies, **William E. Carter** (PhD/CE 1973) helped create a lunar laser ranging station on Mount Lemmon. He went on to lead the development of an observatory on Mount Haleakala, Maui, work for the National Geodetic Survey and teach in academia. His memoir, "Taking the Measure of Planet Earth," is available on Amazon. His granddaughter is studying veterinary science at the UA.

1960s

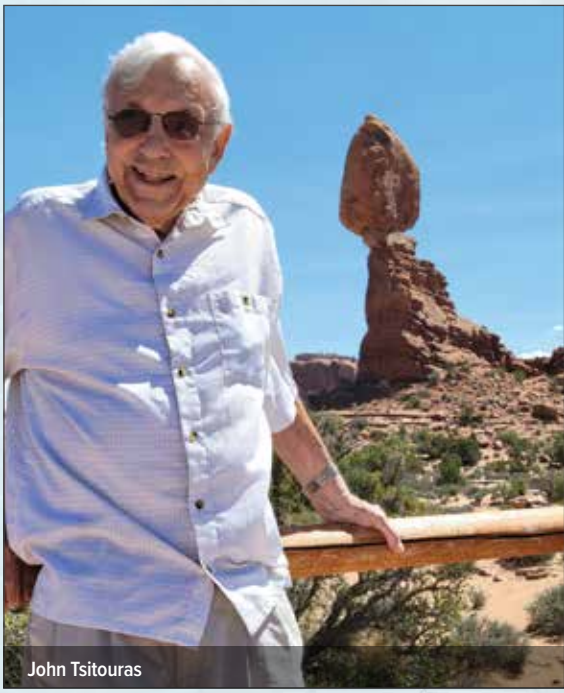
Newton Don (BS/ChE 1968) played the oboe in high school, then picked it up again in the late 1970s and early 1980s. A few years ago, he decided to take it up again after nearly 40 years. He has begun lessons with the San Francisco Symphony's solo English horn player, and plans to join a community orchestra.

Newton Don

1950s

Charles Woods (BS/ME 1957) was classmates with Craig M. Berge, the namesake of the college's Engineering Design Program and Dean's Chair. He worked for the U.S. Naval Weapons Center for 33 years, then opened a shop to make and repair stringed instruments when he retired in 1990. He has made more than 100 instruments, which are scattered over seven states and five countries.

Charles Woods



John Tsitouras

John Tsitouras (BS/EE 1955) went on to work for Howard Hughes Corp., where he got to know Howard Hughes personally. He also worked for Convair and EG&G. Since his retirement, he's had more time for his hobby of collecting and refurbishing rare and exotic cars, even showing a car at Pebble Beach.

Philanthropic **Support** Gets the **College** Where It Is **Going**

Philanthropy is helping take the college from good to great in its quest to educate the next generation of problem solvers, drive the economy, be a global leader in technology and improve quality of life.

DONATIONS SUPPORTING FACULTY and students doing research touch the lives of so many people beyond the actual gift recipients. From wearable health care devices to affordable solar energy, engineering research is an investment geared to bettering society.

The college is dedicated to fostering the next generation of top-notch problem solvers, driving economic growth, being a global leader in technology and improving quality of life.

Tuition revenue, state allocations, research grants and philanthropy fund the college's mission and vision. The role of philanthropy in the college's success, indeed the future of our planet, is immeasurable. Philanthropy bridges the gap between where we are now and what the college aspires to be.

Philanthropy supports research-related endeavors, such as named chairs and professorships, facilities, and graduate student fellowships. Donors also provide startup funding for new faculty and seed funds for developing proof of concept, which often leads to more traditional research grants. These far-reaching contributions help take the college from good to great.

One example of philanthropic support for research is the Peter and Nancy Salter Medical Device Design Lab. Thanks to the generosity and vision of the Salter family, the college was able to convert an underused space in the Aerospace & Mechanical Engineering courtyard into an industry-grade lab for teaching, research and exploration. This lab gives students invaluable real-life experiences and helps researchers move life-changing products toward commercialization.

> "Some men see things as they are and say, 'Why?' I dream things that never were and say, 'Why not?'"
>
> **SEN. ROBERT F. KENNEDY**

Elsewhere in the college, donors are funding undergraduate research opportunities and graduate fellowships across multiple disciplines. The Herbold Family Foundation is supporting five graduate fellowships for students working on air quality improvements, quantum computing capabilities, hypersonic flight, data-driven decision making and medical imaging. Additionally, a generous gift from the Roberts family enabled lab improvements in chemical engineering and provided funding for undergraduates conducting water research.

Endowed Faculty Strengthen Research, Boost College Standing

Endowed faculty chairs and professorships invigorate research and raise the bar for recruiting and retaining research talent. The first leadership department chair was the David and Edith Lowell Chair in Mining & Geological Engineering, and the most recent is the Patrick R. Taylor Endowed Department Chair in Materials Science & Engineering. These faculty members are pursuing extraordinary discoveries in mining sustainability and materials development for use on Earth and beyond. The goal is to establish similar faculty positions in the remaining six academic departments, which will improve the college's competitiveness among peers.

The ways in which alumni and friends can help take the college's research enterprise to the next level are as varied as the dreams of each donor. The development and alumni relations team strives to match donors' passions with college needs and create win-win-win scenarios that benefit donors, the college, faculty and students. It is never too late to explore your interests in research and learn how your support can bring about positive change – not just in the college, but for our communities and society as a whole.

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CALLING ALL ALUMNI!

Where has life taken you since graduation? We'd like to know and so would your college classmates. Please email us with details (no more than 300 words) and be sure to include the following information:

- Name and year you graduated
- Major
- Degree (BS, MS, PhD, etc.)
- Details of your activities

We'd also be interested to see – and share – pictures of your family, your latest work project, that boat or hot rod you just finished building in your garage, or your blossoming gardens. Vacation photos are great, too. We'll publish your news and photos online and in the next print edition.

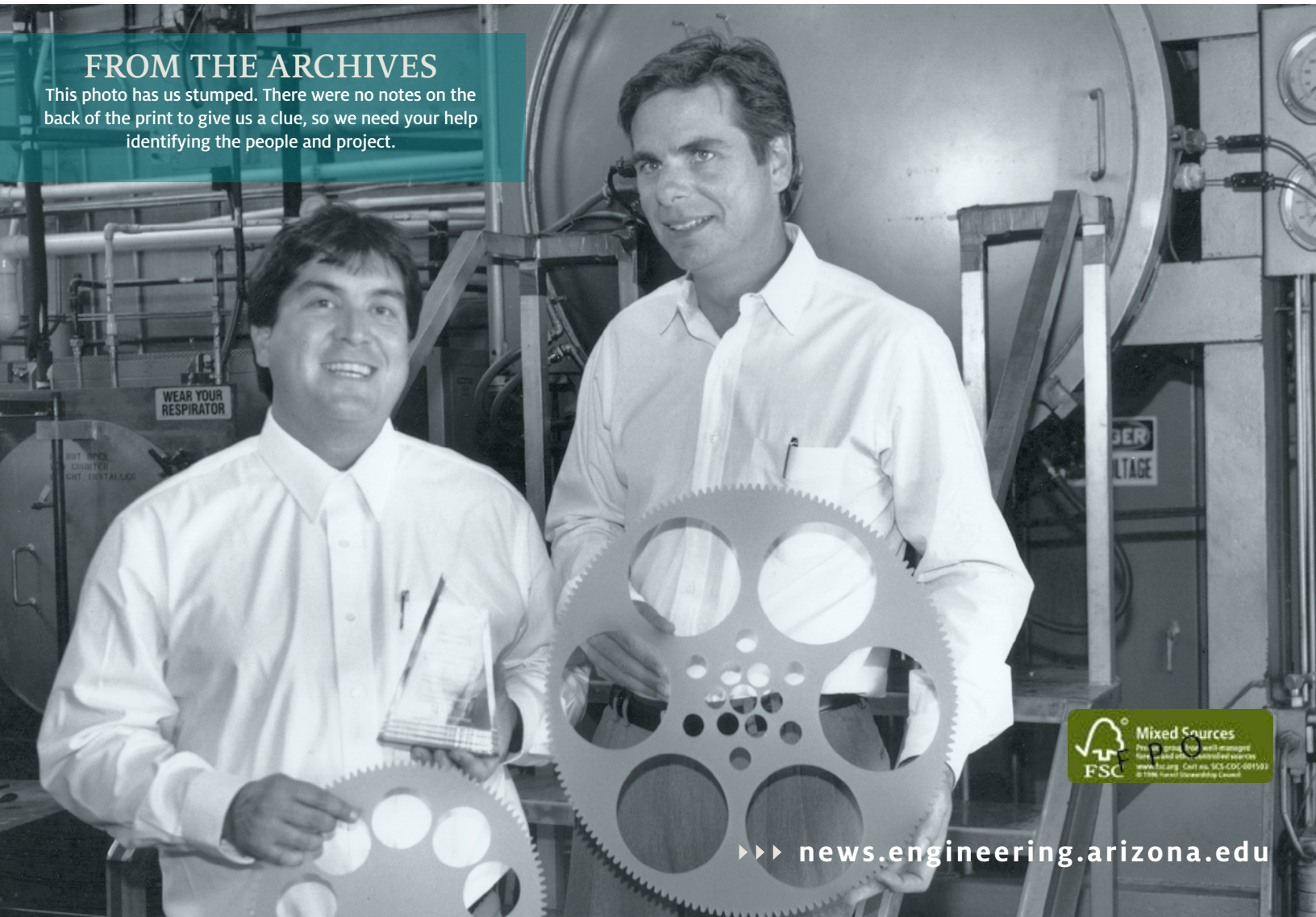
Please send your email to *classnotes@engr.arizona.edu*

BEEN IN THE NEWS LATELY?

Let us know if you've been getting some media attention. Just email the link, and we'll keep spreading the news on the college website and in social media.

FROM THE ARCHIVES

This photo has us stumped. There were no notes on the back of the print to give us a clue, so we need your help identifying the people and project.



news.engineering.arizona.edu