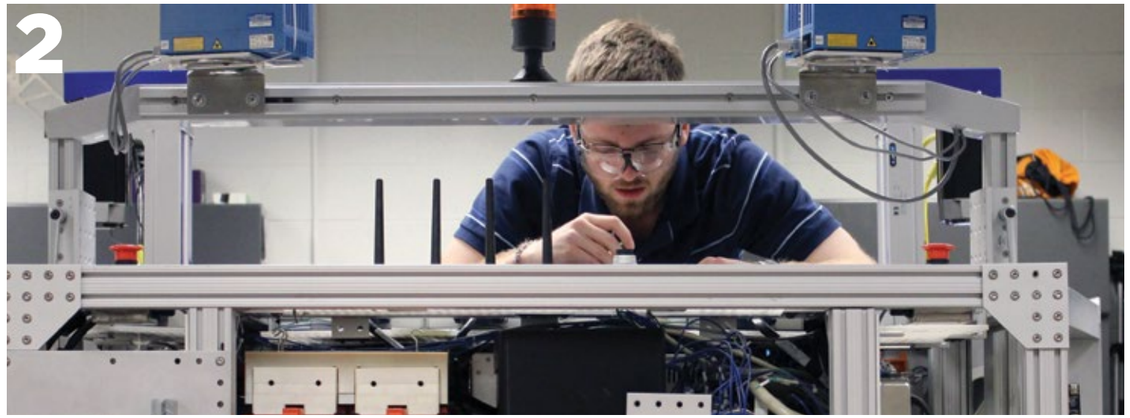
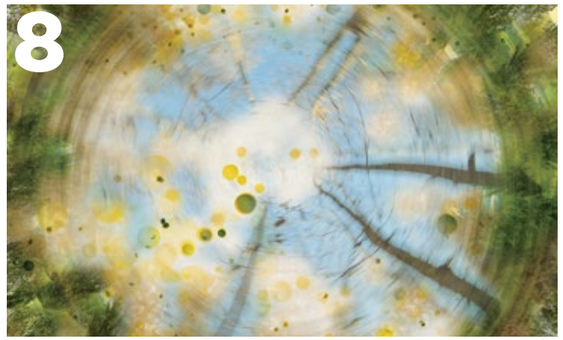
TENNESSEE
ENGINEER
FALL 2017
THE UNIVERSITY OF TENNESSEE, KNOXVILLE • TICKLE COLLEGE OF ENGINEERING

A Life of Service

One student takes the Volunteer Spirit to new depths. Page 18

T ENGINEERING





Features

Departments

Issue No. 2
Tennessee Engineer is published in the spring and fall by the University of Tennessee, Knoxville, Tickle College of Engineering

Bennett Croswell
Chair, Board of Advisors

Wayne T. Davis
Dean; Wayne T. Davis Endowed Dean's Chair in Engineering

Dorothy Barkley Bryson
Executive Director, Engineering Development

Christie Kennedy
Editor
Director of Communications

Mitchell Williamson
Designer

Randall Brown
David Goddard
David Brill
Whitney Hines
Writers

Printer
University Print and Mail

On the cover:
Electrical engineering senior Alex Weber training to recover shuttles for the Orion Space Project at NASA's Neutral Buoyancy Lab in Houston, Texas.

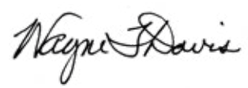
Engineering is in a constant state of improvement. We often hear it said that engineering is a profession in which one of our primary objectives is to make a better world. That theme is ever-present in the stories of our students, faculty, and staff as well as our friends and alumni across the globe. This issue of *Tennessee Engineer* is filled with examples of how we are accomplishing this objective—from former Navy diver-turned electrical engineering student Alex Weber, to the multidisciplinary group of students that designed a better donation box for the Great Smoky Mountains National Park, and many other stories in between—we are making a difference!

As you read through the magazine, you will note new things happening within the college and the university. For example, we recently named our honors program for alumnus Joe Cook and his wife, Judy. Their support is ensuring our students can focus on conducting solution-driven research to solve the world's critical issues.

We have also announced a national search for the Edwards Assistant Dean and Director of Integrated Engineering Design, a newly endowed position created through the support of alumnus Tom Edwards and his wife, Elaine. The position will focus on providing synergistic programming and experiences that are integrated vertically—from pre-college and freshman up through graduate-level students—and horizontally—across the spectrum of our 12 degree programs as well as other disciplines at UT—with design coursework.

It's not that we haven't had these design experiences in the past, but we will soon have someone whose daily focus is to help plan and facilitate them. We will be looking to our alumni and corporate and industry partners to help provide design challenges on which our students can focus, including the grand challenges identified by the National Academy of Engineering.

You may have already heard about several others changes coming in 2018. The university is conducting national searches for the positions of provost; vice chancellor for research, engagement, and economic development; and dean of engineering. Yes, after being at UT for some 46 years I will be retiring at the end of this academic year. Serving as dean has been the best and most fulfilling position of my career; the college is on a wonderful trajectory. I could not be more proud of our students, faculty, staff, alumni, and friends who are all part of the Tickle College of Engineering team.



Wayne T. Davis
Wayne T. Davis Endowed Dean's Chair in Engineering

Global Challenge; UT Answer

By David Goddard


Photo: Shawn Poynter

Some of UT's top engineering students gained a helping hand this year in their quest to shape the world, all thanks to someone who was once in their position.

Through the support of Joe Cook ('65 ISE) and his wife, Judy, the Joseph C. and Judith E. Cook Grand Challenge Honors Program was created to help bring new perspectives, opportunities, and practical experiences for those select students.

Sarah Davis, a senior majoring in nuclear engineering, is a shining example.

Davis, who came to UT from Memphis, is honing her talents in confronting the grand challenges of Preventing Nuclear Terror and Engineering Better Medicine.

She spent this most recent summer at ORNL working in the Fusion Materials and Technology Applications department, where she tested the performance and reliability of nuclear power plant electrical cables. Understanding that component helps reduce costs, extends the lifetime of parts, and provides better security for the entire process.

"Once I got involved with this program I noticed I was pushing myself to do better and learn more, so that I could actually make an impact with my research," Davis said. "I have taken interdisciplinary classes that I wouldn't have normally chosen to, including presenting at an international conference in Washington, DC."

Davis must soon decide what to focus on next, with nuclear instruction, nuclear security, and proton therapy for cancer research as possibilities.

For now, she's sharing her experiences with the next generation of engineers this fall, fulfilling the service-learning component of the honors program by volunteering at Pond Gap Elementary in Knoxville. There, she will help teachers explain the possibilities and impact of engineering on students' everyday lives.

Cooks' Gift Targets Practical Impact

The focus of the Cook Grand Challenge Honors program on "practical" engineering is an outgrowth of efforts of the National Academy of Engineering and engineering colleges around the country to tackle the world's most pressing issues of the 21st century.

"Solution-driven education and research will be vital to adapt, confront, and conquer some of these challenges," Cook said. "By refining our honors program in such a way to deal with issues that impact lives on a global basis, students will get to participate in and observe the effects of their research and studies on the real world."

Program components include research experiences, service-learning, and coursework in business, ethics, and public policy; participants aren't solely focused on engineering a product or service at hand, but also consider what impact that can have around the world and in the future.

With a focus on interdisciplinary collaboration, global experience, and travel, it's easy to see how the program can shape students for both their—and humanity's—benefit.

The college has graduated 16 NAE Grand Challenge Scholars. Support from the Cooks is helping Dean Wayne Davis's effort to increase this number.

Meet some honors students who call Tennessee home

Austin Ngo

Hometown & Major: Chattanooga, Tennessee; Senior, MSE.

Grand Challenge: Engineering the Tools of Scientific Discovery.

Notable Research: Working on the corrosion of superalloys at ORNL.

"The program has allowed me to see how new alloys and materials would actually be put to real use—particularly in space—rather than just looking at how to make them. It makes me consider various points and counterpoints of my research and ideas, which helps in projects and classes beyond just engineering. By challenging my mindset and encouraging travel and entrepreneurship, it really makes me a different person."

What's Next? Taking knowledge of materials into development of new rocket engines and parts for NASA.

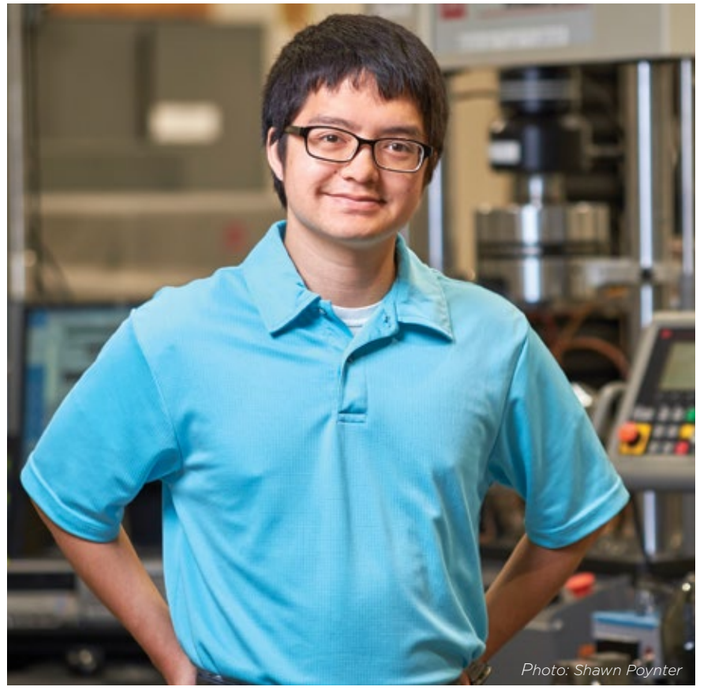


Photo: Shawn Poynter


Photo: Jack Parker

Christopher Neal

Hometown & Major: Lebanon, Tennessee; Senior, CBE.

Grand Challenge: Make Solar Engineering Economical.

Notable Research: Solving issues relating to scalability of solar batteries.

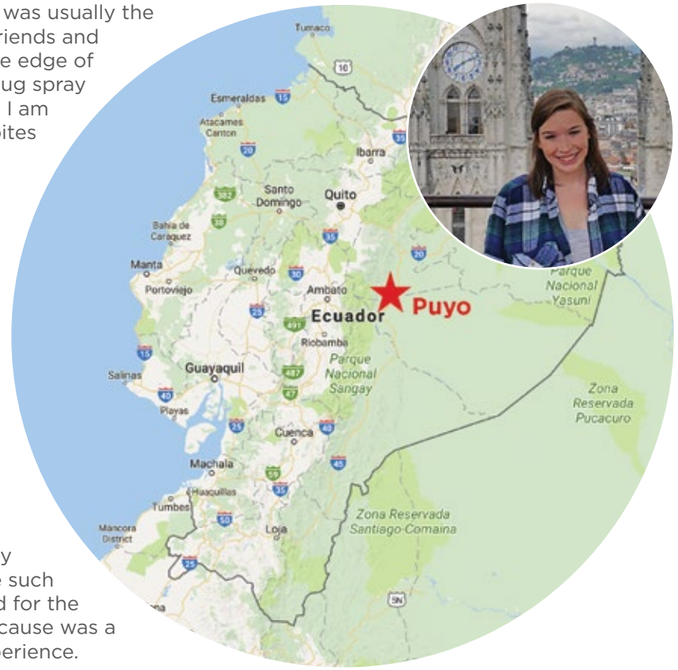
"The most important hurdle to implementing the technology at this point is the ability to store energy for times of no sun in the form of large batteries. The program has helped me realize that tackling large challenges is not a trial for engineers alone, and that each of the Grand Challenges requires assistance from businesspersons, from global leaders, and more broadly skilled professionals from numerous backgrounds."

What's Next? Pursuing a master's in computer science and a doctorate in nuclear engineering.

Global Initiatives: Ecuador

Five students traveled to Ecuador this May for the 2017 Alternative Summer Break. The following article was written by Hannah Landau, a senior majoring in chemical engineering.

"But what about all the bugs?!" This was usually the first response I got when I told my friends and family I would be volunteering on the edge of the Amazon rainforest. A bottle of bug spray and an experience of a lifetime later, I am happy to report a total of two bug bites throughout the entire trip.



Our time in Puyo was spent volunteering at Yana Cocha, an animal and wildlife conservation center. We worked with mechanical engineers, reserve employees, and other volunteers to build a bridge and connecting trail along a fish lagoon. The work was hard, but extremely rewarding. We got very muddy and very sore, but made some great memories along the way. Never again will I take a wheelbarrow for granted, that's for sure. Building the bridge and trail put into perspective the amount of perseverance and tenacity required to run and maintain a place such as Yana Cocha. The respect they had for the environment, the animals, and their cause was a truly humbling and eye-opening experience.

Ecuador itself is an amazingly diverse country and is very different than the United States. The people are extremely loving and open, and they made me feel right at home where ever we traveled. The food was always fresh and I didn't eat one thing I didn't immediately fall in love with throughout the entire trip. Although I must say that I can never look at a banana from home the same way after eating bananas from Ecuador. The produce was amazing. I ate the biggest avocados I have ever seen, and drank juices made from fruits I have never previously heard of.

Personally, the changing geography was my favorite part. Our trip started in Quito, the highest capital city in the world, and moved to Puyo, a small town bordering the Amazon rainforest. The drive from highlands to lowlands was filled with waterfalls, mountain ranges, the occasional volcano, and million-dollar views.

Our time off the clock was spent hanging out with the animals, exploring the jungle, and getting lost in the cities. I had the time of my life while in Ecuador, and encourage anyone who is on the fence to take the jump, go all in, and enjoy!

Special thanks go to the UT College of Veterinary Medicine for generously donating a large suitcase full of needed veterinary medical supplies to the clinic at the reserve.

Two New Programs Launch

Big Data Doctorate

UT and ORNL have created the first-of-its kind Data Science and Engineering doctoral program, the only one in the US to pair a university and national laboratory and one of just three such big data doctoral programs in the nation overall.

"This program will help industry, research, and academia alike," said John Kobza, head of the Department of Industrial and Systems Engineering. "Being able to understand and react to large amounts of data is something that will only continue to grow in importance."

Students will graduate ready to help address key challenges facing society in the areas of business analytics, engineering, health care, and national security.

The vast computing prowess at ORNL will be used to enhance the analytical side of the program, while courses in entrepreneurship and policy making will round out the experience.

Key Facts

The program hopes to enroll 15 PhD candidates this fall, with the eventual goal of having 100 students at any given time.

Students and faculty from business, engineering, arts and sciences, and communications and information could all take part in the new effort, along with the College of Engineering at UT Chattanooga and the UT Health Science Center in Memphis.

The doctorate will be directed by the Bredesen Center for Interdisciplinary Research and Graduate Education.

Integrating Business and Engineering

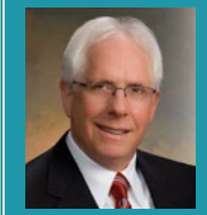
UT's Haslam College of Business and Tickle College of Engineering have partnered to launch a new cross-disciplinary learning experience for undergraduate students this fall.

The Integrated Business and Engineering program aims to develop professionals who have a systems approach to decision making and can understand how their decisions affect organizations as a whole.

"There is a large educational gap between engineering and business students, where the business graduate understands the supply process much better than the engineering graduate and the latter grasps the design and production aspects much better than the former," said Masood Parang, associate dean of academic and student affairs in the Tickle College of Engineering.

A cohort of 20 to 30 students will spend three years together in joint classes in business leadership, communications, and process thinking. A final capstone class will work to solve a real industry problem at the intersection of business and engineering.

The program will also feature co-curricular activities such as guest lectures and site visits, mentorship opportunities with alumni, and an annual $1,000 scholarship for each student.


Ralph Heath


Mary Brow

Key Facts

The program was developed with the help of **Ralph Heath** ('70 BS EE, '75 MB), retired president of Lockheed Martin Aeronautics and a member of the advisory board for both colleges, and is generously supported through the Heath Endowment.

Mary Brow ('06, BS BME; '16, MBA), the program's director, has more than a decade of experience as a process engineer.

Alumni interested in participating as a speaker, mentor, site visit host, or donor should contact Brow at ***marybrow@utk.edu*** or ***865-974-2454***.

A Better Box

By David Goddard

A team of engineering students is continuing its work with Great Smoky Mountains National Park and Friends of the Smokies to redesign and manufacture its visitor donation boxes.

The nonprofit group reached out to the college to help solve a critical problem: how to design and produce a more durable and secure collection box, as vandals have targeted the boxes in the past.

The boxes are costly and not easy to repair, so the damage can take them out of commission, leading to a slowdown in vital contributions.

Students from three engineering departments have worked together to help bring the project to life. Friends of the Smokies assessed their initial prototype and made suggestions for potential modifications. If all goes well with those tweaks, working boxes will be put in place by the fall.

“Engineering is all about making science practical, about developing and improving things that impact our lives,” said Chris Wetteland, a lecturer in materials science and one of the faculty members helping guide the project.

Jenny Retherford, another project leader and lecturer in civil and environmental engineering, pointed out that Friends of the Smokies is a key ally that enables the park to enhance the experience for visitors.

Engineering students from each department used their specific backgrounds to contribute to the project: materials science students determined the best materials to use, civil engineering students helped design and construct it, and mechanical engineering students developed the inner workings of the door.

Further extending the multidisciplinary aspect, students in electrical engineering and computer science are developing an app that would allow visitors to scan a code on the box and make donations wirelessly.

Another key improvement the team made is standardizing the design of the boxes.

“Currently, there are no two donation boxes exactly the same,” said Wetteland. “With this design, it would allow replacement parts to be easily manufactured for a standard box without having to replace the whole device.”

If successful, the Friends of the Smokies could eventually use UT’s device to replace all the boxes in the park, securing the important revenue stream for one of the country’s most iconic locations.

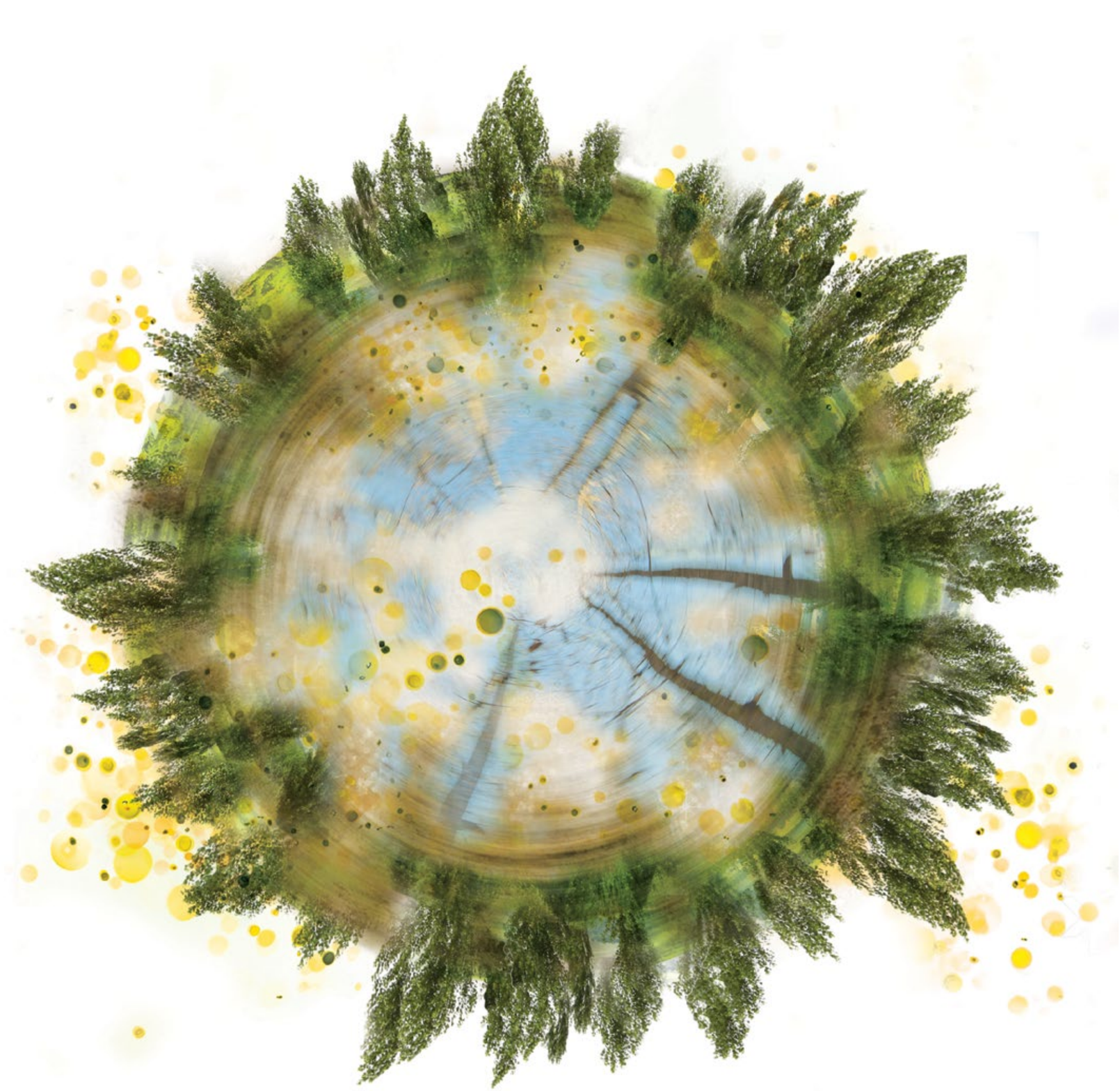
The Smokies are the most visited national park in the United States, with 11.3 million visitors last year. By comparison, the second, third, and fourth most visited parks—Grand Canyon, Yosemite, and Yellowstone—have 11.6 million visitors combined.

Unlike those parks, however, admission into the Smokies is free, so being able to collect donations is critical to maintaining the park.

> “[The Friends of the Smokies] help the National Park Service protect and maintain the Smokies in ways that might not otherwise be possible,” Retherford said. “They’ve helped with everything from restoring buildings and maintaining trails to reintroducing elk to the park. Donations are the key to all of those efforts.”

Photo: Kellie Ward

Engineering students (from left) Sam Medina, Walker Trent, Jesse Johnson II, and Caleb Brownfield collaborate on the project.



SPINNING BIOMASS INTO GOLD

By David Brill

There's a century-old adage coined by the paper industry that claims "you can make anything from lignin except a profit."

Art Ragauskas has heard this maxim countless times during his career, and it gets him a little riled up every time he hears it. As the UT-ORNL Governor's Chair for Biorefining in the Department of Chemical and Biomolecular Engineering, Ragauskas is channeling that ire into proving that the old saying's time has come and gone.

Lignin and its companion sibling cellulose reside side by side in the cell walls of poplar trees, switchgrass, and the residues of harvested crops—materials known as biomass.

Cellulose, the fairer of the two, is a sugar-based polymer. It can be deconstructed and fermented into bioethanol, a renewable and carbon-neutral transportation fuel. But where you find cellulose, you also find its clingy and historically less useful cellmate, lignin.

Understanding the structure of lignin and devising profitable uses for it are top priorities for Ragauskas and his multidisciplinary research team.

Tear Down the Wall

According to the US Department of Energy, the nation's farms and forests can produce more than 1.3 billion tons of biomass annually—enough to meet future demand for bio-based fuels without relying on food grains.

Producing ethanol from corn is relatively easy. But extracting the sugars from biomass is much more difficult, partly because of the complicated relationship with lignin.

Unfortunately, the same properties that make lignin valuable to the plant—structural strength, water repellence, and resistance to decay—also hinder efforts to crack the cell walls and release sugars.

Biorefineries currently use a combination of chemicals and heat to minimize the resistance of cellulose. "But the process is far from perfect," Ragauskas commented. "The pretreatment phase can alter lignin's structure, and the remaining chemicals and sugar degradation products become contaminants."

UT-ORNL Governor's Chair for Biorefining, Art Ragauskas

Photo: Jack Parker

Such contaminants are of little concern for lignin's low-value uses such as dust control on gravel roads or a resource for biopower. But for higher-value applications, these chemicals must be removed and the structure of the lignin tightly controlled.

One potential solution is to extract the lignin early in the process using organic solvents, including ethanol, and milder temperatures. This method can result in nearly pure lignin, but the cost cannot be justified until profitable uses are identified.

The Right Tools

Efforts to improve biofuel production—including finding new uses for lignin—are engaging scientists and students from multiple disciplines at UT Knoxville, Oak Ridge National Laboratory, and the UT Institute of Agriculture. They represent the vanguard of a relatively new line of research.

"Over the past century, industries that use woody plants have produced some good science," Ragauskas said. "But in recent years, we've made truly significant gains in understanding and controlling the structure of lignin and other plant polymers."

Continual advancements in technology are enabling scientists to see and model the inner workings of plant cells. ORNL's Spallation Neutron Source can generate information on the structure of plant cells down to a nanometer. Supercomputers managed by the UT-ORNL Joint Institute for Computational Sciences can use that information to model physical-chemical processes taking place within the cell wall.

Ragauskas is putting these, and a host of other remarkable tools, to good use.

Long-Awaited Payout

Lower-value uses for lignin have been around for decades. But high-value applications remain elusive, largely because there has been little need or urgency to develop them. That will change rapidly as full-scale biorefineries go on line and stockpiles of lignin begin to grow.

One way to avoid a lignin glut is to reduce its presence inside plants. To this end, Ragauskas and his colleagues at the ORNL-led BioEnergy Science Center have engineered switchgrass with reduced lignin content and an altered cell wall structure that shows a 34 percent increase in sugar yield.

"These improvements can aid in the release of plant sugars and boost the recovery of high-grade lignin," Ragauskas explained.

Diverting lignin from the waste stream is important, but developing profitable co-products from it will provide biorefiners with an entirely new income stream, "just like crude-oil refining produces a range of co-products, including petrochemicals," he said. "Many of these chemicals, like lignin, were once regarded as waste. They have since grown into a multibillion-dollar industry."

With a few years of focused research, Ragauskas anticipates that lignin-based products will replace many of the petroleum-based items. As they do, it will help debunk the old adage and prove once and for all that you can make nearly anything out of lignin—including a handsome profit and a cleaner environment.

Originally published in Quest Magazine.

Adding Value

Efforts to develop profit-generating uses for lignin have long been frustrated by its complex structure and chemistry. Researchers at UT and ORNL are exploring ways to generate a profit from what is now regarded as waste. Here are some of the more promising ideas:

- Biodegradable grocery bags and food containers
- Feedstock for low-cost carbon fiber
- Green adhesives for wood-composite furniture
- Green industrial chemicals like solvents, lubricants, and detergents
- Natural and nonflammable furniture foams
- Replacement for graphite in lithium-ion batteries
- Resin for 3-D printers
- Sunscreens (lignin absorbs ultraviolet radiation)
- Synthetic fuels

Data, Take the Wheel

By Randall Brown

Connected and autonomous vehicles—driverless cars—are all the rage these days, from Austin to Boston and Detroit to Silicon Valley. Cities are vying to test the technology and stay on the cutting edge of transportation.

In downtown Knoxville near UT's campus, Mayor Madeline Rogero announced last spring that a self-driving electric trolley will be tested this year and might be in service as a tourist shuttle by 2018.

The driverless revolution seems to be happening fast, but there are speed bumps yet to be crossed. Lawmakers are busy contemplating the types of new regulations that the technology will call for. The phenomenon could influence changes across the culture: new business models, roadway development, insurance policies, and jobs, to name a few.

David Clarke, director of UT's Center for Transportation Research and research associate professor in the Department of Civil and Environmental Engineering, spoke on the topic in a chat broadcast on *The Method*, a science-and-society series on WUOT FM. He pointed out that, while it's a hot topic in the media, highways full of automated cars are still largely on the drawing board.

"At some point, we may get to a place where autonomous vehicle operation is the norm," said Clarke. "But I think it's going to take a while for us to get there."

There are many practical issues to look at in automating a task as complicated as driving.

"For example, you are approaching an intersection and a policeman is standing there directing traffic, and they are beckoning to you to come forth and make a turn, or slow down or speed up, or something like that," explained Clarke. "How does a vehicle with technology, as we currently have on hand, have the same level of understanding?"

Autonomous operation in adverse weather is another concern, as is making the technology affordable. A variety of challenges face the driverless revolution, but vital issues motivate the research: improved mobility, energy efficiency, environmental concerns, and—most importantly—safety.

"Their need comes from the huge costs of fatal and nonfatal crashes, where human driver error is the main contributing factor—about 93 percent of the crashes," said Asad Khattak, Beaman Professor of Civil and Environmental Engineering and transportation program coordinator.

Khattak and fellow transportation engineers at UT are using a unique big-data approach to solving these issues, gathering information from connected and autonomous vehicles and investigating driver behavior. Modern sensors mounted on vehicles and the surrounding transportation infrastructure are used to collect crucial information. The data is uploaded and stored by cities and state transportation offices. In addition, the US Department of Transportation maintains the Research Data Exchange database, which stores information generated by field operational tests.

"The information often comes from a vehicle's surroundings and it is processed quickly to take necessary driving actions—much faster than human drivers can," said Khattak.

Khattak and colleagues have worked on an NSF-sponsored project titled "Driving Volatility in a Connected and Cooperative Vehicle Environment: Algorithms for Driver Warnings and Control Assists." He is accompanied on the project by UT co-researchers Lee Han, a professor of civil engineering, and Subhadeep Chakraboorty, an assistant professor of mechanical engineering.

"By removing human drivers from the loop, driver error can be eliminated."
—Asad Khattak

"By using emerging high-resolution connected vehicle data from different nationwide test beds, we are exploring how to reduce driving volatility by generating appropriate driver warning messages," said Khattak. "Also, using reinforcement learning, we are learning human drivers' behavior and their preferences at a microscopic level. The outcome of this artificial intelligence research can be applied to facilitate the introduction of automated vehicles into the present transportation system."

So, like any parent with a new driver in the family, transportation experts at UT are making sure autonomous cars know what they are doing before they let them hit the road.

Up, Up, and Away

NASA Turns to MABE to Head Major Aviation Project

By David Goddard

James Coder

Stephanie TerMaath

Humanity's fascination with flight dates back at least two millennia, with the Greek myth of Daedalus and Icarus serving as an early example of the dreams—and dangers—of human flight.

Now, the latest NASA project is looking to UT for guidance in that ever-present pursuit of flight, albeit with a much higher safety component than those early Hellenistic fliers.

A UT-led team, headed up by Department of Mechanical, Aerospace, and Biomedical Engineering Assistant Professors James Coder and Stephanie TerMaath, will focus on producing a more aerodynamically capable aircraft, with NASA providing $9.9 million for their efforts—believed to be the largest NASA award for a UT-led project.

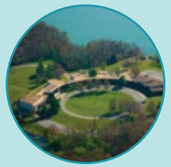
"To have our department chosen to lead such a prestigious endeavor and group of universities is a validation of the faculty, research, and students that we have," said Department Head Matthew Mench. "After all, this is something that won't just affect us at UT, but the very nature of flight itself."

Over the next five years, UT will lead a team composed of researchers from Penn State University, Texas A&M University, the University of Illinois Urbana-Champaign, Old Dominion University, the University of Wyoming, and two aviation companies—the Boeing Corporation and Airfoils Inc.

Through an overall investment of nearly $50 million, NASA's vision is to reshape aviation technology by improving flight dynamics, communications, speed, and propulsion.

Advancements are expected to alter the look, cost effectiveness, safety, and reliability of aviation.

While the recent $9.9 million project might be the largest NASA-backed flight project in UT's history, it is far from the first time the department has impacted NASA's mission.



1958—UT's (then) Department of Mechanical Engineering establishes a graduate program at Arnold Air Force Base. That program has since evolved into the UT Space Institute (UTSI).

1960—Students at UT first have the option to add an aerospace engineering concentration to their mechanical engineering degree.

1964—The department formally changes its name to the Department of Mechanical and Aerospace Engineering, with PhD programs in both disciplines first offered.

1968—UT graduates its first aerospace engineers.

1969—Henry "Hank" Hartsfield begins coursework at UTSI and is selected to the astronaut program, becoming the first UTSI student selected. Eight more will follow.

1982—Hartsfield becomes the first UT graduate in space when he pilots the Space Shuttle *Columbia* with former Apollo astronaut Ken Mattingly.

1991—UT aerospace engineering student Katherine Van Hooser accepts a job with NASA prior to graduating, having fallen in love with the space shuttle as a child.

1992—Chris Hadfield, a Canadian pilot and UTSI grad, is selected to the astronaut corps. He will take part in two shuttle missions, one Soyuz mission, and two space station missions.

1994—Three UTSI grads—Dominic Gorie, Jeffrey Ashby, and Joe Edwards Jr.—are selected as astronauts. Combined, the three complete a total of eight shuttle missions.

Building a Better Wing

The main focus of UT's efforts will be the development of a new type of wing, specifically in regard to flight systems and the way lift and drag are controlled through flaps.

Current flap systems extend and retract various amounts depending on whether the aircraft is ascending, descending, or flying level.

While the system works well enough as is, it requires added bulk—and therefore additional weight—due to the machinery and hydraulics involved.

"Creating a wing that is more efficient, one that also has less drag, is where our research can really make a difference," said Coder. "We have full confidence in the concept and just need to show how it can be integrated."

That concept revolves around what is known as laminar flow.

The design of most modern aircraft creates turbulence in the air as it passes over the surface, pockets of circulating air that can increase drag, reduce efficiency, and disturb people inside the aircraft.

With laminar flow, those pockets are lessened or eliminated entirely by using designs that reduce attributes that contribute to turbulence, including flaps and airfoils.

By replacing those movable components with ones that remain permanently in place—known as slotted natural laminar-flow airfoils—Coder's design reduces drag, weight, and the effect of shock waves at high speeds, while at the same time providing extra lift at slower speeds.

While it's only one design possibility, the fact remains that any leap forward is bound to change the look of aircraft.

Early NASA illustrations of Coder's concept look more like the Pan Am Clippers of yesteryear than modern aircraft, with wing placement returning to an over-fuselage placement rather than midbody.

"In a sense, we're not improving current aircraft as much as we are creating a new building block for aircraft," said Coder. "This is a game changer for aviation."

Holding It Together

While Coder's part of the team focuses on the design, TerMaath will be focused on the feasibility and reliability of the materials and structure of the aircraft itself.

Using materials that are lightweight, durable, and strong without being bulky will be the key to the project's success.

TerMaath said that the team would be open to anything in its quest for the right final product, whether that means adapting existing materials or coming up with something new.

Students will get hands-on experience in testing flow dynamics, designs, and materials, further heightening the value of the project to UT.

It might seem daunting, but it's a process TerMaath is familiar with, having served on the airframe certification team for the military's F-35 fighter jet.

"There is a major testing component to doing the unknown," said TerMaath. "We get to be creative in what we come up with, to customize what we do and use.

"You don't get an opportunity to start fresh on something every day."

TerMaath said she expects the team to go through a series of steps that involve trying out new designs, narrowing the best ones down through optimization, testing those options, and finally simply "getting creative" in their approach.

After all, when there's no blueprint to follow you can do what you want.

"It is gratifying to see the University of Tennessee in a leadership position for this important project. It is a great example of how a public-private partnership and inter-institutional cooperation can result in solutions that address important challenges facing our world."

—Chancellor Beverly Davenport

1996—Scott Kelly completes his degree from UTSI and is accepted into the astronaut corps. He is UT's most prolific astronaut to date, having spent more than 520 days in space across four missions.

1998— UTSI grad William Oefelein is selected as an astronaut. He will later pilot the Space Shuttle *Discovery* on a 13-day mission.

2000—UTSI grad Barry Wilmore is selected as a NASA astronaut.

2004—Randolph Bresnik becomes UTSI's ninth, and, to date, most recent graduate selected as an astronaut.

2005—Van Hooser is named head of the program responsible for the main engines of the very space shuttle program she grew up watching.

2009— Bresnik and Wilmore fly together aboard the Space Shuttle *Atlantis*, spending 11 days aboard the International Space Station.

2010—Kelly takes his third spaceflight and is commander aboard Expedition 26. This is Kelly's first long-duration spaceflight.

2011—Van Hooser is named chief engineer of NASA's Space Launch System Liquid Engines Element.

2011—Wilmore serves as CAPCOM, the person at Mission Control who communicates with the astronauts, for STS-35, the final mission of the space shuttle program.

2013—Hadfield records a cover of David Bowie's "Space Oddity" aboard the International Space Station. It currently has 37+ million views on YouTube. Sing along at *tiny.utk.edu/hadfield*.

2014—Wilmore, who earlier piloted the Space Shuttle *Atlantis*, heads to the space station for a six-month mission, serving as commander for part of the mission. At his request, NASA installs the SEC Network on the station so he won't miss UT football.

2015—Three MABE students—Justine Barry, Carol Miselem, and Meghan Green—join NASA's Johnson Space Flight Center upon graduation.

Barry

Miselem

Green

2015–2016—Kelly returns to the International Space Station for a study to compare his physiology after a year in space with that of his twin brother, who remained on Earth. With Kelly's safe return to Earth, UT astronauts have now spent a collective 993 days in space.

2016—Van Hooser is named manager of the Chief Engineers Office at NASA's Marshall Space Flight Center.

2017—A team of MABE undergraduate students competes in NASA's Mars Ice Challenge.

2017—NASA selects MABE Assistant Professor James Coder to lead a $9.9 million project, with fellow MABE Assistant Professor Stephanie TerMaath leading a key thrust of the project.

2017—Bresnik launches to the International Space Station in July, becoming the most recent UTSI graduate to do so.

A Life of Service

By David Goddard

Like other new recruits to the United States Navy, Alex Weber pledged its motto "Not for self but for country" when he joined its ranks a dozen years ago.

That mindset of putting others first was a driving force in his time as a Navy diver, highlighted by his participation in recovery efforts following the devastating Japanese tsunami in 2011 as well as with missions to recover and identify remains of US soldiers killed in the Vietnam War.

Now the electrical engineering student is working to make a difference on land.

Weber training to recover shuttles for the Orion Space Project at NASA's Neutral Buoyancy Lab in Houston, Texas.

Photo: NASA

Weber meets a local in Ecuador.

Weber grew up in Giles County, Tennessee, joining the Navy after high school. In 2005, while serving as an electrician's mate aboard the nuclear carrier USS *Ronald Reagan*, Weber noticed a dive team doing repairs on a nearby ship.

"I've been in love with the water all my life and have been diving for most of it. Once I saw them at work I decided right there on the spot that I was going to be a Navy diver," Weber said.

He's now been to all seven continents with the Navy and describes the post-tsunami aftermath as one of the most vivid memories of his lifetime. Remnants of houses and roofs greeted his ship even while it was still far out to sea.

"We had a pretty grim task to do, recovering bodies, people that had been trapped in houses and vehicles and swept to sea," Weber said. "Yet even with their families, friends, and possessions gone, the people of Japan went out of their way to make us feel welcome. We're talking about people who had nothing left to give yet gave us all they could. Their gratitude was unreal."

His service as a Navy diver also took him to the jungles of Vietnam to bring closure five decades in the making. Again, faced with the task of recovering human remains, Weber scoured rivers and mud that was "10 feet deep at times" to bring American soldiers and pilots back home.

"I got a handwritten letter from the relatives of a former soldier about helping do what I did in Vietnam," Weber said. "That's better than any medal or ribbon I could ever receive."

From Sea to Tennessee

Weber eventually transitioned from serving in the field to educating future divers at National University Polytechnic Institute in San Diego.

Thinking about his own education, however, is what brought him back to his home state. He had an interest in electrical engineering and knew that UT had a strong program in the field.

While being closer to relatives in his home state was an advantage, the move came with its own set of challenges.

"It wasn't easy to be back in a classroom for the first time in a decade, with vast life experience differences—not to mention age differences—than your classmates," said Weber, who is now a senior. "Questions about where to go, what to do, how to rediscover your social and educational skills are things that plague all veterans. Having support for veterans is critical."

In his spare time, Weber gives back by fostering and training PTSD support dogs for Smoky Mountain Service Dogs. The group helps returning military members cope with getting back into civilian life by placing them with a loving companion who is directly responsible for them.

"Veterans can have any number of stresses that, by their training, they keep hidden. PTSD dogs are a great way of helping alleviate that," Weber said.

Weber also tutors others through the US Department of Education's Veterans' Pre-College program, which is designed to assist eligible students through benefits navigation, school selection, career advice and exploration, financial aid, and education skills.

Into the Deep

Weber's post-college plans merge the two loves of his life: diving and engineering.

Underwater rovers—made famous by Bob Ballard for their use in finding the wrecks of the cruise liner *Titanic*—continue to play an invaluable role in oceanographic research, from exploration and recovery to weather prediction.

Weber's work toward a minor in entrepreneurship has also opened the possibility to him that he might one day start his own deep sea robotics company.

"I'd love to help continue that research, maybe work with the National Oceanographic and Atmospheric Administration in developing and deploying that kind of technology," Weber said. "There are still a lot of things unknown about the ocean, and I think my background would help me make a difference in those efforts."

While that goal might still be a few years away, one thing is certain: if it helps others, there's no doubt he'll achieve it.

In addition to the normal coursework that comes with engineering, Weber tutors other students. This summer, he also raised money through a GoFundMe account for an Ecuadorian animal sanctuary where he and other engineering students helped build a foot bridge and walking trail during a Global Initiatives trip (see page 4).

"I didn't specifically set out to do those things, but when they came up and I knew I could help I felt like I should. I enjoy being able to help ease the burden on other people if I can."

—Weber

ENGINEERING

Better Health Care

By Randall Brown

Patients hospitalized with a debilitating condition often struggle with the ability to communicate urgent needs.

When a patient told her, “I want to speak for myself,” Rebecca Koszalinski, a certified rehabilitation nurse and assistant professor in the College of Nursing, sought to develop a method that would improve communication and care for patients suffering from cerebral palsy, spina bifida, and other diseases that affect the ability to speak.

Koszalinski turned to Industrial and Systems Engineering Associate Professor Xueping Li to partner with her on the project and develop an app called simply Speak For Myself.

Li and Koszalinski brought in College of Nursing Associate Professor Sadie Hutson to develop and improve the app, which helps patients relay their needs to medical staff in situations where spoken communication is difficult or impossible. The app is currently being piloted in hospitals throughout Knoxville and East Tennessee.

“When collaborators bring the problems to me, I bring together a team,” said Li, who also co-directs UT’s Health Innovation Technology and Simulation (HITS) Lab.

These teams are often interdisciplinary, incorporating faculty and students from across the university.

Xueping Li

Assistive Apps

Indeed, the Speak For Myself project is far from the first time Li has teamed up with faculty from outside his department.

He teamed with the HITS Lab co-director and College of Nursing professor, clinical assistant professor Sheila Taylor, and simulation director Susan Fancher on the Simulated Electronic Fetal Monitoring (SEFM) app, which trains nurses to interpret data from fetal monitoring systems.

Li and Wyatt also developed DocuCare, a learning tool that simulates the use of electronic health records in patient care.

Li’s research areas include complex systems modeling, simulation, and optimization; health information technology; mobile health; health systems engineering; and information systems, all of which factor in his collaborations.

Lis saud he applies industrial engineering techniques to the projects while also learning from them as he contributes.

His participation in these projects reflects back to ISE in multiple positive ways, giving students critical insight into real-world issues and how their chosen degree can help.

DocuCare is being used by more than 400 universities around the world, while the SEFM app won second place at the Institute of Industrial and Systems Engineers 2015 Annual Conference, demonstrating UT’s expertise.

Better Patient Care

ISE’s ties to health care improvements extend even further, with Assistant Professor Anahita Khojandi helping Li develop predictive models for early sepsis detection.

“Xueping is leading the efforts on setting up the database and gathering data, and I’m leading the analytics efforts and modeling,” Khojandi said.

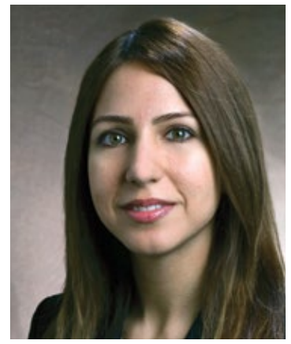
On another project, Khojandi and ISE Assistant Professor Oleg Shylo collaborate with the Movement Disorders Division at Icahn School of Medicine at Mount Sinai Hospital in New York to improve the follow-up care of patients with Parkinson’s disease via deep brain stimulation therapy.

By analyzing test results and classifying patients accordingly, the duo can accurately place patients into either 60Hz or 130–185Hz stimulation groups, offering the potential of uniquely targeted therapy.

Khojandi also works with Bruce Ramshaw, chair of the Department of Surgery at the UT Graduate School of Medicine, to investigate complications following abdominal wall reconstruction procedures.

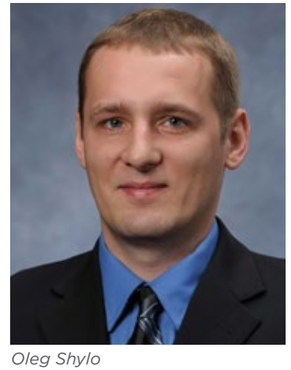
> “Perhaps the most important lesson is how to better communicate with other researchers,” Li said. “Sometimes you need to be creative to ask the right questions, other times you need to be creative to explain the solutions.”

“We analyze patient demographics and intraoperative factors and develop predictive models that can accurately determine whether a procedure on a new patient will result in complications or not,” she said, adding that the technique helps develop patient-specific treatment.



Anahita Khojandi

Within the college, Khojandi and Shylo have teamed with Assistant Professor of Electrical Engineering and Computer Science Nicole McFarlane on hardware, software, and mathematical frameworks for inexpensive neuro-headsets that are easy to sleep in and can conduct sleep scoring.



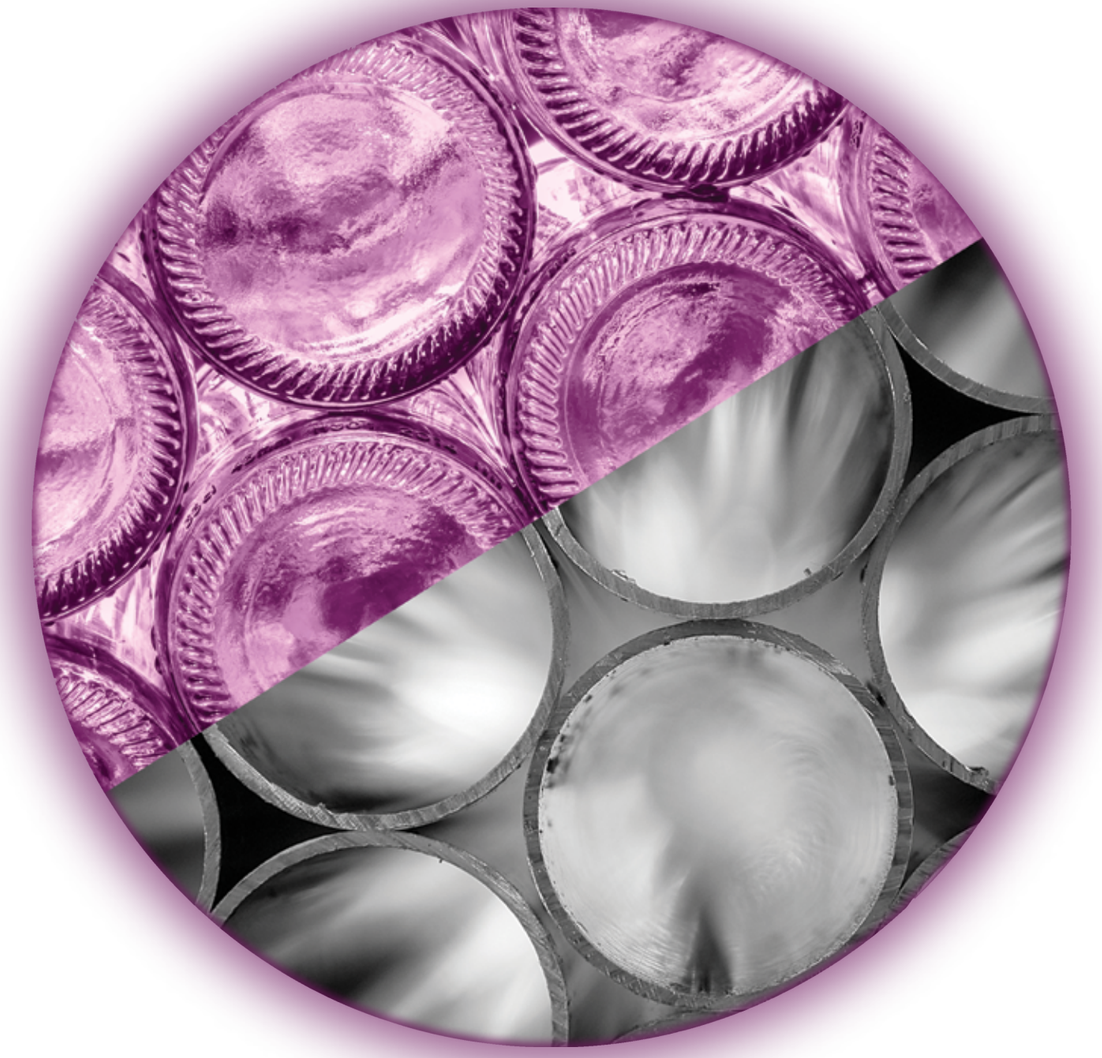
Oleg Shylo

Khojandi said the headsets will enable studies that could shed light on the mysteries of sleep, how it affects various body systems, and even potentially some neurodegenerative diseases.

It’s just another sign that the human body might be the most complex system engineers can tackle.

Best of Both Worlds

By David Goddard



Metallic glass may sound like an oxymoron, but it's an actual thing. How is it possible to take the best characteristics of metals and glasses and combine them into one super-strong yet easily malleable material?

Takeshi Egami knows the answer, because he's been working on it for over 45 years. And there are still plenty of secrets yet to be unlocked.

You may not be familiar with metallic glasses because they've been around for only a few generations. But according to Egami, a UT-ORNL Distinguished Scientist and professor of materials science and engineering, it's only a matter of time until they are everywhere.

"Glasses have existed since the beginning of history, but the science of glasses has always been shrouded by big mysteries," Egami said. "Due to metallic glass, the newest addition to the glass family, we are now solving those mysteries and will soon be ready to use these materials in technologically advanced products."

Welcome to the New Age

The key to the metallic glass revolution lies in understanding the properties of both metals and glasses at the atomic level.

Metals offer advantages in strength and durability that are unmatched by other substances. Their conductive properties helped usher in the electronics age. Another positive is the abundance of metals, making them easily available and cost effective.

On the downside, metal atoms tend to line up in an orderly fashion—like a marching band—making the material susceptible to breaking or shearing under heavy loads. Additionally, even the finest metals have a much higher tendency to corrode compared to plastics or glasses.

While regular glasses used in windows clearly don't have the same inherent strength as metals, the one crucial benefit they offer is that their atoms are arranged chaotically—like a throng of football fans flooding the field after a big victory. This lack of alignment makes straight-line failures nearly impossible.

Their main disadvantage, however, is fragility. Once they start to fail, they fail catastrophically, limiting their use in areas where strength is a concern.

Egami believes that coming up with a material that combines the strength and ductility of metals with the fracture resistance and anticorrosive properties of glass will truly prove to be an important milestone.

"Much like silicon has defined the information age, this new wave of substances will set the tone for coming innovations," Egami said.

A Cooling-Off Period

The first recorded production of metallic glass happened in 1960. Scientists knew that when a metal melts into a liquid, its atomic structure becomes disorganized. But they discovered that rapidly cooling the molten metal preserves the chaos.

This process produces a glass by locking the atomic structures of the liquid-state metal in place before they can return to solid-state patterns of the crystals.

While that breakthrough proved metallic glass could be fabricated, there were some drawbacks. At the time, only very thin ribbons could be formed because the liquid needed to be cooled so quickly.

As the years progressed, new expertise and alloy development moved the needle exponentially. Today, it's possible to manufacture metallic glass more than an inch thick—almost a thousand times thicker than the original experiment.

"Our knowledge of the basic properties of liquids and glasses—such as viscosity, strength, and ductility—has increased greatly over time," Egami said. "We still have a long way to go in understanding the physics, but we are going down the right path. Soon we will be able to design new glasses based upon the science."

Potential Outcomes

Even though metallic glasses are used in small quantities in many applications, much more research is needed before they can be used in widespread commercial applications. But their properties are promising for a number of reasons.

For example, their tendency to resist scratching and breaking makes metallic glasses ideal for mobile phones, tablets, and laptops. Their strength—even at extremely small widths—could allow them to replace plastics used in those devices.

Other beneficial properties like high strength and low energy loss have made metallic glasses useful in tools and sports equipment such as golf clubs that are designed to convey the maximum possible force.

In an odd twist, the extreme durability of metallic glass could actually hamper its adaptation.

While having a phone that won't break or a razor that never dulls might seem great for consumers, it could severely limit a company's profits. Why would they sell something you had to buy only once?

"If they made a product that never broke or never needed replacing, they could sell one to everyone and that would be it," Egami explained. "There would be no ongoing market."

So you might say that makes metallic glass a bit of a paradox as well as an oxymoron.

Originally published in Quest Magazine.

US soldiers take a break during a mission at Camp Stanley, South Korea. The soldiers were participating in an exercise focused on being able to detect, identify, and defend against chemical, biological, radiological, and nuclear threats. Courtesy United States Army

BOOTS ON THE GROUND
and in the Classroom

By Whitney Heins

"They know what it is like to be out there in the middle of a pitch-black desert on a moonless night and have people shooting at you."

Hall teaches a class about proliferation detection and resistance.

Howard Hall, director of UT's Institute for Nuclear Security and UT-Oak Ridge National Laboratory Governor's Chair for Global Nuclear Security, is talking about some of the students he has in his classes. These students are active duty military.

The US Department of Defense pays for their education at UT to gain a graduate degree in nuclear engineering. The program began in 2011 with the US Army sending soldiers assigned into a group called Functional Area 52, which is the Army's nuclear research and operations core. Years later, the US Navy began sending students, and now the US Air Force is joining in too.

"This program is really important because it is these students' first foray into the nuclear counterproliferation world," explained Hall. "Then they go on to become the connective tissue for the Department of Defense and all agencies that deal with nuclear security and proliferation issues."

The students take classes within the Department of Nuclear Engineering's Nuclear Security Science and Analysis program, learning about subjects such as issues of proliferation, the nuclear fuel cycle, nuclear terrorism, and US and international nuclear doctrines.

While a few other universities offer similar coursework to military personnel, UT's program is unmatched because of its relationships with federal partners such as Y12 and ORNL. Thus students get the chance to work on something that is not just educating them but also having a real impact on what they're going to do in the future.

"These students have active clearances so they can do research at Y12 and ORNL that has real operational use," explained Hall. "This is why we have grown to three branches of the military. We turn out a really good product."

Graduates have gone on to manage threat reduction programs, serve as an advisor in weapons of mass destruction for special operations in the Army, and teach at West Point.

"I think it's cool that we are influencing these guys, who then influence the next generation of military personnel," said Hall. "I think this is the sort of thing a land-grant university ought to be doing."

Hall said the program has been strengthened because of the caliber of the active duty students and the real-world insights they bring into the classroom. He hopes to see more and more in the future.

"We now just need to add the US Coast Guard and Marines," he laughed. "Then we will have them all."

Building Bridges

Female Students Connect at Interactive Events

Women represent around 23 percent of the Tickle College of Engineering's student population, a number that surpasses the national average and continues to grow. To harness this momentum, a coalition of students, faculty, and members of the college's Board of Advisors launched the biennial WomEngineer's Day in 2015. The conference offers opportunities for all involved in STEM areas—both women and men—to network and collaborate.

The 2017 conference took place in April at the Holiday Inn World's Fair Park, in the heart of Knoxville near the UT campus. The WomEngineer's Leadership Council was established to coordinate the conference and continue the message of growth and inclusiveness.

"One of the most important achievements was being able to provide a broad range of information to the participants through our amazing panelists and speakers," said Civil and Environmental Engineering Associate Professor Angel Palomino, who is an executive member of the leadership council.

"The speakers were so eager to share their experiences and knowledge with the attendees, and attendees were equally as eager to learn from the speakers," said Taylor Short, an undergraduate electrical engineering major who helped plan the events as the council's conference chair. "There was just so much passion and excitement in the room."

Assistant Professor Jamie Coble of the Department of Nuclear Engineering worked closely with Short to support the conference as a faculty representative on the executive committee.

"WomEngineers Day is student led, which means the topics and discussions are really geared to student interests," Coble said, describing an "amazing" energy for the day, beginning with an opening address from Chancellor Beverly Davenport.

"The questions and discussions on everything—from going to graduate school to starting your own business—were interesting and engaging," Coble said.

A strong showing of non-UT students was evident at the conference, including students from high schools, community colleges, and neighboring universities.

"I was very pleased to see the level of interest and support from so many people in the engineering community," Palomino said.

"The varied cross-section of the attendees really shows that the event is filling a need for engineering professional development that can't be captured in the classroom," Coble added, also noting the importance of engineering faculty members in attendance, including some department heads. "This sends a strong message that the entire college supports the goals of WomEngineers Day."

Complementing the conference, the annual WomEngineer's Welcome Dinner in August gave incoming freshman a chance to mingle with Board of Advisors members, faculty, other students, and staff.

Participants in WomEngineers Day look on and applaud one of the many speakers who helped make the event a success.

"The most important aspect of the dinner is helping to establish a support network," Palomino said. "We want to engage with the students by providing them the opportunity to interact with representatives from various student groups, get valuable advice about different majors, and meet current engineering students."

"One of the most encouraging aspects of the dinner was watching the freshmen interact with each other as well as with the upperclassmen volunteers," Short said. "Building peer-to-peer relationships early on in college can impact your day-to-day college experience."

UT Icon Burdette Honored with Dougherty Award

The award is named for Nathan Dougherty, an engineering student, star athlete, and renowned faculty member at UT. Dougherty also served on UT's Athletic and Academic Council from 1917 through 1956 and was dean of the college from 1940 through 1956.

Edwin "Ed" Burdette spent six decades at UT, watching the university and the world change around him. Through it all, his expertise in concrete engineering never wavered as he educated generation after generation of civil engineers.

For that dedication and service, the college has presented Burdette with its highest honor, the Nathan W. Dougherty Award, for 2017.

"I'm very grateful for the opportunities that UT gave me, both as a student and then later as a teacher," said Burdette. "The education I got from the college and the rewarding experience I got from working there changed my life in ways I can't imagine."

"Dean Nathan Dougherty was one of the true pillars from our college's history, and the selection of the award in his honor is something we take very seriously," said Dean Wayne Davis. "Ed Burdette is a great example of our college, its faculty, and the impact they make on students and the world at large."

Burdette, who grew up in rural West Tennessee and attended UT Martin when it was a two-year college, transferred to UT Knoxville to complete his undergraduate studies in the mid-1950s.

At that time, UT was $335 per quarter, so the cash-strapped Burdette would attend school for one quarter on borrowed money and then work the next six months to pay that back, repeating the process until he graduated.

Earning his doctorate at the University of Illinois and then working in Memphis, Burdette returned to UT to teach in the 1960s. He retired from UT in May 2016 but can still be found on campus, encouraging the new generation of engineers and researchers.

In contemplating his legacy to the college, he paraphrases the epitaph on the grave of another civil engineer, Sir Christopher Wren.

"At my retirement party, I asked all the students I've had over the years who were there to stand up," said Burdette. "Then I said, 'If you would see my monument, look about you.' "

View a list of all the college's 2017 award winners at ***tiny.utk.edu/tceawards***.

Alumni and friends were buzzing on Facebook about Burdette's award.

> Dr. Burdette was great in all ways. He was a great teacher and very strict. I appreciated his 'no-nonsense' approach. He expected you to show up every day, be quiet (awake and not on your phone) and learn a bunch. I didn't love structures but I did very well and likely wouldn't have without such a great professor.
>
> *—Jamie Maynes ('12)*

> Congratulations to Dr. Burdette. I remember him as a young professor who took on a so-called guaranteed rollover prevention device company and proved their claim to be phony. Back in late 60s.
>
> *—Joe Polk ('69)*

> Dr. Davis was my advisor and Dr. Burdette was my favorite structural engineering professor. I was blessed! Two amazing guys.
>
> *—Rick Welsch ('85)*

Faculty & Staff Notes

The American Welding Society awarded UT-ORNL Governor's Chair for Advanced Manufacturing **Suresh Babu** (MABE) the 2017 Comfort A. Adams Lecture Award, recognizing his efforts to bring new ideas to the field.

Associate Professor **Micah Beck** (EECS) was awarded a Fulbright Scholarship in Nairobi, Kenya, for academic year 2016–17.

Professor **Ben Blalock** (EECS) was awarded UT's 2017 Alexander Prize for exceptional undergraduate teaching and distinguished scholarship at the 2017 Chancellor's Honors Banquet.

Executive Director of Development **Dorothy Bryson** was awarded the 2017 Board of Directors Award, which recognizes exemplary performance and outstanding achievement by members of the UT Foundation.

Assistant Professor **Jamie Coble** (NE) received the American Nuclear Society HFICD Ted Quinn Early Career Award, named in honor of an expert in nuclear instrumentation.

Distinguished Professor **Jack Dongarra** (EECS) was named a foreign member of the Russian Academy of Sciences.

Assistant Professor and Pietro F. Pasqua Fellow **Maik Lang** (NE) was recently awarded a three-year $800,000 grant from the DOE Nuclear Energy University Program.

Professor **Thanos Papanicolaou** (CEE) was named a fellow of the American Society of Civil Engineers.

UT-ORNL Governor's Chair for Biorefining **Art Ragauskas** (CBE) received AIChE's prestigious Professional Achievement Award for Innovations in Green Process Engineering for his outstanding work in advancing green process engineering.

Assistant Professor **Caleb Rucker** (MABE) has been awarded an NSF CAREER award for his work on improving health care and STEM education by advancing knowledge in robotics.

Assistant Professor **Cong Trinh** (CBE) received the 2017 American Society for Engineering Educators Southeast New Researcher Award.

Professor **Richard Wood** (NE) has been selected as a 2017 fellow of the American Nuclear Society.

Assistant Professor **Zhimin Xi** (ISE) received a 2016 Department of Defense DARPA Young Faculty award of $481,006 for the next two years.

Assistant Professor **Mariya Zhuravleva** (MSE) has been selected by the US Department of Homeland Security to receive a three-year $1 million Exploratory Research award to address the grand challenge of Global Nuclear Detection Architecture.

Alumni News

Top Honors

Two engineering alumni have received top awards from UT and the UT Knoxville Alumni Council.

Michael C. Crabtree was one of four to receive the Distinguished Alumnus/Alumna Award. Dedicated to the spirit of the Volunteer, this is the single highest alumni award given and is reserved for alumni who have excelled at the national or international level.

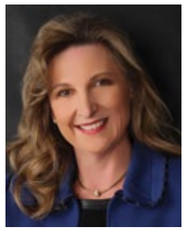
The award recognizes an alumnus who has attained extraordinary distinction and success in their field and whose achievements have brought credit to the university and benefit to their fellow citizens.

Crabtree earned both his bachelor's and master's degrees in electrical engineering in 1973 and 1975 respectively from UT. His successful career in engineering began in 1969 at NASA's Kennedy Space Center through the UT and Tennessee Tech co-op program. Between 1976 and 1983, Crabtree worked in various capacities for EG&G ORTEC, distributor of the first commercial PET scanner, the ECAT. In his time at EG&G ORTEC, Crabtree was a software designer, development engineer, senior development engineer, ECAT project engineer, ECAT marketing manager, and ECAT program manager.

In 1983, he co-founded Computer Technology & Imaging Inc. While at CTI as vice president, he led the worldwide marketing and sales of the company's PET scanners and medical cyclotrons prior to a distribution agreement with Siemens.

Crabtree served as chairman, CEO, and COO for US Internet Inc. from 1995 until 1999. In 1999, Crabtree served as director, CEO, and president of the Southeast Operating Group for OneMain.com Inc. Between 2000 and 2008, Crabtree joined IdleAire Technologies and became chairman, CEO, and president.

Crabtree has served on many civic and community boards, including the East Tennessee Children's Hospital, East Tennessee Foundation, and Knoxville Chamber of Commerce. He currently serves on the Tickle College of Engineering's Board of Advisors and is a past member of the UT Chancellor's Associates.



Barbie Bigelow received an Alumni Professional Achievement Award, which recognizes alumni who have achieved a high level of success in their chosen field. The trademark of this recipient is a record of notable career accomplishments and a history of outstanding contributions to their profession. The award is presented to acknowledge their successes, which bring honor and credit to the university.

Throughout her distinguished career, Bigelow has served as a role model for many young engineers, and especially for young women. She graduated from the college in 1985 with a master's degree in computer science. She has held executive positions in companies such as TASC, Lockheed Martin, B Better Technology Partners, and the Jacobs Engineering Group, one of the world's largest and most diverse providers of professional, technical, and construction services, where she is the senior vice president and CIO.

Bigelow is a native of Tennessee whose family has been in the state for over three generations. She is a member of the Washington Women's Leadership Initiative and the Executive Advisory Board for Moxie Rocket. She has recently become a member of the Tickle College of Engineering's Board of Advisors.

After receiving the highest student honor, the Torchbearer, at the 2017 Chancellor's Honors Banquet, **Josh Dobbs** ('17, AE) was drafted by the Pittsburgh Steelers as the 29th pick in the fourth round of the 2017 NFL draft.

The City of San Francisco named **Linda Gerull** ('80, CEE) its new chief technology officer.

Randy Inklebarger ('82, MSCE; '86 Structural) recently became president of the engineering consulting firm MS Technology.

Brian Maholic ('05, EE) recently became state market manager for AT&T FirstNET, a nationwide LTE solely for first responders.

Shima Mohebbi ('15, ISE) joined the School of Industrial Systems Engineering at the University of Oklahoma as an assistant professor this fall.

NCI Building Systems has appointed **Donald Riley** ('84, ME) chief executive officer.

Alumni from BWSC Endow New Scholarship

Randy Ferguson and Dean Davis

Twenty-five UT alumni from Barge Waggoner Sumner and Cannon have joined forces to endow a scholarship for engineering undergraduates. Former CEO **Jim Downing** ('69 Civil BSCE; '74 MS EE) and Executive Vice President **Randy Ferguson** ('80, BSCE; '84, MS EE) came up with the idea, which Ferguson then pitched to a roomful of his coworkers—who also happened to be UT graduates.

The group decided that endowing a scholarship would be a great way to give back to their alma mater while at the same time raising the company's profile when it comes to recruiting new UT graduates. With engineering being the dominant discipline at the firm, BWSC—which currently employs 42 UT grads—chose the Tickle College of Engineering as a natural landing point for the new scholarship.

While the company set an initial goal of having a $50,000 endowment in place by the end of five years so as to fund it in perpetuity, the outpouring has already surpassed that, with $52,115 being contributed.

"In a competitive marketplace, we seek talented engineers," Ferguson said. "BWSC hopes, over time, that the scholarship will boost students' awareness of the company and further entice future engineering graduates to join our employment ranks throughout the Southeast and beyond."

The inaugural BWSC Endowed Scholarship will be awarded in the fall of 2018. All UT engineering students will be eligible to receive the scholarship, with preference granted to students with a demonstrated financial need.

Student News

Nuclear engineering doctoral students **Chris Andrews**, **Dorothy Miller**, and **Adam Stratz** were recently selected by the DOE for the National Nuclear Security Administration's Graduate Fellowship program, one of the most exclusive paths afforded to budding nuclear engineers who are seeking to work in the nuclear energy sector. Recent UT graduates in the program have gone on to work for the NNSA, ORNL, and the US Department of State.

This May, UT's **EcoCAR team** had their best performance in 20 years at the EcoCAR 3 competition, held at the General Motors Milford Proving Grounds in Milford, Michigan.

During vehicle dynamic testing, the team garnered 1st in 0–60 acceleration, 1st in 50–70 acceleration, 1st in ride quality, and 2nd in autocross. Overall, they came in 5th, a huge step up from last year's 13th-places finish.

UT's team is composed of 30 students from mechanical and electrical engineering as well as communications and business.

Toks Omishakin

Graduate student **Toks Omishakin** (ISE) was named one of the *Nashville Business Journal*'s 40 Under 40 for his work with TDOT as deputy commissioner and environmental bureau chief. He created a new $30 million program to support improving access on roadways for people with disabilities, transit users, bicyclists, and pedestrians.

Christopher Neal

Juniors **Christopher Neal** (honors, CBE) and **Andrew Wintenberg** (EECS) were selected as 2017–18 Goldwater Scholarship recipients, one of the nation's highest, most selective awards for undergraduate students.

Neal aims to earn a doctorate in chemical engineering with a focus on electrochemistry, conduct research on alternative electrical energy storage devices, and teach at the university level. Wintenberg aims to earn a doctorate in mathematics and conduct research on mathematical methods in signal processing.

Andrew Wintenberg

"Earning the Barry Goldwater Scholarship is perhaps the greatest honor I have ever received. This scholarship has afforded me the opportunity to realize my full potential in research and academic excellence."—Neal

In May, the chancellor and the college received an inspiring note from a proud parent.
We felt it too good not to share!

Chancellor Davenport,

I just wanted to let you know that next Thursday afternoon, May 11, the Tickle College of Engineering will have graduated three siblings within four years!!!! My son Jim, who will graduate Summa Cum Laude in Electrical Engineering Honors next Thursday, will join his brother Stan, who graduated Magna Cum Laude in Mechanical Engineering with a minor in Reliability and Maintainability in May, 2016, and his sister Caroline, who graduated in Mechanical Engineering in May, 2013, as proud alumni of UT's Tickle College of Engineering.

All three siblings participated in co-ops through the Office of Engineering Professional Practice. Caroline was an Engineering Ambassador and a math tutor, did a co-op with Southern Company, and now works as a Project Manager for Schneider Electric in Nashville. Stan participated in undergraduate research with graphene under Dr. Kenneth Kihm, both at UTK and Seoul National University, did a co-op with BSH, and he is currently pursuing a joint MS-MBA; he has a graduate internship with Pepsico this summer and will teach EF230 next Fall and Spring; Jim has been conducting undergraduate research on the CURENT project, participated in a co-op with Eastman Chemical and will begin working for Eastman this summer. Stan and Jim were both Chancellor's Honors graduates as well.

My children come from a long line of UTK graduates, both grandfathers—one in 1927, College of Engineering; the other in 1951, College of Business; both parents, and many, many uncles, aunts, and cousins! But I think that it is a testament to the UNIVERSITY OF TENNESSEE COLLEGE OF ENGINEERING that all three have chosen to pursue their education within the hallowed halls of Perkins, SERF, Min Kao, Tickle, Dougherty, Estabrook…

I want to thank the University, and especially the wonderful, wonderful professors in the Tickle College of Engineering, for providing my children with, in my opinion, the finest education in the world, and the resources necessary to succeed in any and all endeavors!!! I forever will sing the praises of the UNIVERSITY OF TENNESSE COLLEGE OF ENGINEERING and I will forever be grateful!!

Thank you!

—Ellen Pickering Hunter

In Memoriam

Alumni

John Anderson (MS/EE '50), April 28, 2017

Earl Anspach (MS/ES '63, PhD/EE '80), August 3, 2015

Frank Paul Baranowski (MS/ChE '54), August 30, 2017

Robert Bell (BS/ChE '52), June 26, 2017

Stephen Byers (BS/EE '70), March 16, 2017

William Doggett (BS/EE '60), July 16, 2017

Robert Ely (BS/EE '47), March 8, 2017

Dewey Ewing (BS/ChE '71), March 15, 2017

Gordon Ford (BS/CE '51), March 13, 2017

Paul Foster (BS/ME '73), March 21, 2017

William Fowler (BS/ChE '66), April 30, 2017

Grady Fox (BS/EE '43), March 14, 2017

Mark Gray (BS/ME '90), April 2, 2017

Col. Donald Hancock (BS/IE '85), August 2, 2017

Billy Hargis (BS/ChE '56), March 21, 2016

Robert Harper (BS/ME '48), June 9, 2017

James Haynes (BS/IE '50), August 22, 2017

William Haynes (BS/CE '50), April 18, 2017

Albert Hodapp (MS/AE '67), March 8, 2017

George Holt (BS/EE '42), February 5, 2017

Robert Hutchins (BS/EE '54), July 5, 2017

R. Harold Jenkins (BS/ChE '44), April 21, 2017

Gregg Lagerberg (BS/ES '80), June 19, 2017

Allison Lampley (BS/ME '72), April 24, 2017

Jason Markley (BS/CompE, EE '04), October 21, 2016

Elbert McBee (BS/EE '67), May 25, 2017

Debra McCroskey (MS/NE '14), February 13, 2017

Nicholas McDaniel (BS/IE '61), April 1, 2017

Roy McInturff (BS/EE '61), June 10, 2017

Marvin McKee (MS/EE '63), July 4, 2017

Herbert Meyer (BS/IE '52), April 12, 2017

Joseph Morris (BS/EE '67, MSEPh '71), August 8, 2017

Bert Mullins (BS/CE '62, MS/SanE '63), November 4, 2016

Daniel O'Brien (BS/ME '80), March 4, 2017

Gary Owens (BS/CE '80), January 26, 2017

Gaylord Oyler (BS/AE '70), June 9, 2017

Morris Patterson (BS/IE '58), August 7, 2017

Clarence Patty (BS/EE '40), June 7, 2017

Alex Ridings (BS/ME '50), May 1, 2017

Gerald Roberts (BS/ME '64), August 14, 2017

Howard Sain (BS/CE '61), May 4, 2017

Edward Scott (CE/CE '50), February 15, 2017

William Shelton (BS/CE '54), May 9, 2017

Dale Smelser (MS/CE '49), July 13, 2017

Richard Snead (CS/IE '73), December 23, 2016

Charles Teague (BS/CE '66), April 2, 2017

John Tomlinson (BS/CE '83), July 28, 2017

Fred Walker (BS/ChE '56), June 8, 2017

Roy Cary Wehman (BS/EE '49), July 17, 2017

Hubert Williams (BS/AgE '50), March 17, 2017

Louis Wiser (BS/ME '66), June 8, 2017

David Wohlscheid (BS/CE '69), October 31, 2016

Harvell Worley (BS/ChE '62), March 21, 2017

Faculty

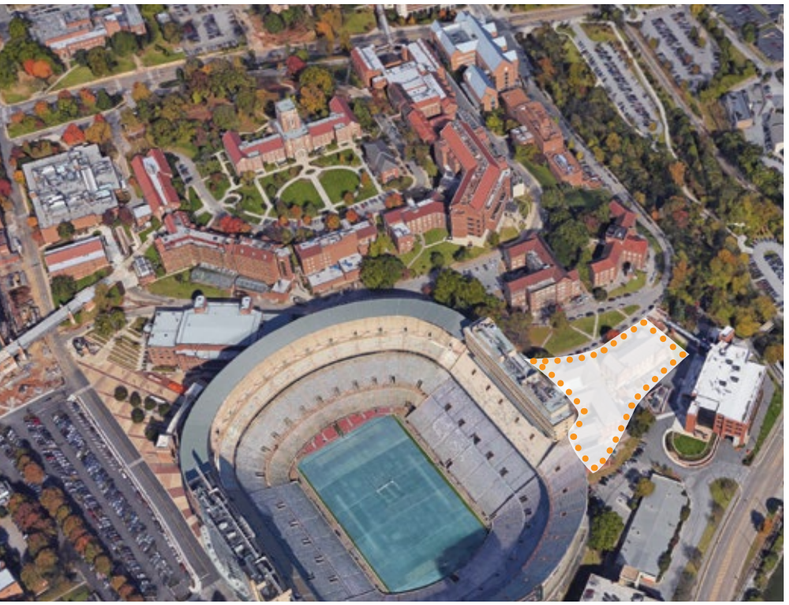
Alumnus and former faculty member **Bert Clifford Mullins** (BS/CE '62, MS SanitaryE '63) died on November 4, 2016, at the age of 90. Mullins was a World War II and Korean War veteran who graduated in 1962 with a bachelor's degree in civil engineering, then earned his master's degree in sanitary engineering in 1963. He taught in the college from 1965 to 1974 and afterward became an engineering consultant.

Marshall Osteen Pace died at the age of 75 on June 25 at the UT Medical Center. He was a professor in electrical engineering at UT from 1970 to 2007. During his career at UT, Pace was named the Tennessee Tomorrow Professor in 1980. He was named the Engineering Distinguished Faculty Member in 1984 and was a member of IEEE, Phi Beta Kappa, Tau Beta Pi, and Eta Kappa Nu. Pace was also a faculty fellow with NASA in Huntsville, Alabama, and a principal investigator for NSF programs.

Bruce Tschantz died on June 28 at age 78. He taught water-resources courses in the Department of Civil and Environmental Engineering from 1965 until his retirement in 2002, receiving numerous teaching awards during his tenure. He was a fellow in the American Society of Civil Engineers, and in 2016 he was recognized by the American Society of Dam Safety Officers (ASDSO) for lifetime achievement. After retirement from teaching, his research and advocacy focused on low-head dams, with the goal of educating agencies and the public about their danger.

Graham Walford passed away on August 26. The veteran engineer was a research faculty member in the Department of Nuclear Engineering. Originally from Bristol, England, he moved to Tennessee in 1975 and worked with ORNL for many years. He provided radiation measurement and monitoring expertise during the 1979 Three Mile Island nuclear reactor accident. Walford enjoyed leading UT first-year studies discussions to guide students as they began their college experience, and mentoring nuclear engineering students through their senior design projects.

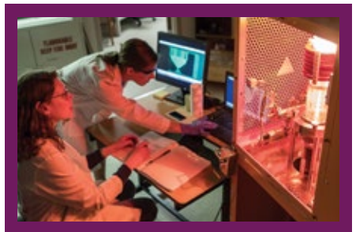
Facilities Update



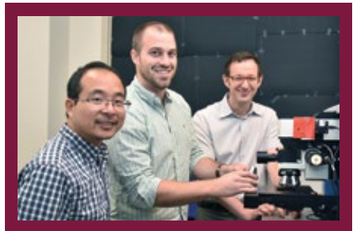
Gateway to Engineering

The UT Board of Trustees and Tennessee State Legislature have approved funding for a new engineering complex. With $90 million in state funding and a further $39 million in university and donor support, the building will house the sixth-ranked Department of Nuclear Engineering as well as the college's freshman *engage*™ Engineering Fundamentals and Cook Grand Challenge Honors programs, earning it the unofficial title of the Gateway to Engineering.

The State Building Commission has approved the full budget for the 228,000-square-foot building to proceed with design and construction.



43,700+ sq-ft
Flexible research labs & offices



38,200+ sq-ft
Nuclear Engineering offices & labs

20,800+ sq-ft
engage™ Fundamentals & Cook Grand Challenge Honors

15,800+ sq-ft
Student Design & Innovation Labs

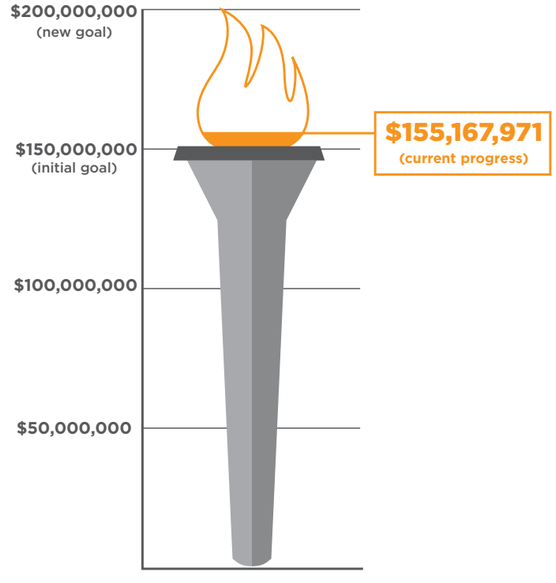
8,900+ sq-ft
Academic Affairs & student commons

5,900+ sq-ft
other uses

On September 22, 2017, the University of Tennessee launched its most ambitious campaign ever, with a $1.1 billion goal. Earlier this year, the Tickle College of Engineering soared past its original goal of $150 million and set a new goal of $200 million. The impact can already be seen in the stories you have read here—students, faculty, staff, and programs are all benefitting from your gifts.

Engineering Campaign Gifts include:

- $10.9M for faculty endowments, more than doubling pre-campaign faculty endowments
- Over $2M for graduate fellowships
- $17M for undergraduate scholarships
- Naming the college
- The Cook Grand Challenge Honors Program (*see page 2*)
- The Integrated Business and Engineering Program (*see page 5*)
- The Edwards Endowed Assistant Dean and Director of Integrated Engineering Design
- For more on our priorities and progress: **engr.utk.edu/give**



JOIN THE JOURNEY

TICKLE
COLLEGE OF ENGINEERING
THE UNIVERSITY OF TENNESSEE, KNOXVILLE

114 Perkins Hall
Knoxville, TN 37996
865-974-0533
tce@utk.edu
engr.utk.edu

utk.tce
@utk_tce
@utk.tce
linkedin.com/groups/4919219

Non-Profit Org.
US POSTAGE
PAID
Permit No. 481
Knoxville, TN

The Great Smoky Mountains National Park had an issue. UT engineering students found a solution. *Page 6.*