A YEAR IN REVIEW

2017

2018

UNT
EST. 1890
COLLEGE OF ENGINEERING

Message from the Dean

Dear Friends of the College of Engineering,

UNT College of Engineering is a young and dynamic college in a Carnegie R1 doctoral university. Since opening its doors to students in January 2004, the college has become a powerhouse of research and education with more than 100 full-time faculty members and more than 3,000 students. Carrying this momentum, the college is in its next phase of major growth in size and excellence.

As the new dean since January 2019, I'm proud to update you on what has happened in this college during the past year. In this year in review, you'll read about the fascinating research we have going on in materials science, including an alternative, eco-friendly replacement for batteries; gain an understanding of how our biomedical engineering department is changing the face of medical stents; and learn about how one of our faculty members is cracking the code on the Zodiac Killer.

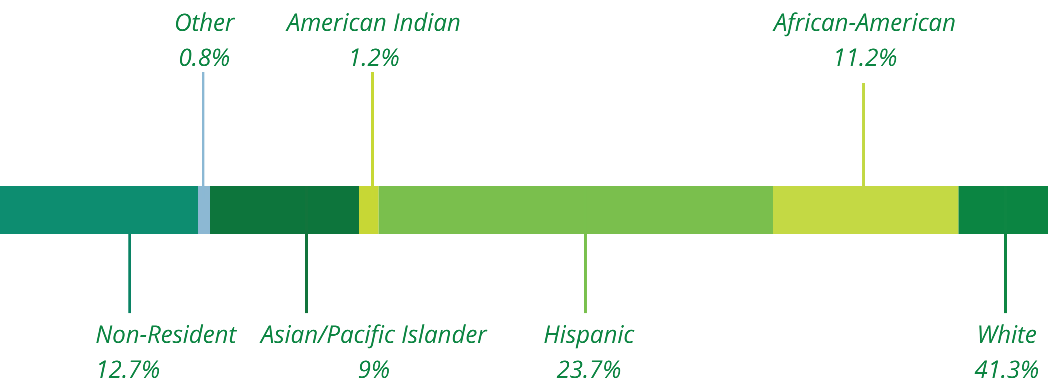
You'll also view a few photos from our first-ever Department of Biomedical Engineering graduating class at the spring commencement as well as a rendering of their new addition we're building here at Discovery Park. You'll get an inside look at how our STEM@thePark initiative is bringing science, technology, engineering and math to K-12 students across the Dallas/Fort Worth metroplex. And you'll catch up with two of our alumni, Ashton Baltazar and Natalie Parde, on what they've been up to since graduation.

Of course, there are many more stories spanning our six departments throughout this publication. It's been quite a year, and I've enjoyed learning about all that our students, faculty and staff have accomplished. I can't wait to see what the coming months and years will bring as we continue to build upon our excellence.

Hanchen Huang
Dean and Lupe Murchison Foundation
Professor in Engineering

FACTS AND FIGURES

UNDERGRADUATE STUDENT DIVERSITY



1,423
Undergraduate and graduate first-generation students

103
Faculty in the College of Engineering

21
Undergraduate and graduate programs offered at the College of Engineering

6,000+
College of Engineering alumni

UNT ENGINEERING IN MEDIA

41,046,499
people reached

$385,083
equivalent advertising value

168
media hits
70 internal hits
98 external hits

It's no vibranium or proto-adamantium, but researcher's new alloy comes close

Dallas Morning News, The Charlotte Observer, The Miami Herald

Serendipitous discovery may lead to eco-friendly lubricant

Science Daily, Dallas Morning News, KRLD 1080

ENROLLMENT

UNDERGRADUATE

300 Electrical Engineering

230 Biomedical Engineering

481 Engineering Technology

89 Materials Science and Engineering

638 Mechanical and Energy Engineering

1,145 Computer Science and Engineering

3,400 Undergraduate degrees awarded since 2002

GRADUATE

1,899 Master's degrees awarded since 2002

209 Ph.D. degrees awarded since 2002

66 Mechanical and Energy Engineering

213 Computer Science and Engineering

73 Materials Science and Engineering

67 Electrical Engineering


Research plus
eppendorf

NEWS

Kyle Rose

SMART Scholarship for Service

The U.S. Department of Defense awarded Kyle Rose, a junior in the Department of Materials Science and Engineering, with the prestigious Science, Mathematics and Research for Transformation (SMART) Scholarship for Service. He's the third to receive the scholarship in the past 10 years in the College of Engineering.

The SMART scholarship covers full tuition and fees along with an annual stipend v, health insurance, up to $1,000 for books, a summer internship, and employment with the Department of Defense upon graduation.

Rose, who plans to complete his Bachelor of Science in Materials Science and Engineering in spring 2019, is also a student in UNT's GradTrack program, which allows students the opportunity to complete a bachelor's and master's in the same field within five years.

"I chose UNT, because I wanted a veteran-friendly state with an engineering department that was active in research affiliated with the Department of Defense," said Rose, who spent four years in the U.S. Army as a crew engineer on MH-47G Chinook helicopters.

UNT's Department of Materials Science and Engineering has just that. With a recently established partnership with the U.S. Army Research Laboratory and research aimed at creating next-generation ballistics armor, Rose had the chance to work with spark plasma sintering of ceramics to improve their fracture toughness and strength for use in military armor.

"This is a fantastic platform for Kyle to apply his knowledge acquired from both the classroom and military to study current materials-related issues to help US Soldiers in combat," said Thomas Scharf, materials science and engineering professor and mentor to Rose.

After completing his degrees at UNT, Rose will put his materials science and engineering background to work at the U.S. Army Armament Research, Development and Engineering Center (ARDEC). There, he'll be working on certification of manufacturing techniques with a goal of protecting those serving in the armed forces.

"It's an amazing opportunity, and it allows me to continue serving my country in a new capacity more suited towards my education, while still remembering where I started as an enlisted soldier," said Rose.

Kayla Green

PROPELLING WOMEN IN ENGINEERING

For her dedication, leadership and advocacy, Nandika D'Souza, the University of North Texas College of Engineering's associate dean for undergraduate studies, has been named to The Women in Engineering ProActive Network board of directors. The organization's mission is to propel higher education to increase the number and advance the prominence of diverse communities of women in engineering.

D'Souza says it's her aim to help develop processes to retain female faculty.

"Research shows that the largest reason women are dropping out of the field is intentional or unintentional experiences in the engineering workplace," D'Souza said. "WEPAN has strengths in looking into what the drivers are for women leaving, different nuances of the issue and best practices to fix it. We need to stop feeling like women have to change all the time, but actually start asking the environment to adapt more."

D'Souza says that while the corporate world has a very clear human resources structure to report negative work environments, academia is lacking in processes to deal with faculty concerns.

"If you have a staff issue, you can go to HR. If you have a student issue, you have a dean of students. But for faculty, it's very ambiguous," D'Souza said. "I recently queried a large group of women and found the absence of clarity is widespread. There is a substantial amount of anecdotal information, but unlike the corporate world, there is no process to resolve, heal and move forward as colleagues. You need to bring everyone into the room and hear what the negative experience was like so it doesn't happen again."

WEPAN's expansive research enables the organization to target workplace culture issues, create transformations and measure the impact of new environments. This, D'Souza says, is why she's excited to be on the board.

"I definitely wanted to be part of a group that wanted to change the culture," she said. "I like being on boards that grow my awareness of what needs to be changed and where I can have an impact. Women in academia need to realize it's not what you're doing, it's what the workplace is giving you."

Courtney Taylor

A MEANER, GREENER BATTERY ALTERNATIVE

Lithium-ion batteries power some of the most used electronics, including smartphones, laptops, tablets and electric cars. But now UNT researchers have developed a higher-power, longer-life, environmentally-friendly lithium-sulfur alternative that could replace the lithium-ion battery.

"The lithium-ion battery has limited capacity," said Wonbong Choi, professor of materials science and engineering and mechanical and energy engineering. "For example, when you charge a cellphone, you get maybe one day of use. We need higher efficiency – maybe where one charge lasts a week. The lithium-sulfur battery has five times, or more, of the charge and discharge capacity of the lithium-ion battery."

Choi collaborated with his Ph.D. students – Juhong Park, Mumukshu D. Patel and Eunho Cha – as well as Vish Prasad from UNT mechanical and energy engineering – to create the battery. The researchers have applied for a patent through UNT and are working towards potential prototyping and production.

"If the lithium-sulfur battery is produced commercially, it will be safer and cost less than the lithium-ion, have higher power density and be environmentally friendly. It can also be manufactured at a large scale. The Li-S battery has been studied by many researchers, but no commercial products have been produced because of several critical problems. We have resolved those issues," Choi said. "We want to use lithium metal on one electrode and sulfur on the other electrode, but lithium metal is too reactive and sulfur is an insulating material. We are using nanotechnology in our lab that produces a three-dimensional sulfur carbon nanotube composite material to add conductivity and a nanomaterial coating on lithium metal for a stable electrode that can be commercially produced."

The team discovered that the element molybdenum, when combined with two atoms of sulfur, creates a 2-D material called MoS_2 that allows them to control the surface reaction of the coating and create the necessary performance of lithium metal. They also have proven the battery's stability allows for more than 1,000 cycles with much higher energy density than lithium-ion, which is a Department of Energy requirement prior to commercial production.

"Thanks to the discovery and research into MoS_2, this conceptual technology of building next-generation batteries can become a reality in the next five years or so," Choi said.

Courtney Taylor

YANG EARNS POWE AWARD

Microgrids are the future of electrical distribution. University of North Texas College of Engineering assistant professor Tao Yang earned the prestigious 2018 Ralph E. Powe Junior Faculty Enhancement Award from the Oak Ridge Associated Universities for his research of microgrids.

“Traditionally, electricity is provided through one central distribution network. This means a problem in one area will affect the entire grid causing power outages and blackouts,” Yang said. “Now, imagine if each user had a microgrid. People would be able to manage their own power distribution so if the main grid goes down they will still have power.”

While a microgrid does draw power from the central grid, it can break away and operate using

BANERJEE NAMED UNT REGENTS PROFESSOR

For his seminal contributions to research in the field of materials science and engineering at the national and international levels, Materials Science and Engineering University Distinguished Research Professor Raj Banerjee has been named a UNT Regents Professor.

A Regents Professorship Award provides recognition to faculty who have performed outstanding teaching, research and service to the profession, and who have achieved a high level of national and international recognition.

Banerjee’s work focuses on lightweight metallic materials, high temperature alloys, metal matrix composites, metallic thin films and high entropy alloys for aerospace, biomedical, and energy-related applications. He also has been working in the area of 3D printing or additive manufacturing its own generators and other power sources such as solar and wind. The microgrid Yang designed has its own generator and draws power from renewable energy sources currently in use on campus. Yang's microgrid would continue to work if the rest of campus lost power due to mechanical failure, severe weather, etc.

The Powe award, aimed at enhancing the research and professional growth of young faculty, is awarded to professors teaching engineering, sciences, mathematics, policy management or education. Awards from Oak Ridge, a consortium of 121 major Ph.D.-granting universities nationwide, can be used as funds for faculty summer salary, graduate student salary, travel, equipment or other assistance relevant to the faculty member's research.

Jim Rogers

of metals since 2004, and is considered one of the pioneers of this technology at UNT.

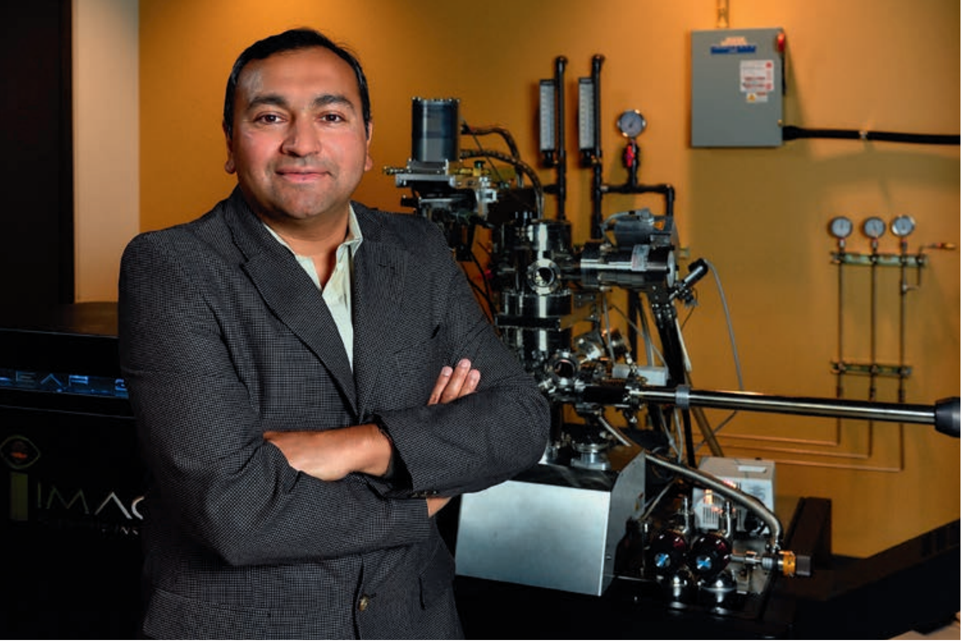
Banerjee was also awarded a $900,000 grant from the Air Force Office of Scientific Research to create new aircraft alloys expected to revolutionize the future of aerospace materials. In total, Banerjee has received more than $10 million in research funding at UNT.

"Raj is clearly an international leader in metal alloys and processing, including his pioneering achievements in additive manufacturing research for over a decade. He is eager to share his expertise with undergraduate and graduate students, contributing to exemplary engineering education and research excellence," said Andrey Voevodin, chair of the department. "This award is the reflections of Raj's impact on the UNT research enterprise and new education opportunities for our engineering graduates."

Banerjee also played a substantial role in the development of UNT's nationally-ranked materials science and engineering department since its earliest days under the College of Engineering and its Materials Research Facility (MRF).

Banerjee was formally honored for his accomplishments at the Salute to Faculty Excellence awards dinner October 5, 2018.

Kayla Green



ADVANCING AIR FORCE AIRCRAFTS

The Air Force Office of Scientific Research has awarded University Distinguished Research Professor Raj Banerjee from the University of North Texas College of Engineering and his research group a $900,000 grant. The funds will be used to develop and investigate multi-phase high entropy alloys – also referred to as complex-concentrated alloys – that are expected to revolutionize aircraft construction.

“This new class of materials is expected to substantially improve the performance of aircraft structural components by enhancing their mechanical properties, including fatigue and creep properties, at room and high temperatures,” Banerjee, who is part of the Department of Materials Science and Engineering, said.

Traditional high-performance structural alloys have multi-phase microstructures and are designed based on the principle of selecting a base element – such as iron – and adding limited amounts of alloying elements – such as chromium or nickel – to engineer their structure and properties through thermo-mechanical processing, making high-performance steels.

High entropy alloys, however, transform the traditional alloy process by employing concentrated amounts of multiple alloying elements, instead of a single one. The original concept of these alloys was that they form a single-phase solid solution despite their complex chemistry. However, the performance of these single-phase alloys is limited at elevated temperatures, which can be problematic for aircrafts exposed to varying levels of heat.

Banerjee says complex-concentrated alloys are the best of both worlds. He hopes through the use of computational and characterization tools, he can combine the multi-phase architecture of traditional alloys with the newer high entropy alloys to expand upon their performance and develop a new class of materials for enhanced structural performance in aircrafts and for other engineering applications.

“Research on high entropy alloys is expanding very rapidly worldwide and could potentially be a game changer in terms of the future development of structural and functional materials,” Banerjee said. “It has opened up a hitherto unexplored category of metallic alloys and, in principle, the concept can be expanded to other classes of materials, such as ceramics and semiconductors.”

Courtney Taylor

JOHN TO REVAMP INTERNATIONAL ENERGY JOURNAL

Kuruvilla John, chair of the Department of Mechanical and Energy Engineering, was named editor-in-chief of the International Journal of Energy for a Clean Environment published by Begell House.

He, along with Kevin Crist, director and professor of chemical engineering at Ohio University and co-editor-in-chief of the journal, are revamping the journal and changing its overall direction to focus on the theme of energy for a clean environment.

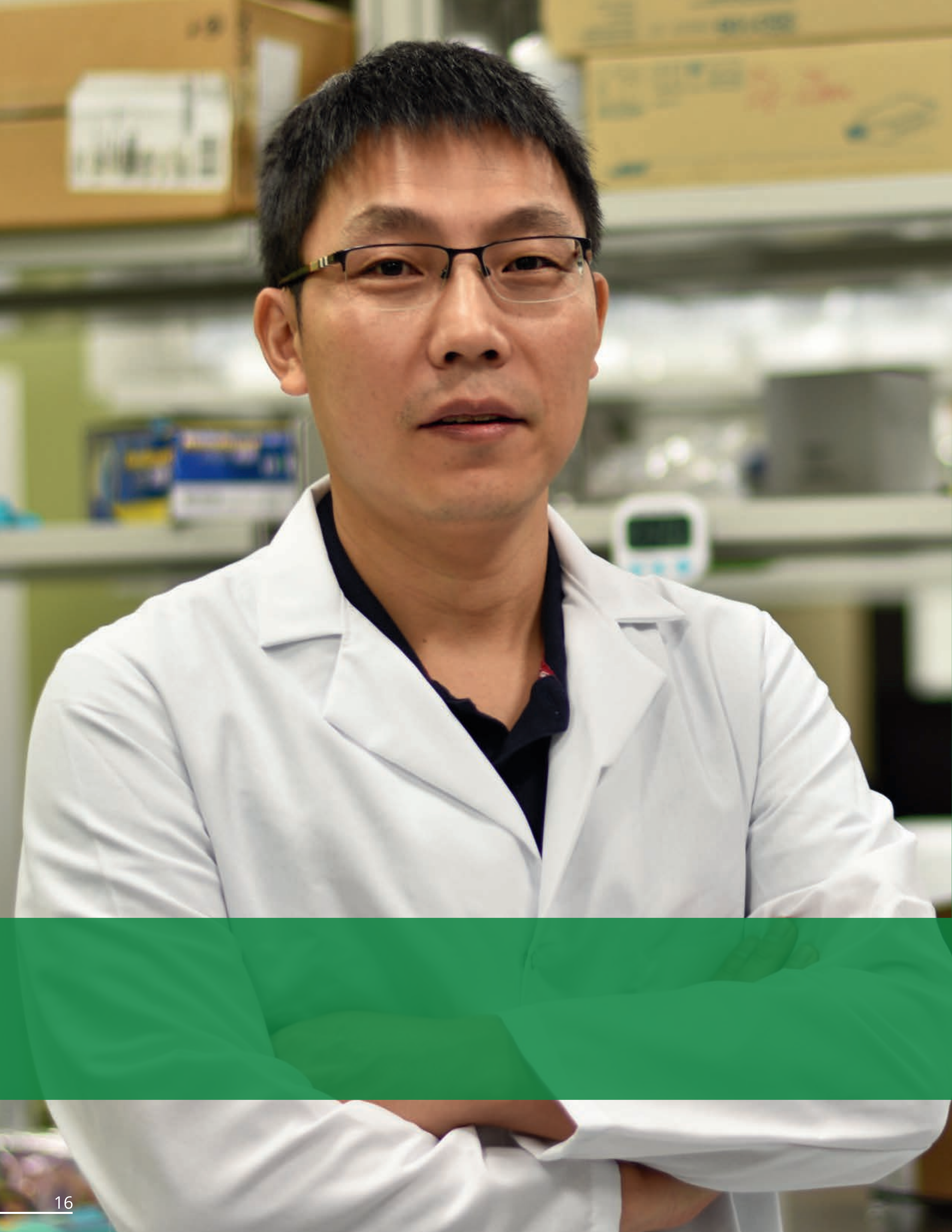
"Energy production and consumption have huge footprints affecting the environment surrounding us and the planet at large," said John. "The dominant sources of energy today are heavily dependent on fossil-based fuel systems and these have multi-media environmental impacts in the form of air, water and soil pollution, climate change and resource utilization. Development of new and innovative clean energy technology is extremely crucial for our world as we move towards a sustainable future needed for human survival."

By redesigning the journal, John feels it will more closely reflect the field.

"The focus of the journal was very narrow and it targeted a very specific sub-discipline of heat transfer within mechanical and energy systems. The area of clean energy and the environment, however, is much more inter-disciplinary in nature," said John. "We decided to revamp the focus of the journal and also bring in new faces on the editorial board from around the world with certainly much more diverse experience. We are currently recruiting top scientists from various research productive nations in Asia-Oceania, EU, Africa and the Americas to serve on this board."

The appointment, which began in January, lasts for four years.

Kayla Green



With problems arising from the permanent presence of traditional medical stents, there is a demand for a new type of medical stent. The University of North Texas College of Engineering received a $2 million grant from the National Institutes of Health to develop a biodegradable medical stent.

Medical stents are small tubes used to widen passageways within the body, such as the trachea and blood vessels. Traditional stents are made of anti-corrosion polymers or metals such as stainless steel, but the permanent presence of these stents can cause problems such as in-stent restenosis – the re-narrowing of an artery or other large blood vessel – and late thrombosis – or clotting.

“Unlike traditional medical stents, our bioresorbable stents are not permanent. They are engineered to disappear after the area around the stent has healed and regenerated,” said Don Zhu, associate professor in the Department of Biomedical Engineering. “Our stents will be made of a new zinc-based biomaterial that provides strength, biocompatibility and full-biodegradability that matches the body’s natural healing process and pace.”

The bioresorbable stents also will be more cost effective in the long term because the degradation of the stents will decrease in-stent restenosis and late thrombosis, making it less likely that patients will be back in the hospital for a replacement stent, tissue graft or bypass surgery.

Kayla Green

Don Zhu

$2M National Institutes of Health Grant

SAFER STORAGE FOR NUCLEAR WASTE

After experimenting with advanced modeling and characterizations while working to develop new glass materials to store nuclear waste, University of North Texas Department of Materials Science and Engineering professor Jincheng Du found that a gel layer that forms on the glass surface, has unique properties. This gel layer holds the key to long-term durability of nuclear waste storage.

"The problem is corrosion of the material used to hold waste. Over time, environmental conditions lead to corrosion and the release of radioactive elements into the environment. We want to prevent that," said Du. "Borosilicate glasses have high durability and are the chosen form to immobilize high-level nuclear waste. The key is to maintain durability in the very long term: thousands to hundreds of thousands of years.

"By combining a wide range of analytical techniques and advanced computer simulations, we have made great progress in understanding the important characteristics of the gel layer formed on the glass. The gel layer prevents water transport and makes the glass chemically durable in the long term."

Through a process called vitrification, nuclear waste is melted with glass-forming additives into a glass that fully contains the waste. This molten glass is then poured into a stainless steel container and stored underground at selected sites with geological stability. Because the waste emits different levels of radiation and environmental conditions are different from site to site, storage materials will break down at different rates. As a result, it is critical to obtain a fundamental understanding of the long-term corrosion mechanism of these glass materials.

"In order to build a usable predictive model of the corrosion and find ways to stop it, the properties of the gel layer must be fully understood," he said. "When that is done, we will have a better idea of how long this method of storage will work in different environments with different levels of radiation."

In a paper published June 4, 2018 in Nature Communications titled Dynamics of self-reorganization explains passivation of silicate glasses, Du and co-authors explain how the glass gel layer is formed and its unique anti-corrosion properties. This work is in collaboration with French Alternative and Atomic Energy Commission, the Pacific Northwest National Laboratory and funded by the U.S. Department of Energy Frontier Research Center - Center for Performance and Design of Nuclear Waste Forms and Containers.

Jim Rogers

A LIFETIME ACHIEVEMENT

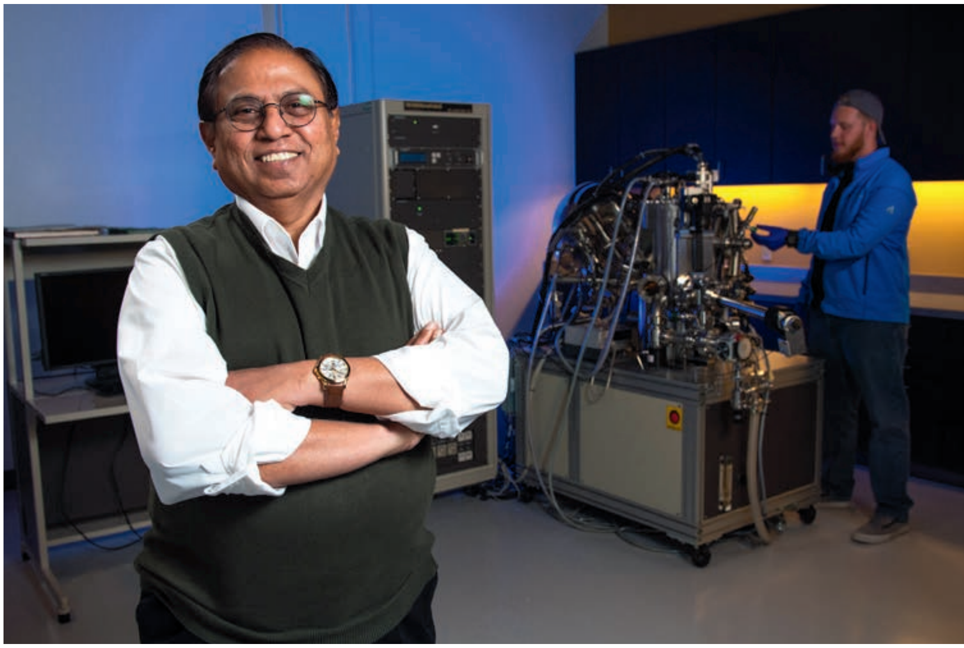
Narendra Dahotre, interim vice president of research and innovation and a distinguished professor with the University of North Texas College of Engineering, recently received the Society of Manufacturing Engineers Eli Whitney Productivity Award for lifetime achievement in the area of manufacturing engineering.

“Receiving such recognition from the international manufacturing community was a moment of great pride for me,” said Dahotre. “I’ve spent my entire career developing laser-based surface engineering for advanced materials. You could say that I was using laser technology before laser technology was cool.”

The Eli Whitney Productivity Award specifically recognizes an individual for distinguished accomplishments in improving capability within the broad concept of orderly production. For more than 80 years, the Society of Manufacturing Engineers has been recognizing individuals from industry and academia for their contributions in manufacturing technologies.

Dahotre has been continuously working in the field of laser processing for more than 25 years.

Jim Rogers



REVOLUTIONIZING MATERIALS SCIENCE

Researchers in UNT's College of Engineering's Department of Materials Science and Engineering have found a way to create an ultralight, highly heat-resistant, magnesium-based material by engineering bonds at an atomic level. Their research has been published in the "Nature Communications" journal. Their work took place in UNT's Materials Research Facility, which combines the high-quality and sophisticated characterization and processing instruments from UNT's Materials Research Facility (MRF) and the Nanofabrication Cleanroom.

"We've been metallurgists for some time and deal with metals, but the fact that we can peer into atoms and we are able to connect the bonding between atoms and the material properties for practical use is amazing," says Deep Choudhuri, research assistant professor. "To be able to do that, it says to us, 'what's going to happen 50 or 60 years down the line based on this?' We are breaking new frontiers."

Choudhuri, together with University Distinguished Research Professor Raj Banerjee, Associate Professor Srinivasan Srivilliputhur and David Jaeger, senior research scientist in UNT's Materials Research Facility, was able to use this discovery to create a magnesium alloy that can withstand usage at higher temperatures – such as those experienced in aircrafts and automotive engines.

"Magnesium is great, but its melting temperature is only 650 degrees Celsius, making it difficult to use at high temperatures since it then softens like candle wax," Banerjee says. "This discovery can have a huge impact in terms of light weighting future aircraft and making them, as well as other forms of transportation, more fuel efficient. Right now, it's expensive, but down the line when its production becomes more cost-effective, this new alloy could work in any moving part."

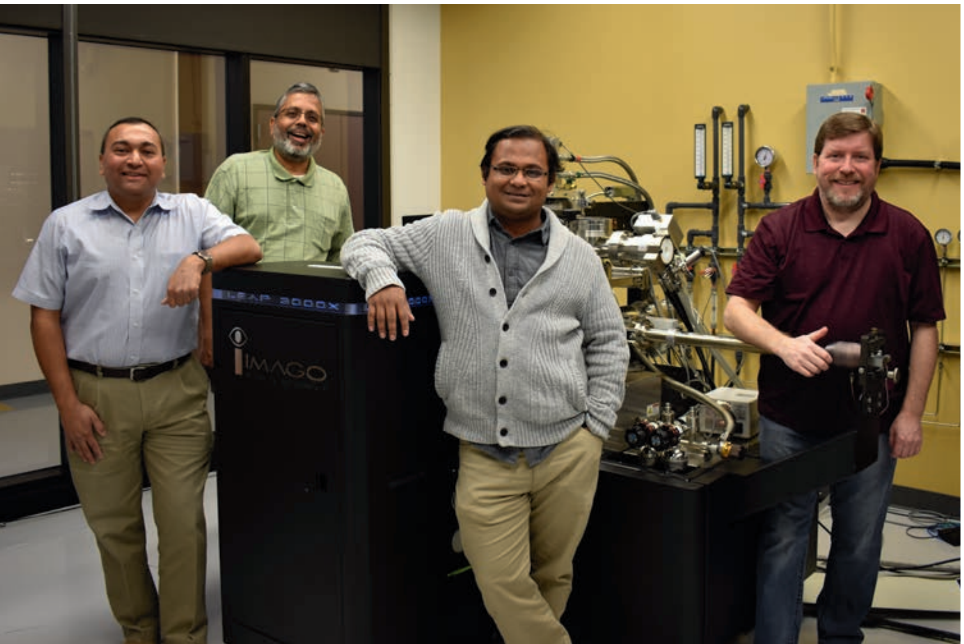
The researchers hope to use the principle they discovered to design other materials.

"How much of each element do you add, what proportion do you add, all of those questions need to be asked," Srivilliputhur says. "The moment you create this metal cocktail – we call them alloys – there are trillions and trillions of possible combinations."

The researchers say it's an honor to have their research featured in a scientific journal.

"To publish something on a classical metallurgy problem in this journal means we must be treading on new ground," Srivilliputhur says. "So, when we look at it from that point of view, this is a problem that thousands of materials scientists have looked at, and we were still able to dig deeper and find a new gem. It's exciting."

Courtney Taylor



HEATING UP BIOFUEL RESEARCH

Professor Sheldon Shi and Associate Professor Haifeng Zhang, both from the Department of Mechanical and Energy Engineering, have received a $482,905 grant from the United States Department of Agriculture to develop a high-temperature sensor to improve the production efficiency of biofuel from biomass.

“For this project, we’re going to build a high temperature censoring system to put into the pyrolysis furnace, so it can detect the gases coming out from the biomass during the pyrolysis,” said Shi. “Right now, there’s no such system available.”

Shi says pyrolysis is when the biomass material decomposes due to high temperatures. Currently, for the pyrolysis of biomass, the material is loaded into a furnace and “cooked” for a certain period of time at a certain temperature. The determination of the temperature and time is based on experience and multiple experiments, which may not be exact each time. Shi also says that when the feedstocks changes, the “cooking” parameters may also need to be changed during the process.

“Traditionally, it’s all been done through guessing,” he said. “Now, if we have such high temperature censoring system in the furnace, we can monitor it in real time based on the gases emitted from the furnace.”

It’s a tool that could not only help researchers determine optimal parameters for the pyrolysis of the biomass, but also create a more efficient and cost-effective process by eliminating the repetitive and unnecessary testing.

“Once we have the censoring system, we’ll be able to analyze the pyrolysed materials at different processing parameters so that a process model of pyrolysis can be established through simulation,” said Shi.

Kayla Green

FROM JEANS TO HOUSING MATERIALS

Oh, jeans! The wasted denim fibers from jeans production are proving to be more than just scraps. Sheldon Shi, a Department of Mechanical and Energy Engineering professor, has partnered with a jeans company in North Carolina to make use of wasted denim and turn it into something more useful.

“We’re working with VF Jeanswear to fabricate structural panels for flooring in buildings,” said Shi. “By re-using their wasted denim fiber, we can hopefully create a new use for the material that is both practical and applicable to modern households.”

Shi says UNT is in a unique position in that it offers a 4-by-8 foot hot press capable of creating a full-size panel – a machine most universities do not have.

“University of North Texas is the only university in the central south who has the 4-by-8 foot hot press,” said Shi. “I think one of the reasons they chose us was because we have the capability to fabricate full-size panels.”

The team has been asked to create 20 panels using the wasted denim fiber collected during production. Once the panels have been fabricated, Shi and his team will deliver them to the company, who will then construct a demo house to test the realistic capability of using the panels as flooring.

Kayla Green

FUTURE OF ELECTRONIC DEVICES

UNT researchers in the College of Engineering's Department of Materials Science and Engineering have created a uniform, thin, two-dimensional material that could revolutionize materials science. Their research has been published in Nature's "Scientific Reports" journal.

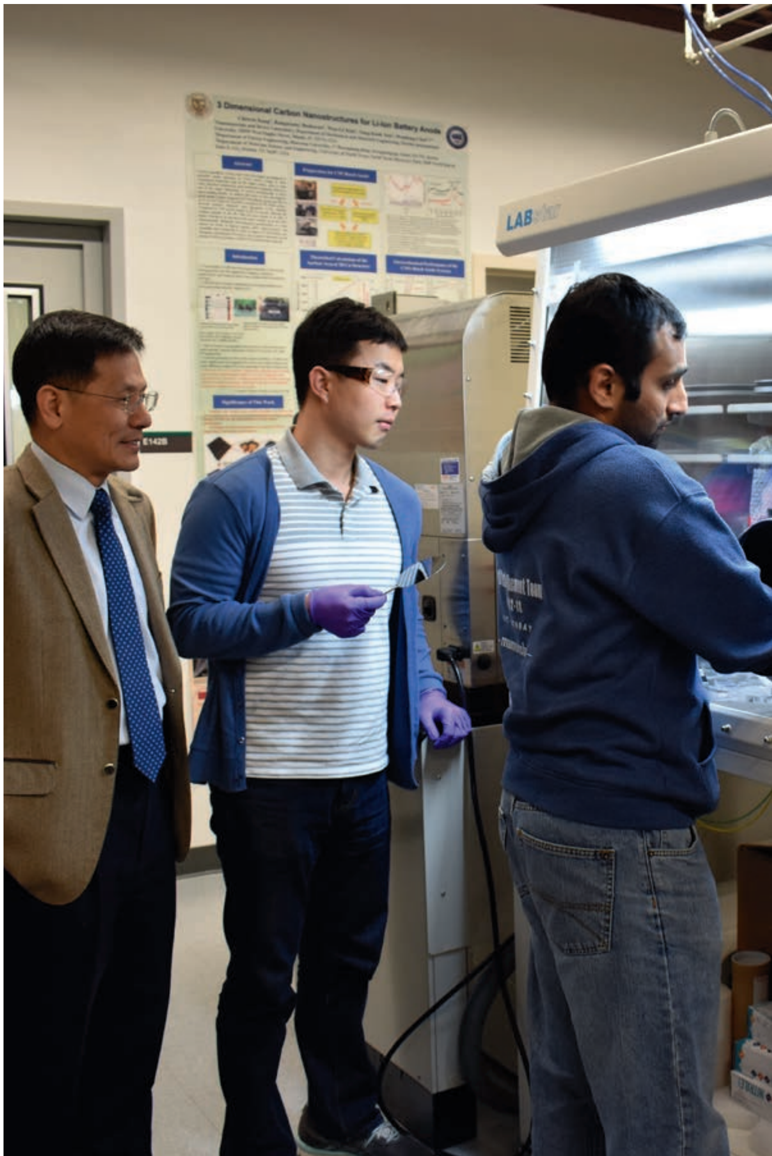
"We have synthesized two-dimensional WS_2 – tungsten and two sulfur atoms attached two dimensionally – that shows semiconducting behavior and relatively good electron mobility and we have brought it down to a one atom thickness," said Wonbong Choi, professor of materials science and engineering and mechanical and energy engineering. "When we changed the thickness from a few layers to a single layer, we found that we can engineer energy bandgap of WS_2. This is a very interesting phenomenon."

Choi collaborated with two of his doctoral students – Juhong Park and Eunho Cha – as well as two scientists from South Korea to develop WS_2. Their goal was to create a flexible, transparent material that was capable of semiconducting since graphene, a commonly used form of carbon, has no semiconducting behavior. Their discovery, which is patented through UNT, could lead to the design of next-generation ultra-thin opto-electronic devices.

"The most practical use of WS_2 – a beyond graphene material – is application in devices such as transistors, microchips, displays and circuitry," Cha said. "This material could improve upon the existing technologies for more sophisticated applications. For instance, we don't see that many wearable technologies, such as biochips, optical sensors or paper-thin flexible displays, but the ideas and concepts are there."

Creation of the 2-D material took place in Choi's lab where equipment allows for synthesizing and testing at an atomic level. The team plans to continue working with the material to master precise control of the layers for integration into future devices.

Courtney Taylor



DEVELOPING HIGH-PERFORMANCE PHOTODETECTORS

Anupama Kaul, director of the UNT College of Engineering's PACCAR Technology Institute, and her Ph.D. student Gustavo Lara Saenz have developed ultra-high performance optoelectronic devices based on molybdenum disulfide – or MoS_2 – which shows excellent performance compared to prior studies.

"We have these multi-layer stacks of MoS_2 membranes that are contacted on either side using metals, molybdenum in this case," said Kaul, who also is the PACCAR professor in engineering and a professor in the departments of Materials Science and Engineering and Electrical Engineering. "The use of molybdenum is unique, because other research typically has reported on gold with titanium as the contact metals, but molybdenum gives a very small barrier at the two interfaces, the so-called Schottky Barrier."

Kaul's group is the first to experimentally report that molybdenum gives a small Schottky barrier, which makes it easier for charge carriers to be collected efficiently at the molybdenum contacts and is just one reason the device yields a higher responsivity.

"The responsivity is basically a figure of merit that tells you how sensitive a device is at collecting optical energy and then transducing that into an electrical signal," Kaul said. "If someone's measuring the electrical current and I shine light on the device at a particular incoming power, the higher responsivity device would show a higher current compared to the background. Our responsivity is about 10,000 times higher than prior reports based on multilayer MoS_2. It was high across the entire spectrum of light wavelengths, from the visible spectrum to the near infrared, making it broadband."

Kaul says the other factors that can influence this collection efficiency are likely due to the suspended nature of the MoS_2 membrane structures, which minimizes the scattering of the electrons from the substrate surface.

"When these electrons experience a lot of scattering, they kind of zigzag and it diminishes their ability to make it to the other side efficiently," Kaul said. "The fact that these are suspended structures minimizes the scattering events."

Kaul says the high performance devices could have implications for broadband photodetectors useful for the U.S. Department of Defense or for NASA's uncooled imaging platforms.

Courtney Taylor

FUNDING THE FUTURE

The Department of Biomedical Engineering received a $300,000 grant from the Hoblitzelle Foundation to build upon its research and teaching.

“The goals and objectives of our biomedical laboratories directly relate to the Hoblitzelle Foundation’s passion for supporting the educational, scientific and medical needs of North Texans,” said College of Engineering Dean Costas Tsatsoulis. “Providing world-class instrumentation will transform the educational experiences of more than 200 Biomedical Engineering students in addition to cultivating research and innovations vital to discovering solutions for a variety of diseases on a regional, state and national scale.”

New to UNT’s College of Engineering, the Department of Biomedical Engineering began in fall 2014. In just three years, the department has grown to nearly 220 students, with its first graduating class this May, and admitted its first group of graduate students –MS and PhD track, in fall 2017.

One of the initial goals for the department is to buy an Anatomage, a virtual anatomy machine that allows our graduate students and faculty researchers to obtain a 3-D visualization of an organ of interest and plan medical interventions.

“The Hoblitzelle grant enables our faculty and graduate students to expand their research horizons by working with state-of-the-art equipment and software,” said Vijay Vaidyanathan, founding chair of the Department of Biomedical Engineering. “Active involvement in research with sophisticated equipment, such as Anatomage, benefits our undergraduate students, as well.”

The grant also is eligible for 50 percent matching state funds from the Texas Research Incentive Program, a state program that matches funds awarded based on how much an institution raises in private gifts and endowments to enhance research activities. The program is limited to eight evolving research universities in Texas.

Kayla Green

FIRST-OF-ITS KIND PROCESS DEVELOPED

Corrosion and wear are very common – they can happen to any material exposed to an environment. But, what if materials could be tested at the atomic level to determine exactly how and why they break down and then be improved to create ultra-high performance alloys? Researchers at the University of North Texas have done just that – and are designing next generation alloys that could be used in bio-implants or even outer space. Their study was published in Scientific Reports.

"We characterized how materials degrade under extreme conditions using a combination of characterization techniques that have never been brought together before," said Aditya Ayyagari, a recent doctoral graduate with the College of Engineering's Materials Science and Engineering Department, who is the lead author on the study. "We have measured the wear and corrosion behavior at the microstructural length-scales and presented a comprehensive understanding from different viewpoints."

The material tested was a complex alloy composed of six different elements and a unique microstructure with crystalline phases in a glassy matrix. The alloy was tested simultaneously for bulk wear and bulk corrosion resistance. Their next step is what makes this research so unique.

"The next level of characterization is where we go beyond the state-of-the-art. It's called phase-wise characterization," Ayyagari said. "We actually can understand how components inside the alloy respond. We used a combination of scanning kelvin probe, scanning vibrating electrode technique and Pico-indentation to map the phase-specific properties.

Some of these novel, in-situ tests were performed by Vahid Hasannaeimi, a graduate student in the Materials Science and Engineering department and second author on the paper."

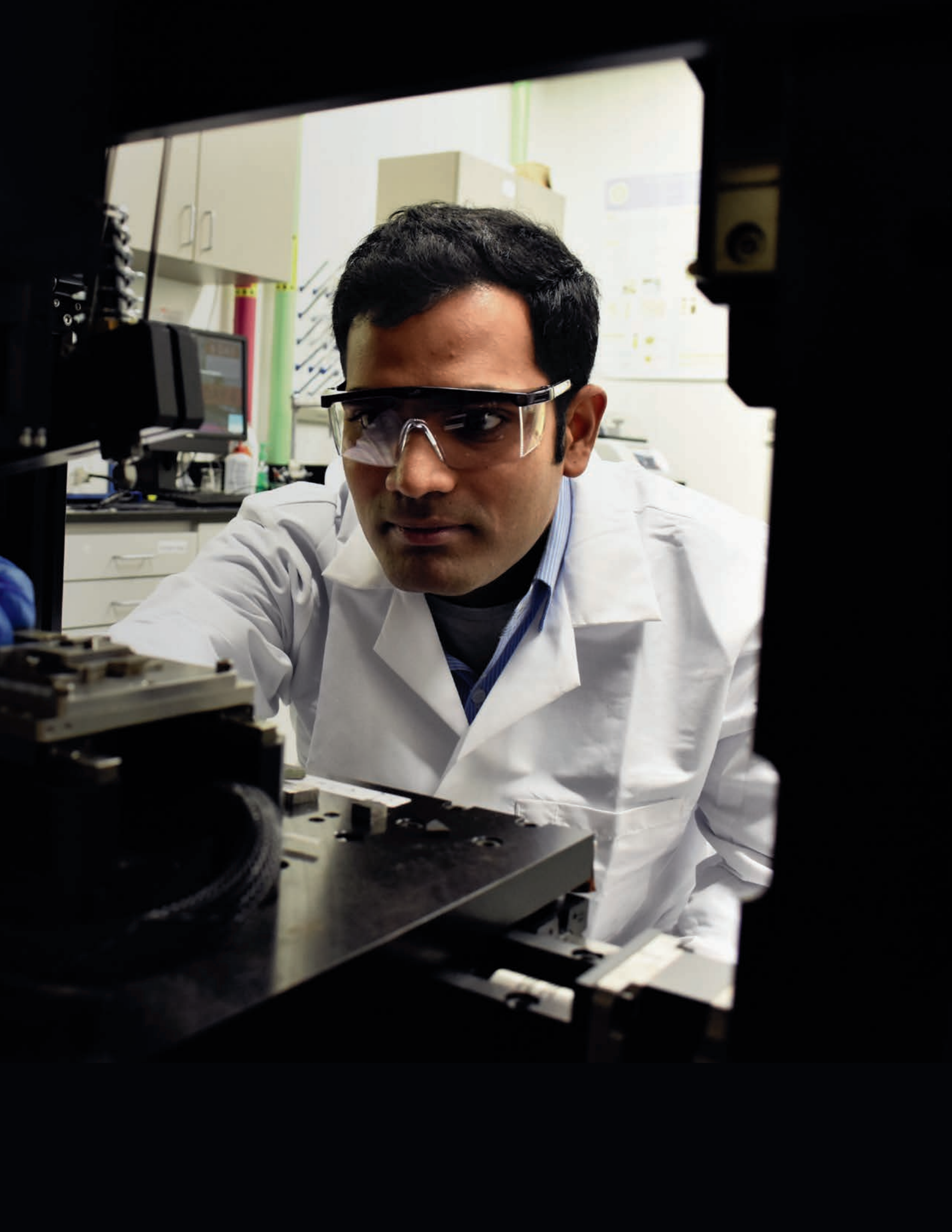
UNT is one of very few universities equipped for this type of testing all in one place.

"We take the sample, polish it so you see the different phases, put it in a microscope and zoom in so you can see all of them," said Ayyagari. "You can then use a probe on individual phases to see the wear and corrosion properties. The microscope has a vacuum inside so you have an environment just like you have in space. It is very representative of how this material will behave out there."

Their testing was partly supported by a National Science Foundation grant earned by Sundeep Mukherjee, associate professor of materials science and engineering and corresponding author on the paper who supervised the project. Their alloys are expected to have major implications for everything from space travel to the future of medical devices.

"This material has a great combination of strength and ductility – the amount a solid material stretches under stress," Mukherjee said. "Our hope is that once we present these results on phase-specific friction and electrochemical behavior, the applications for it are going to explode."

Courtney Taylor

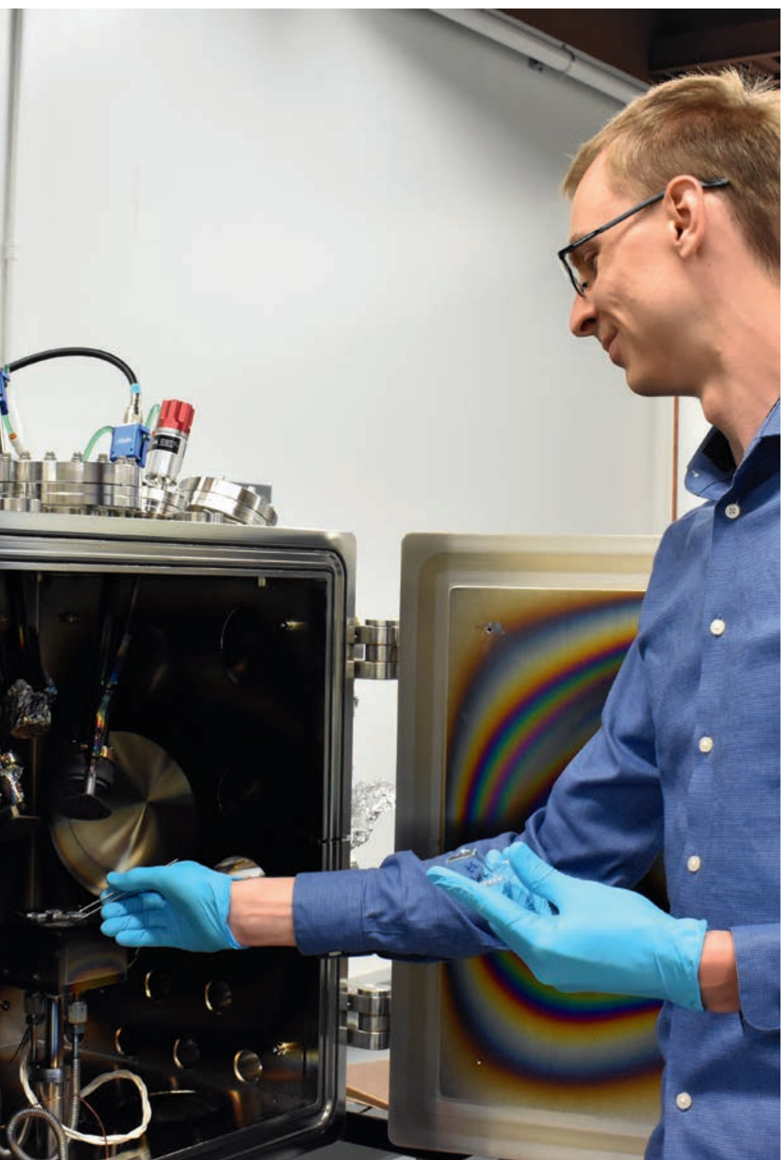


PROTECTING NANOELECTRONICS

In a paper published in Nature's Scientific Reports, University of North Texas Ph.D. graduate student Benjamin Sirota explains a new method for protecting nanoelectronics that will result in longer-lasting components with better electronic stability.

"When dealing with electronics at the nanoscale, exposure to foreign substances can have devastating effects," said Sirota. "Remember, we are dealing with electronics at the smallest scale. Main electronic components such as transistors can now be made from metal dichalcogenides films only a few molecules thick. Even the smallest amount of air, moisture and/or temperature increase will result in oxidation and deterioration of the transistor rendering it unreliable."

After two years of research, Sirota, advised by his graduating professor Andrey Voevodin and working with a team of collaborators from the Air Force Research Laboratory and the National Institute of Standards and Technology, has developed a metal film for nanoelectronics that can be sandwiched with an ultra-thin protective layer.



"I used boron nitride to act as a barrier to outside oxidizing substances," said Sirota. "This unique combination of materials not only protects the nanoelectronics but also allows for improved electrical flow and chemical stability even at high temperatures."

The paper is titled "Hexagonal $MoTe_2$ with Amorphous BN Passivation Layer for Improved Oxidation Resistance and Endurance of 2-D Field Effect Transistors" and can be found in Nature's Scientific Reports.

Jim Rogers

NAVIGATING ICY WATERS

Kristal Jacobs

Due to new shipping routes through icy areas, high-fidelity propeller and ice interaction is being researched by UNT mechanical and energy engineering assistant professor, Hamid Sadat, graduate student, Morteza Heydari, and engineering technology interim chair and professor, Seifollah Nasrazadani.

"One of the major concerns for ships operating in icy water is the extreme loads applied to the propulsion system due to propeller-ice interaction. Current literature predictions on the propeller-ice interaction are mainly based on specific measurement data or empirical models and not very accurate," Sadat said.

With ice melting at a quick pace, transportation across the sea has changed. New routes have decreased the travel and shipping distances, which allow ships to consume considerably less fuel, speed up trade and reduce undesirable environmental impacts.

The aim of the team's study is to develop advanced numerical techniques to accurately simulate the interaction between a ship's propeller and the ice along the routes and gain an understanding of the complex physics involved in this process.

"Some of what we'll be looking at from the materials perspective would be the selection of the propeller material – which is cost effective, durable and resistant to cracking – and developing a coating that would allow the propeller material to survive in extreme environments," Nasrazadani said.

The team has divided the simulation into three parts in order to develop a proper model and validate their results between stages.

"The first part is open water simulation where we only have the propeller and no ice," Heydari said. "Then, after that, we add the ice part to our solution domain, and lastly, we want to add more details to our assumptions where we have both propeller and ice. Currently, we are in the second stage."

The difficulties that they've encountered include modeling the brittle ice structure.

"The model we have for the fluid field is perfect, but once you add ice, the physics cannot be captured well," Sadat said.

After they move on to the final stage, it will be possible to investigate other factors such as erosion on the propeller surface due to contact with ice blocks.

MAKING CONNECTIONS IN CYBERSECURITY, ANALYTICS

UNT College of Engineering hosted its first Cybersecurity Summit on Oct. 27, 2017, and its first Data Analytics Summit on May 4, 2018, at the John Q. Hammons Center in Allen. The summits will be hosted annually as a part of the College of Engineering's initiative to showcase insights from the industry, research and academia.

"The goal of these summits is to engage the college and members of industry in further dialogue about the future of engineering and technology," said Yan Huang, interim dean of the college.

The Cybersecurity Summit included keynote speeches from Armor Chief Security Officer, Jeff Schilling, and Vice President of Enterprise Cybersecurity Threat Detection, Daniel Shnowske, while the Data Analytics Summit included keynote speeches from CEO of Lone Star Analysis Steve Roemerman and CEO of Lease Analytics Tom Agnew.

Connecting on cybersecurity topics

As the first program in the U.S. to be federally certified by the National Security Agency as a Center for Academic Excellence in information assurance, education and research and cyber defense research, UNT College of Engineering hosted 125 people at the one-day Cybersecurity Summit. During the summit, Schilling delivered his keynote speech focusing on his journey and experiences within the cloud, while Shnowske spoke on trends in the industry and how Fidelity Investments was tackling the latest cyber threats.

"There are still those out there who will question the security of the cloud and write it off as too high-risk," said Schilling. "Over the course of my career, I've become a firm believer that your workloads are safer residing within the cloud, should users abide by the shared security and compliance model that makes those reliant on it accountable for its security. I'm honored to be included amongst so many notable industry experts on a topic that has, and will, become more relevant with the progression of the digital transformation."

Through the guest speakers and three panels, the summit addressed the latest cybersecurity topics pertaining to today's business world, including the Internet of Things, network security, big data analytics and wireless security. Panelists included the Department of Computer Science and Engineering Professor Ram Dantu, director of UNT's Center for Information and Cyber Security, Professor Krishna Kavi, director of the Network Centric Systems Center at UNT, and Assistant Professor Hassan Takabi.

Diving into data

At the Data Analytics Summit, Roemerman discussed seven problems and issues that should be addressed as part of maturing and defining data analytics, while Agnew tackled the many issues associated with oil and gas leases and the roles natural language processing and deep learning play in mining thousands of documents.

The one-day summit hosted 60 people and addressed the latest data analytics topics, including state-of-the-art analytical/machine learning methods, business and intelligence applications and future trends. Panelists from Verizon, Walmart Technology, UPS, Armor and the U.S. Army Research Laboratory also provided insight into how they are using and integrating data analytics into their daily operations.

"Our goal for the summit was to facilitate a discussion and inform participants about the current state of analytics, and I think we did just that," said Thomas Derryberry, assistant dean of corporate relations for the College of Engineering.

Kristal Jacobs

BUILDING BIOIMPLANTS FOR THE BODY

As the population age 65 and older continues to grow, so does the need for bioimplants like artificial knees and hips, dental prosthetics and cardiovascular devices. Implant surgeries can be taxing on older demographics who tend to take longer to recover, and once a bioimplant is inserted, there's no guarantee it will last. Sundeep Mukherjee, associate professor of materials science and engineering, wants to change that.

"There are a lot of very pertinent issues surrounding bioimplants that need to be remedied," Mukherjee said. "The body is a fairly aggressive environment, and you don't want a patient to require implant replacement surgery every five years because the implant is failing."

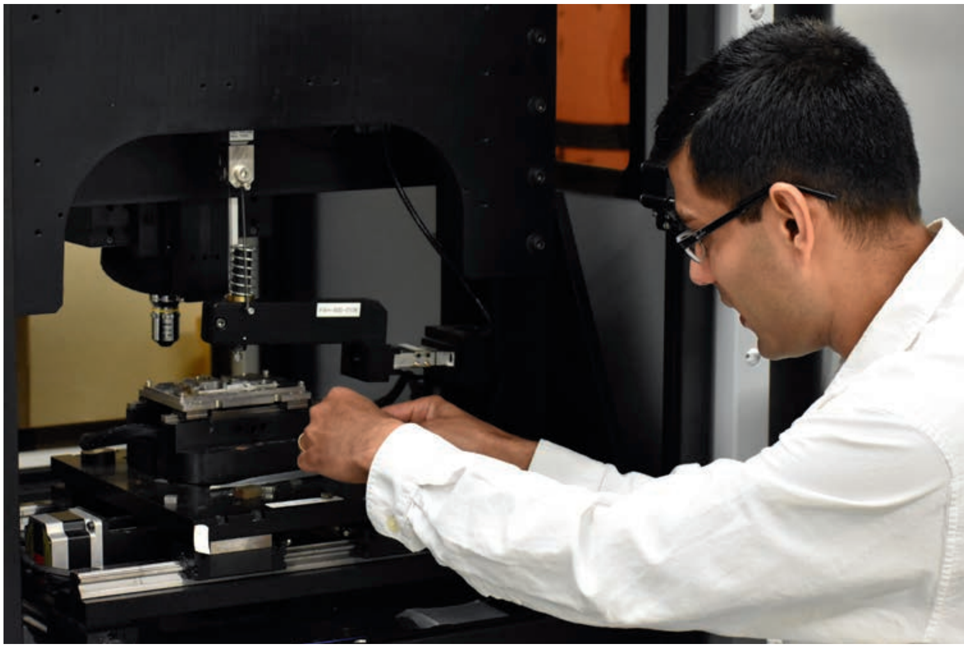
To expand his current bioimplant research, Mukherjee partnered with a colleague in India – Harpreet Singh, a dean and professor at the Indian Institute of Technology – to apply for a grant from the Indo-US Science and Technology Forum and form the Indo-U.S. Joint Center for Development of Durable Advanced Materials for Bioimplants.

"All of us are honored that we're a part of something so big," Mukherjee said. "The scope of this problem is huge and when Harpreet pitched the idea, I jumped on it – not only for the knowledge, but for the prospect of exchanging students and providing them a unique perspective of another country."

The two-year grant covers travel for faculty and students between the countries and some supplies needed to further their research. Mukherjee says they will focus not only on new types of bioimplants, but on improving the quality and longevity of current forms.

"There are a large number of patients with lower income and the implant they can afford may be made out of steel – they can't use the latest and greatest implants," he said. "We want to build the next generation implant, but also want to improve the lower-end materials based on conventional metals that can be targeted towards lower income people."

Courtney Taylor



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Materials
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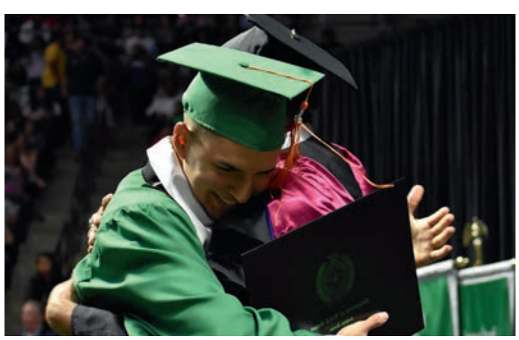
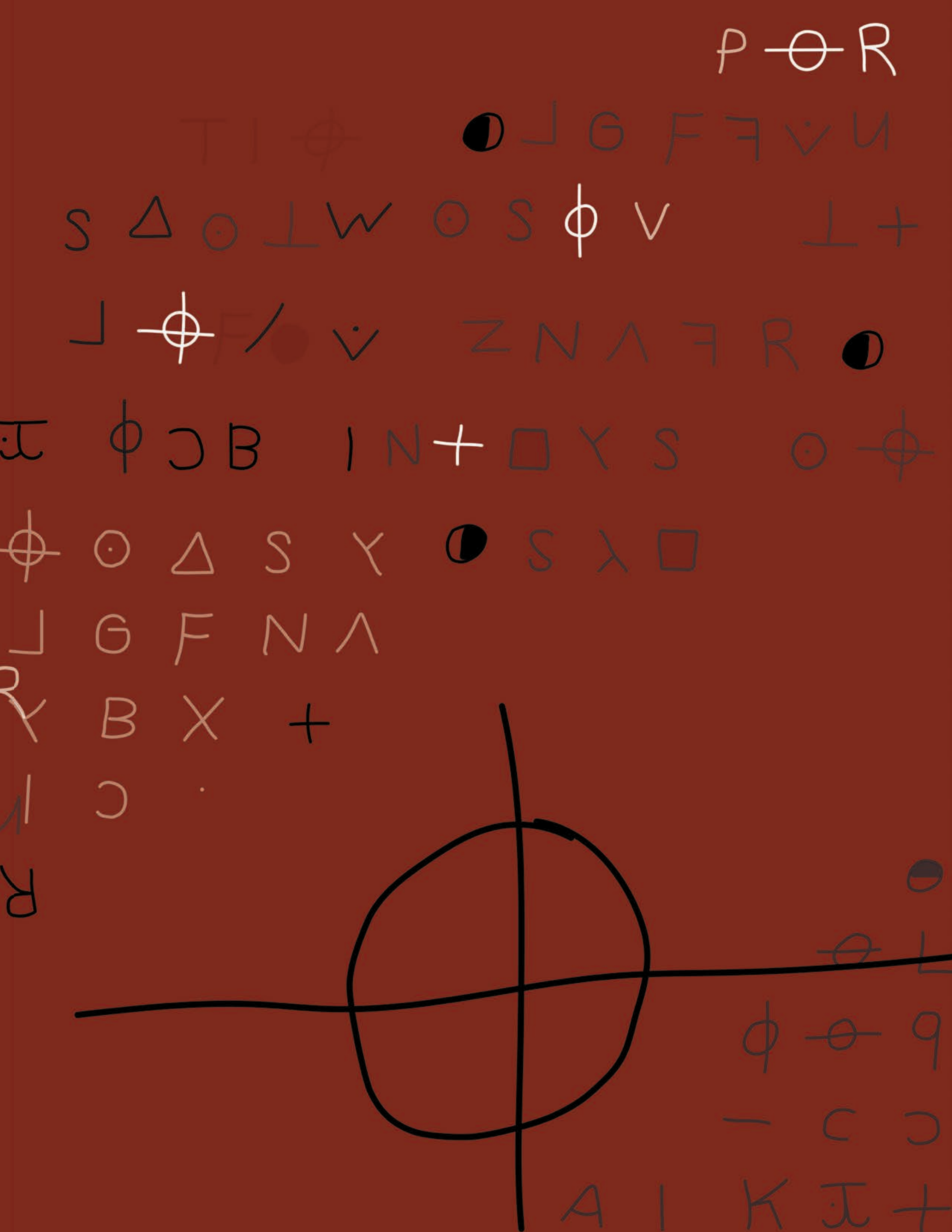


BIOMEDICAL ENGINEERING

FIRST GRADUATING CLASS

SOLVING THE ZODIAC KILLER CIPHER



To aid in solving a decades old cipher to help reveal the infamous Zodiac Killer's identity, University of North Texas computer science and engineering professor, Ryan Garlick, joined a five-member code team in a special series, "The Hunt for the Zodiac Killer," that premiered in November 2017 on the History Channel.

The Zodiac Killer

The Zodiac Killer terrorized northern Calif. in the late 1960's and early 1970's. It has been confirmed that he killed at least five people, but he claimed to have killed up to 37 people in the letters and postcards he sent to local newspapers and law enforcement. The killer would taunt law enforcement and the public in the letters.

In July 1969, the Zodiac Killer sent his first letters to the Vallejo Times-Herald, San Francisco Examiner and the San Francisco Chronicle claiming responsibility for two shootings and providing specific details about the murders. Accompanied by the information, he included a cipher split into three parts for each newspaper and a threat to kill again if the cipher was not published by the newspapers. The cipher was solved within a week by a couple at their breakfast table. The cipher began "I like killing people because it is so much fun" and continued with why he liked killing and described his victims as slaves for his afterlife. A few months later, the Zodiac Killer sent another 340 character cipher, "Z340," along with a humorous greeting card. Almost five decades later, the 340 character cipher is still challenging experts like Garlick.

Garlick's Expertise

Garlick began his work on solving the Zodiac cipher because he was always interested in solving puzzles and intrigued by the unsolved Zodiac Killer case. Based on his knowledge and experience of the cipher and coding, Garlick was asked to join the code team for the History Channel series. Garlick, who has had students in his UNT computer science class develop software to try to crack the Z340 cipher, was previously on the 2009 National Geographic documentary "Code Breakers" for his work with the cipher in his class. His paper, "How to know that you haven't solved the Zodiac-340 cipher," is what Garlick believes gained the initial attention from the networks, along with his existing connections to other members of the code team.

In his paper, he discussed the similar patterns of people who believed they have solved the cipher, but likely had not. Using patterns such as a symbol representing multiple letters and anagramming often led to incorrect solutions because these methods allow the possibility of inserting virtually any solution. Garlick thinks they should focus on a consistent pattern.

"All of these people thought they solved the cipher, but unknowingly introduced many degrees of freedom in their solution," Garlick said. "They were really opening up so many possibilities that the solution could be any number of things."

The Hunt for the Zodiac Killer

Garlick was joined on the code team by York College math professor Craig Bauer, Google computer engineer Sujith Ravi, Zodiac expert David Oranchak and University of Southern California computer science professor and the code team leader, Kevin Knight. The show also features Knight's high-tech artificial intelligence called Carmel, which is a super computer that can search through trillions of patterns in the cipher and is programmed to think like the killer.

On "The Hunt for the Zodiac Killer," along with the detectives working on the case, Garlick and the code team were evaluating evidence and other previously unrevealed details to make connections and solve the cipher. In an attempt to recreate the killer's thought process, all known Zodiac writings and code were plugged into Carmel to look for the language he uses in the cipher. Through the team's software, they could evaluate words and word usage in the evidence database. The software was able to discover common words used and even repeated misspellings, so every detail could aid in revealing the killer's identity.

"The show was unscripted," Garlick said. "They told us a topic; we started talking and they picked out what was interesting."

On the code team, Garlick worked specifically on transpositions of the ciphers. In other words, he looked at the different directions the cipher could be read. Instead of reading left to right and top to bottom, he would look at reading it vertically, in a spiral, or thousands of other possibilities.

Garlick also had two UNT students, TAMS student Julian LaNeve and Ph.D. student Jacob Hochstetler, contributing to the process while on "The Hunt for the Zodiac Killer." Garlick believes working on the Zodiac Killer cipher is a good practical application of algorithms and computer science for students.

"We're not just solving a problem in a textbook," Garlick said. "We have a real problem here that might help solve one of the biggest serial killer cases in history. We can use computers to write software to help us with that."

The biggest challenge for Garlick is how many different possibilities of how the cipher could be read. From the direction the cipher is read to what each character represents to any other minor or major detail, every possibility has to be tried. There is a chance the cipher is in a language other than English. Some theories even say the cipher could be entirely gibberish. However, Garlick doesn't think it is because of linguistic statistics and corrections made by the killer in his ciphers.

"It hasn't been solved in 50 years and the Zodiac liked to taunt the public and police so what better way to do it than to send something that you knew they would work on forever," Garlick said. "But there are some things that indicate that it is not gibberish. Some of the statistics of the cipher itself, once transposed - it doesn't look like random symbols."

Join the Hunt

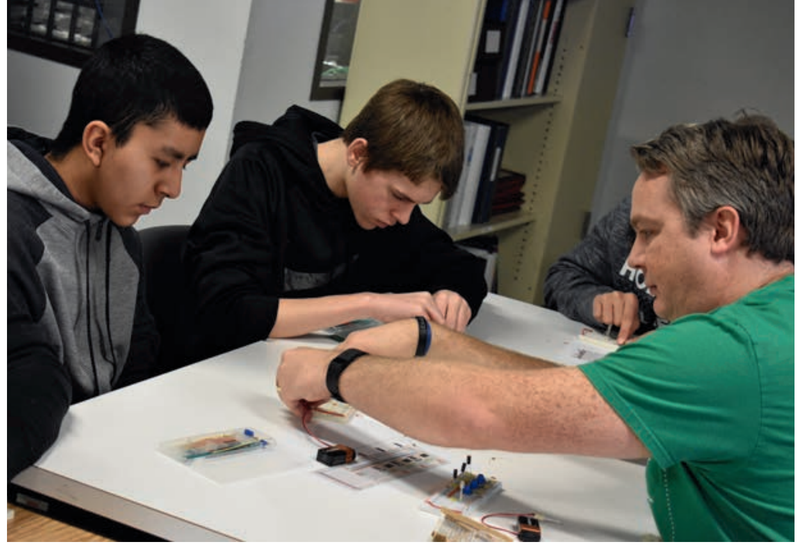
For those who want to contribute to solving the case and cipher, Garlick's advice is to "keep at it." He believes the internet community working on the case have contributed to it greatly. He says that more people working on the case results in more diverse viewpoints and ideas being contributed to the case.

"There is a really great community of people working on it that have uncovered amazing things," Garlick said. "They've uncovered comic books that he clearly referenced in his communications to the police. Just knowing that he had this comic book gives us a year range; we might find a subscription list for that comic book."

Garlick encourages anyone interested in the Zodiac Killer case and coding to watch "The Hunt for the Zodiac Killer" on the History Channel and join the online communities. He recommends looking at message boards to learn more about the case and going to the website, zodiackillerciphers.com, to use the tools David Oranchak has created for exploring and experimenting with statistics and patterns of the cipher text.

"The number of people the internet can bring to work on this is incredible and very helpful," Garlick said. "The more people we have in the community to look at it, the greater the chance someone is going to come up with something."

Kristal Jacobs



STEM @ THE PARK
STEM @ THE PARK

STEM @ THE PARK

STEM @ THE PARK
STEM @ THE PARK


AIR FORCE JUNIOR ROTC

The UNT College of Engineering hosts STEM@thePark events to give local youth to learn about science, technology, engineering and mathematics (STEM) principles in a hands-on environment at the Discovery Park Campus.

STEM@thePark began under the name Design Your World, a daylong outreach program for girls in grades 4-12 that was co-hosted by UNT's Society of Women Engineers and the Society of Women Engineers Dallas chapter in 2016.

"I was the VP for Outreach of Dallas SWE and hearing how exceptionally our students led and organized the daylong event inspired me to create a program that could be led by UNT," Associate Dean of Undergraduate Studies Nandika D'Souza said.

The first official STEM@thePark event, co-organized with West Point LEADS, hosted more than 200 high school students Nov. 11, 2017.
During STEM@thePark, there are a variety of activities that enable K-12 students to get hands-on engineering and leadership experience. Through projects like robotics, ballistics, construction and drones, students acquire a comprehensive view of the many fields of engineering. Students learn principles, cause and effect, parameters of the design and then work towards the solution in interactive ways.

"While the solution is just as cool and cutting edge, we explore the joy of thinking and cognitive experiences," she said.

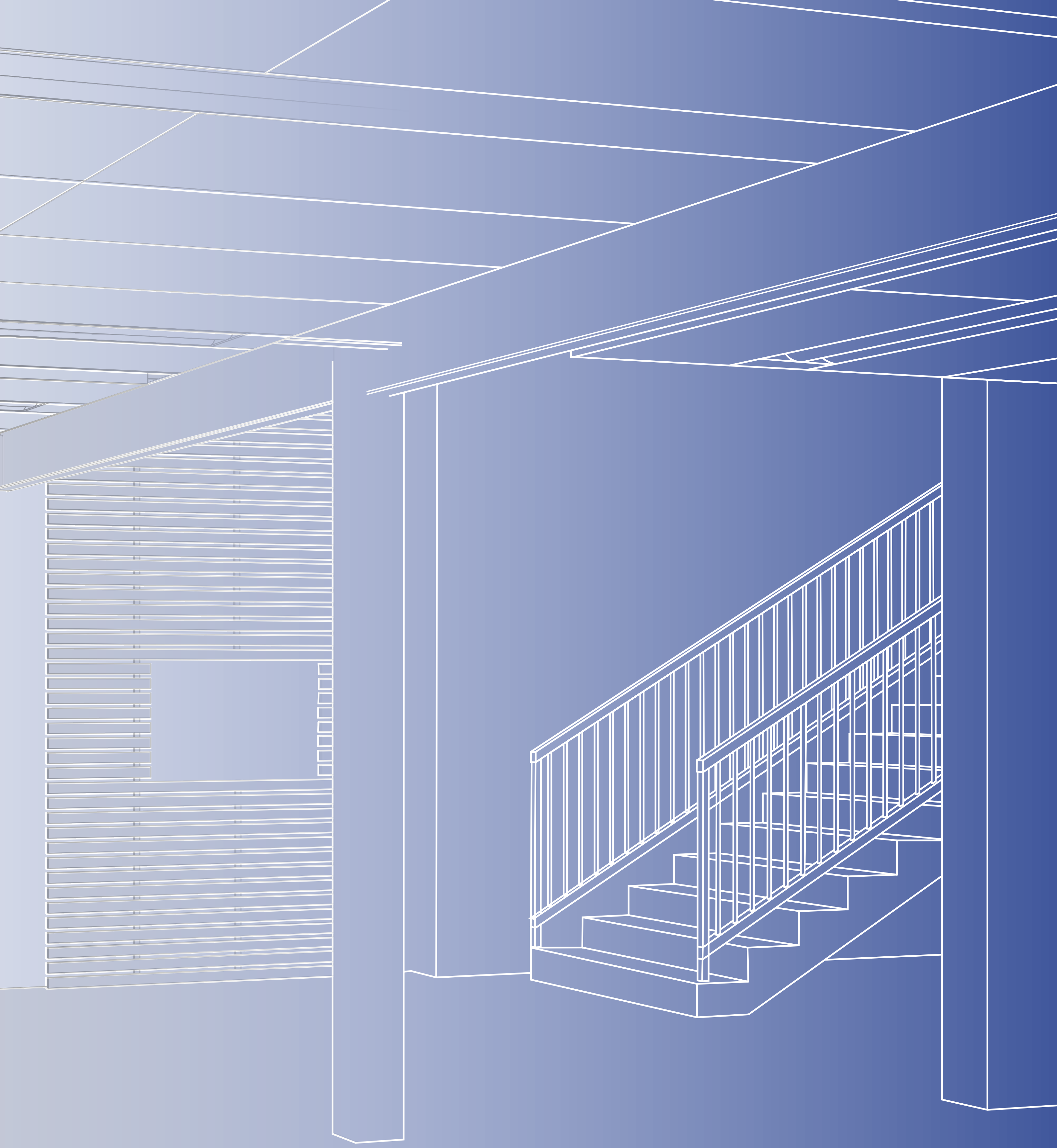
The activities are led by many UNT diversity organizations, honor societies and professional technical organizations. Since projects are organized by UNT student organizations, K-12 students are able to engage with them and learn more about what it's like to be a UNT student.

"We mix race, gender and cultural diversity into each volunteer group so that every design has role models for students to identify with even as they gain courage and experience in solving problems," D'Souza said.

Kristal Jacobs

UNT College of Engineering is adding a new 26,250-square-foot building to its Discovery Park campus.

The $12.8 million state-of-the-art building will house the Department of Biomedical Engineering, and enable distance learning through connectivity and projectors. It will contain two large research labs, three teaching labs, and three classrooms, one of which will be tiered and seat approximately 200 students.



BUILDING UP BIOMEDICAL

ALUMNI

Biomedical engineering major Ashton Baltazar started her academic experience in the public school system before entering a fine arts charter school for high school. There, she found herself surrounded by peers who play instruments, dance and write creatively. But she was more interested in discovering the "how" and "why" things work.

So instead of pursuing college degrees in the fine arts like her peers, Baltazar wanted to grow the opportunities females had in STEM degrees.

"With the help of some school faculty, I developed the National Science Honor Society to help broaden STEM subjects, student projects and my own personal interest in the fields of math and science," Baltazar said.

The summer of her senior year, she began volunteering at a local hospital where she discovered the many ways math and science added value in health care. She was given the opportunity to follow an orthopedic surgeon into the operating room and observed patients receiving total joint replacements.

"It was during this time I realized how necessary the utility of innovation was as I observed the mechanisms of the instruments used in the operations," Baltazar said. "The joints that were being replaced and the mechanics behind the techniques of the surgeon all relied heavily on engineering designs."

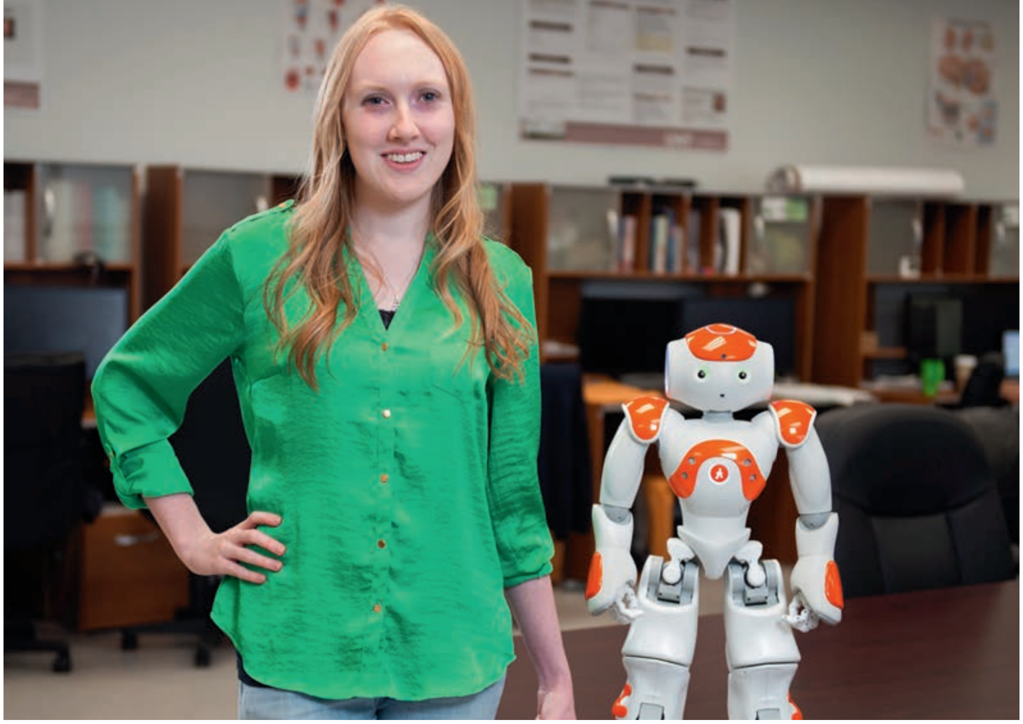
After many college tours, scholarships from fine art universities she'd turned down, and her parents' support in passion to study math and science, Baltazar made the decision to join UNT's new biomedical engineering program. This program allowed her to continue graduate work in a STEM field and provide a strong academic basis for pursuing medical school.

While at UNT, Baltazar was involved with numerous student organizations including the Biomedical Engineering Society, UNT student alumni and Zeta Tau Alpha Panhellenic Sorority. She also continued to volunteer with local hospitals and community activities in her spare time.

"I was a very busy student on top of working part time and minoring in mathematics, biology and chemistry, but it was extremely fulfilling, and I never regretted my decision to major in biomedical engineering," Baltazar said. "I owe my perseverance to the University of North Texas biomedical engineering department for pushing me through my shortcomings from when I first started," Baltazar said.

Kristal Jacobs

ASHTON BALTAZAR



NATALIE PARDE

Recent College of Engineering doctoral graduate, Natalie Parde, has been a consistent face in the Department of Computer Science and Engineering. Not only did she receive her Ph.D. in computer science and engineering in August at UNT, but she also received her bachelor's and master's degrees in computer science at UNT in 2013 and 2016.

A lot of Parde's time at UNT was spent in the Human Intelligence and Language Technologies Laboratory (HiLT) where she pursued her research interests in natural language processing with an emphasis in human-robot systems, computational processing of creative language and grounded language learning. The research allowed her to work with HiLT's companionbots, Grace, Bobby and Banlu.

"I was afforded a lot of flexibility to explore different projects and applications that really resonated with me, and I'm very grateful for that," Parde said. "My dissertation work combined aspects of computer science, linguistics and psychology to create a reading robot companion for elderly adults."

In 2014, Parde was awarded the National Science Foundation Graduate Research Fellowship for her work researching natural language processing, which advances how computer systems understand and interact with how humans speak and write.

"I was extremely happy to receive it, because not only did it mean I'd have more flexibility to pursue my personal research interests in the coming years, it also helped increase visibility for UNT," Parde said.

While at UNT, she received a number of other external and internal awards, co-authored 19 publications and spoke about her research at a variety of national and international conferences. Parde also was part of many student and professional organizations, participated in various outreach programs and even mentored UNT and TAMS students. As president of the UNT's Women in Computing student organization, her favorite memories include the women in computing book clubs and attending the Grace Hopper Celebration of Women in Computing.

"There really aren't a ton of women in STEM fields, and particularly in computer science and engineering, so it was awesome being able to build a cool, supportive community of peers interested in two of my passions: computer science and STEM diversity," Parde said.

After graduating from UNT, she accepted a position as an assistant professor of computer science at the University of Illinois at Chicago.

"In the long-term, I'd like to become a leading figure in AI and natural language processing research and mentor students who go on to do the same," Parde said.

Kristal Jacobs

THE COLLEGE OF ENGINEERING THANKS THE FOLLOWING FOR THEIR GENEROUS CONTRIBUTIONS. YOUR GIFT TO THE COLLEGE IS TRANSFORMATIONAL – FOR OUR STUDENTS, FOR OUR FACULTY AND FOR OUR POTENTIAL. THANK YOU.

INDIVIDUALS

Dr. Robert Akl
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