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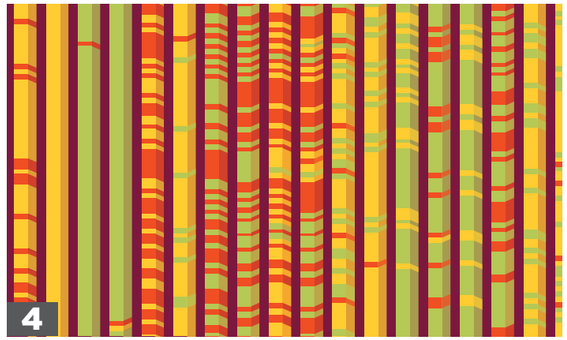
ENGINEER

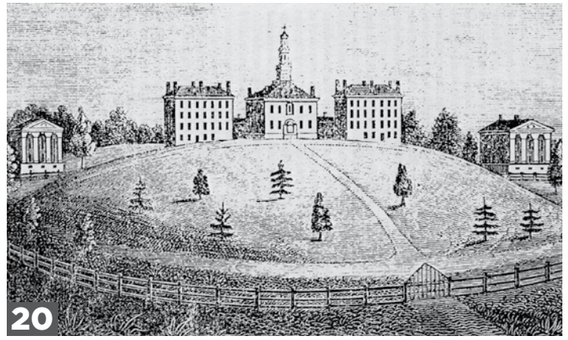
THE UNIVERSITY OF TENNESSEE, KNOXVILLE • TICKLE COLLEGE OF ENGINEERING

225 Years of Service: *Vols Light the Way.*

Page 22

TENNESSEE ENGINEERING





Features

Departments

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Janis Terpenny
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Brian Shupe
Executive Director, Engineering Development

Christie Kennedy
Editor and Director of TCE Communications

Melissa Callahan
Project Manager

Mitchell Williamson
Designer

Randall Brown
David Goddard
Andrea Schneibel
Kathy Williams
Élan Young
Writers

Steven Bridges
Randall Brown
Shawn Poynter
Jessica Tezak
Photography

University Print and Mail
Printer

On the cover: Environmental Engineering PhD student Taylor Blackstone taking data at the Noland Divide Water Quality Station in the Great Smoky Mountains National Park.

TICKLE COLLEGE OF ENGINEERING
THE UNIVERSITY OF TENNESSEE, KNOXVILLE

Dean's Message

I am thrilled to have joined the college on Rocky Top this summer, especially at the start of the university's 225th anniversary. Being the Tennessee Volunteers is a powerful moniker that carries a humbling responsibility of serving others. The 225th theme of "Lighting the Way" is indicative of what our college already does so well—advance society through engaging service projects and life-changing research. Read about some of the amazing work of our faculty and students starting on page 22.

One of my top priorities as dean is to connect with you—our alumni and community and industry partners—to find new and different ways to collaborate and build on our existing body of work. Turn to page 2 to read about my vision for the college and please reach out to connect; I encourage your ideas and input on how we can create an enabled, passionate community.

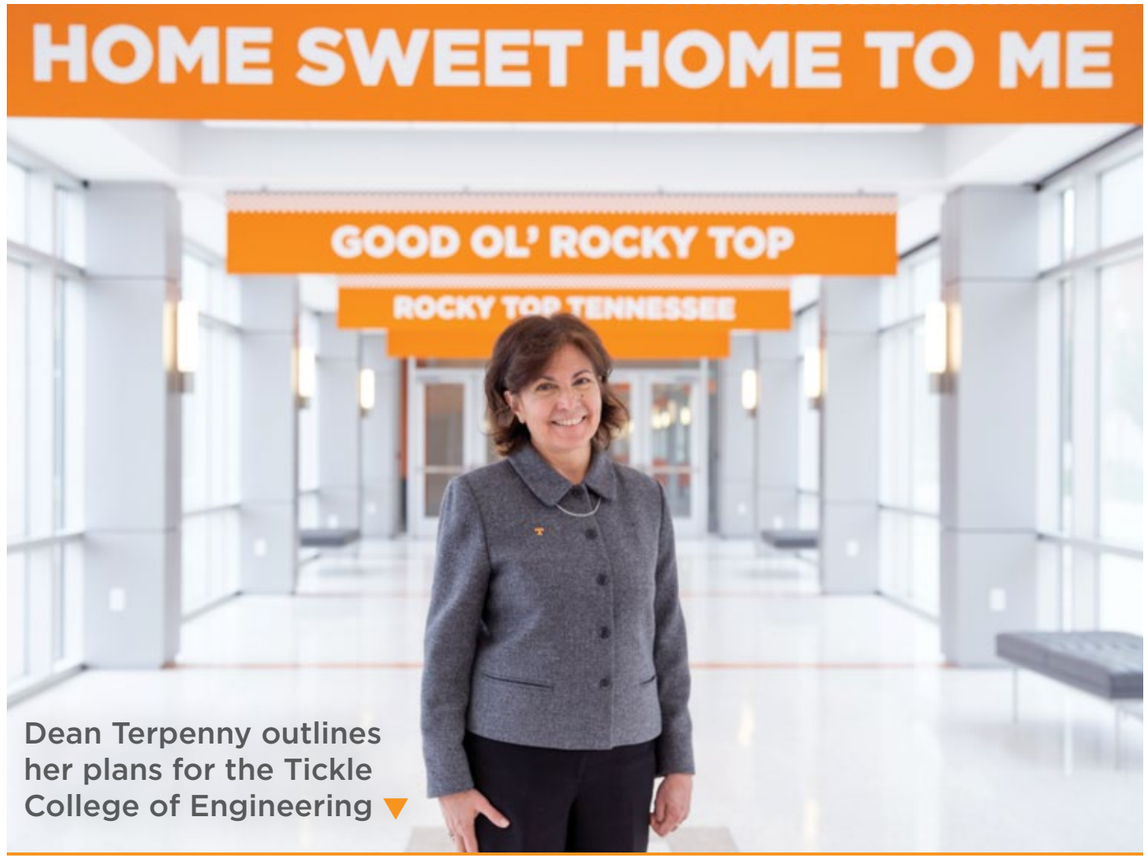
The ever-strengthening ties we have with Oak Ridge National Laboratory and the Departments of Energy and Defense, among others, have led to our faculty working on breakthrough research with significant impact, in particular in the areas of additive and advanced manufacturing and high performance computing (see pg. 14). Beyond this research, I look forward to engaging more of our students in this important research as well as with real-world projects to help tie our curricula to what they will experience as practicing engineers.

Another key priority for me is to be actively involved in ways to increase diversity with both multicultural and female populations. There's a good base here, but I'd love to see that grow, especially in partnership with our board and with industries. I cannot overstate the importance and need for diversity in the work force and in academia.

I am excited to be here at UT and look forward to building on the tremendous momentum set by former Dean Wayne T. Davis and Interim Deans Lynne Parker and Mark Dean. I am deeply grateful for their service to the college and the foundation they laid for me as incoming dean.

Sincerely,

Janis Terpenny
Dean and Wayne T. Davis Dean's Chair



Dean Terpenny outlines her plans for the Tickle College of Engineering ▼

A Vision for the Future

By David Goddard. Photography by Jessica Tezak.

▼ Opportunity

Even a brief meeting with new Tickle College of Engineering Dean Janis Terpenny immediately reveals that finding, providing, and developing new opportunities is a big part of her vision for the college.

"I love that Tennessee is the Volunteer State, and that UT as an institution fully embraces that," said Terpenny, who is also the Wayne T. Davis Dean's Chair. "There are so many opportunities here for engagement locally, nationally, and beyond."

Terpenny was quick to highlight the college's work with Oak Ridge National Laboratory as something that helps its reputation beyond UT, and explained that she wants to seek out new partners to further strengthen the way the college is viewed. She's also looking to establish ties with new industry and non-profit partners on both the local and national level, which will have the added benefit of cementing what students learn in the classroom.

"While it is important to have connections and collaborations for research, it goes far beyond that," Terpenny said. "Connecting our students with real-world projects helps provide context for what is being learned throughout our curriculum, while at the same time helping solve particular problems for our partners."

If that sounds familiar, it should.

Keith Stanfill was brought in as the Edwards Assistant Dean and Director of Integrated Engineering Design in the summer of 2018 with a goal of creating more of an emphasis for student design projects that are introduced by businesses.

Terpenny and Stanfill are of one mind when it comes to using practical projects to help aid and cement curricula. They met while serving on the national Capstone Design Conference, whose purpose is to better align education and practice together through projects in the way Terpenny described.

"There's a basis already that has been placed here with Keith, which is kind of cool and a good start," Terpenny said. "Businesses and organizations change and evolve over time, so there will always be opportunities and challenges for our students."

▼ New Partners

While Terpenny affirmed the importance of continuing to expand areas where the college already thrives, she also sees healthcare as a potential growth area for the college and UT, given its obvious application and importance around the globe.

"We've got UT Hospital right across the river, we've got East Tennessee Children's Hospital here beside campus, there are just some great opportunities for collaboration and growth," Terpenny said. "If we could do it right, I really think UT could become a national example as a healthcare research leader."

Terpenny noted that many engineering-focused research avenues related to healthcare could also tie in with some of UT's other colleges including nursing, social work, and the social sciences.

She would also like to see the college partner with the UT College of Veterinary Medicine and Zoo Knoxville, pointing out that both would provide new, easy to understand avenues to show students the impact of what can be achieved through a STEM-related degree field.

"I'm a big collaborator, and I always have been," Terpenny said. "The opportunities are immense here, and I'd love to see them grow."

▼ New People

In addition to research, Terpenny also places a strong emphasis on creating opportunities for individuals. One of her plans is to continue the recent significant growth of the college's undergraduate and graduate student populations, with a corresponding rise in faculty and staff to meet those needs.

But she doesn't plan to grow the college haphazardly.

"I want to see a true welcoming environment and a significant growth in respect to diversity, not just in the student population, but with faculty and staff as well." Terpenny said. "I hope to work to develop new scholarships and programs to help support our efforts to diversify our campus. A diversity in people leads to a diversity in thought, which is a good thing."

She notes that solving problems frequently requires multiple disciplines with many viewpoints, and that such diversity can help deliver new ideas through different perspectives that are brought to the table.

In turn, those new ideas might lead to other collaborations down the road, meaning the ability to forge new partnerships can be tied to having a diverse college, and vice versa.

"The ability to enable others is my passion," Terpenny said. "When good ideas resonate, that's exciting. Whether it's an idea I've had or an idea someone else brings to me doesn't matter. It's about creating an enabled, connected, passionate community."

▼ New Steps

Terpenny hopes to spend the early part of the fall semester getting to meet every department, lab, faculty member, and student group. Beyond that, she wants to begin to lay the groundwork for a national network of partnerships with universities, industries, and agencies, while at the same time fostering a stronger connection with UT's local community.

Building connections, growing the student, faculty, and staff numbers, and creating a culture of collaboration are all key steps in what Terpenny ultimately hopes to achieve.

"We have a goal to be in the top 25 engineering programs, and if we're not there, I want to at least be darn close," Terpenny said. "And it won't be by numbers alone or just among publics. I want us to be top 25 nationally, full stop."

She cited communications as being an integral part of that process, saying that her hope is to make the college less of a "well-kept secret."

In addition to expanding the college's efforts to share its good news, another big priority is to increase the presence of the college and its departments at national conferences as well as see the college host more conferences and increase sponsorship of engineering events in order to put UT's experts at the forefront.

While implementing these ideas will not come without challenges, Terpenny is very eager to begin transforming the college into her vision for what it can be.

"I'm delighted to be here, am excited about the future, and am taken by the welcome I have received and the energy that exists," Terpenny said. "I know we will do great things together."

For her, that's the perfect opportunity.

GENETIC ALGORITHMS:

Where Evolutionary Biology Meets Nuclear Engineering

By Élan Young.

What does Charles Darwin have to do with building an advanced nuclear reactor? Potentially quite a lot. In the groundbreaking 1859 book, On the *Origin of Species*, Darwin introduced the scientific theory of biological evolution through natural selection: the strongest live on, breed, and create the next generation.

Nuclear Engineering Department Head Wes Hines has found that the same genetic algorithm (GA) can be adapted for mechanical systems—including nuclear reactor designs—in which designs can "mate" and create new designs.

Hines was brought to UT by Bob Uhrig in 1995, a Distinguished Professor of Engineering and Distinguished Scientist in the Advanced Science and Technology Division at ORNL under the Science Alliance program.

Once at UT, Hines began to write a supplement to Uhrig's book on the specific applications of artificial intelligence (AI) to nuclear engineering.

"It was about fuzzy logic, neural networks, and expert systems," Hines said. "After I got here, we started looking at other types of AI and began using GA as an optimization method."

Now, with the Fast Neutron Source (FNS), a subcritical nuclear facility design underway for the new Engineering Complex, Hines revisited GA as an optimization method specifically for design—a first for the department in at least 25 years.

"The goal of this research is to explore how AI can be used to aid in the design of a complex nuclear system," said John Pevey, a doctoral student on Hines's team. "Twenty years ago, it would have required an unreasonable amount of computer resources, but today we have that kind of computer power at our fingertips."

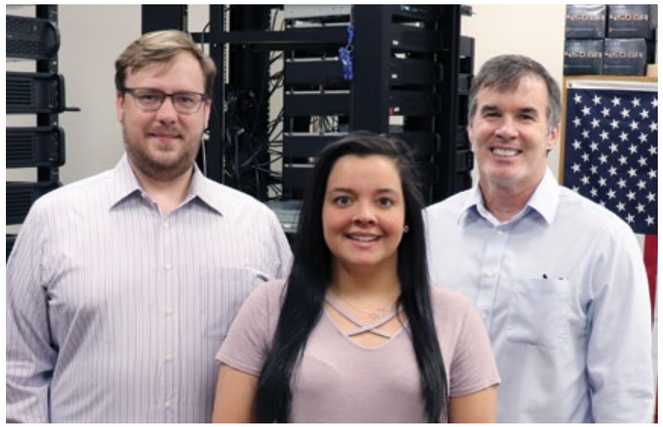
At first, Hines's team optimized the FNS design manually, which only resulted in a marginal improvement. Pevey proposed removing some of the constraints on the system to let the computer try its hand at designing the FNS.

Using the department's advanced computational resources, they ran a GA that evaluated thousands of potential designs. In a matter of hours, it had found designs that improved the performance metrics by a factor of three.

"We still have the opportunity to check the GA's designs manually for safety, but its ability to evaluate thousands of designs allows us to create blueprints for the FNS that we could not have come up with ourselves," said Sarah Davis, a master's student who is also working on the project.

This new way of thinking about GA opened up the possibility for the team to contribute to ORNL's Transformational Challenge Reactor program, which aims to combine the latest innovations in materials, manufacturing, and machine learning to design the next generation of reactors.

"There are solution algorithm methods that have been applied to optimization problems in general, so we need to study and experiment with how they apply to reactor design," said Vladimir Sobes, a research and development staff member at ORNL. "The genetic algorithm is just one of the optimization methods."



(L–R) John Pevey, Sarah Davis, and Wes Hines.

Hines added that GA has potential when there are single or multiple goals, and many possible solutions.

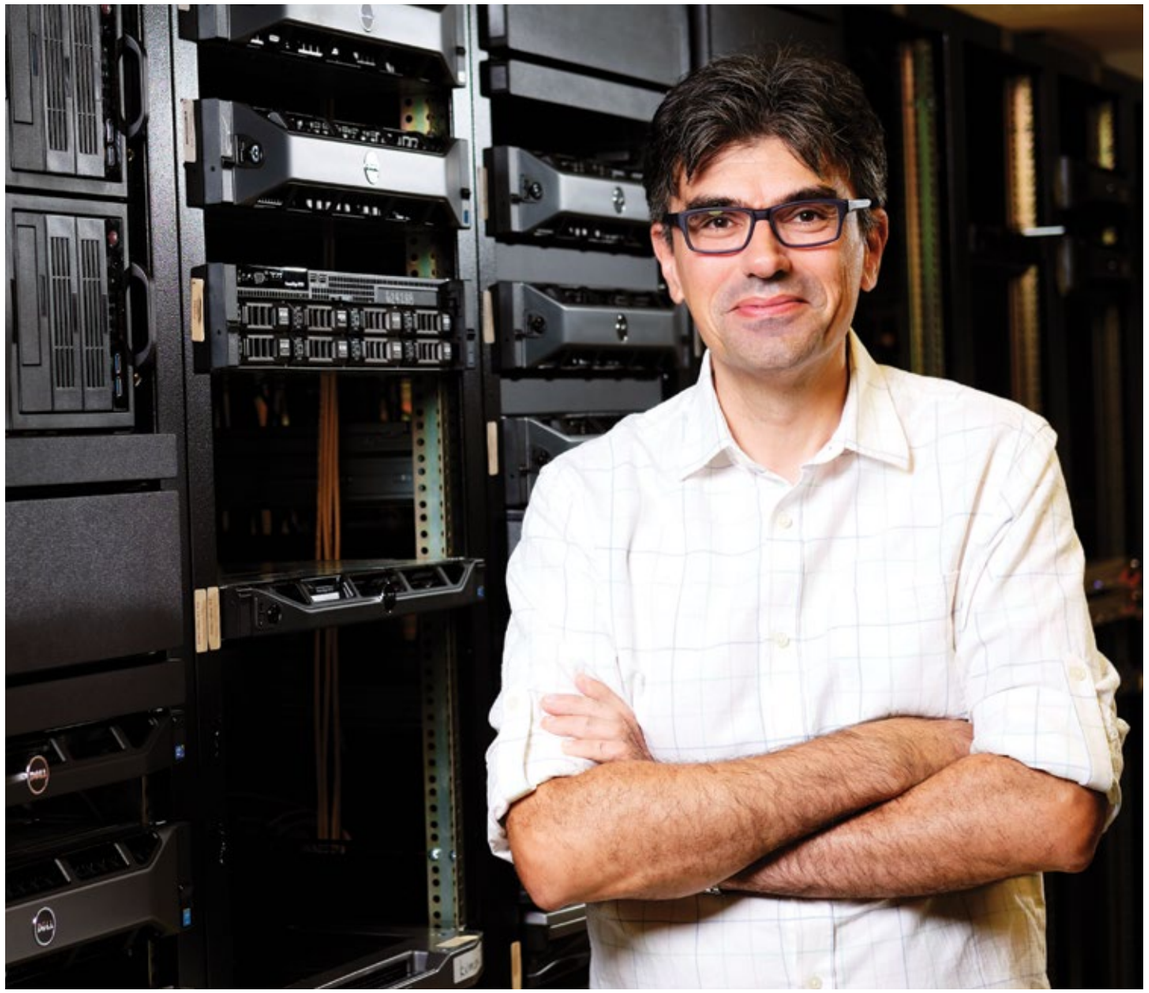
"Sometimes when you do optimization, you can apply mathematical techniques to find an optimal solution," Hines said. "In the case of nuclear reactor designs, it's not a problem you can solve with equations."

While the team is using GA for the FNS, it's just the tip of the iceberg of how increased computer capability can allow for safer and more efficient reactor designs.

"This opened up our eyes that old gray-haired men think they know the best way to solve a problem—the best way to design a core—and in reality, we are constrained in our thinking, and the constraints penalize us," Hines said. "What we need to do is look outside the box and do things that we didn't think we were allowed to do. When you remove the biases that people have and let the computer figure things out, we get results we've never thought of."

Those results could help fuel the next generation of nuclear engineering.

Research Tidbits



The Future of Modeling

While computers have evolved into machines capable of incredible computations and modeling, there remains a significant gap between where they are and where CBE Associate Professor **Manolis Doxastakis** thinks they can be.

He hopes to bridge that gap through the use of multiscale modeling, which uses data derived from one technique to influence and guide the next set of tests using a different technique, and so on.

Through this modeling, researchers can interpret lab results, determine if surprise findings are due to noise in the data or if they're worth following up on, and design new materials to achieve specific properties. Eventually, the goal is to have computers that can design and predict material needs without the need of experimentation.

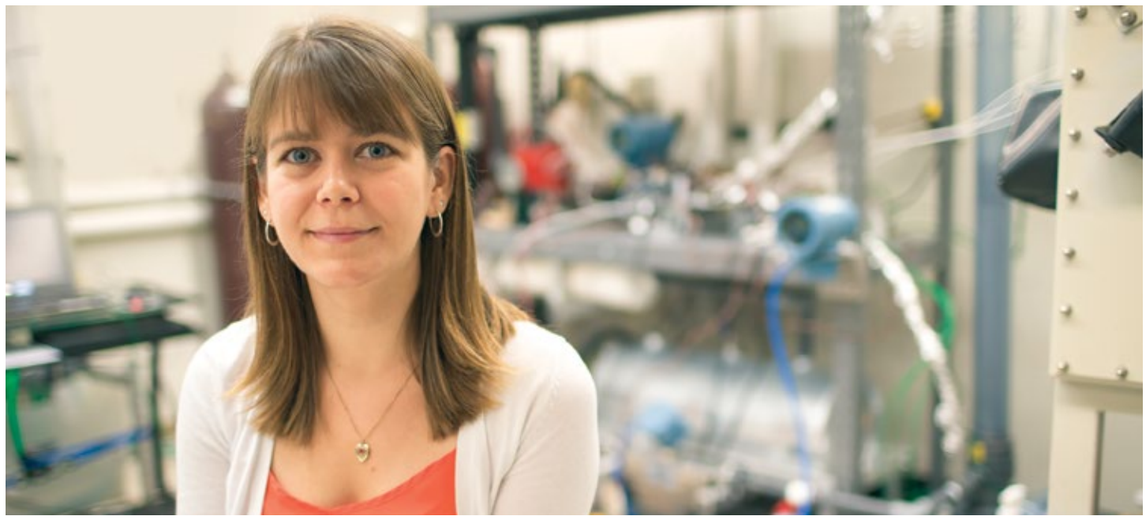
His research has caught the eye of industry partners, with the thought being that his research team will take the idea to a point where businesses can make their accumulated data into a physical application.

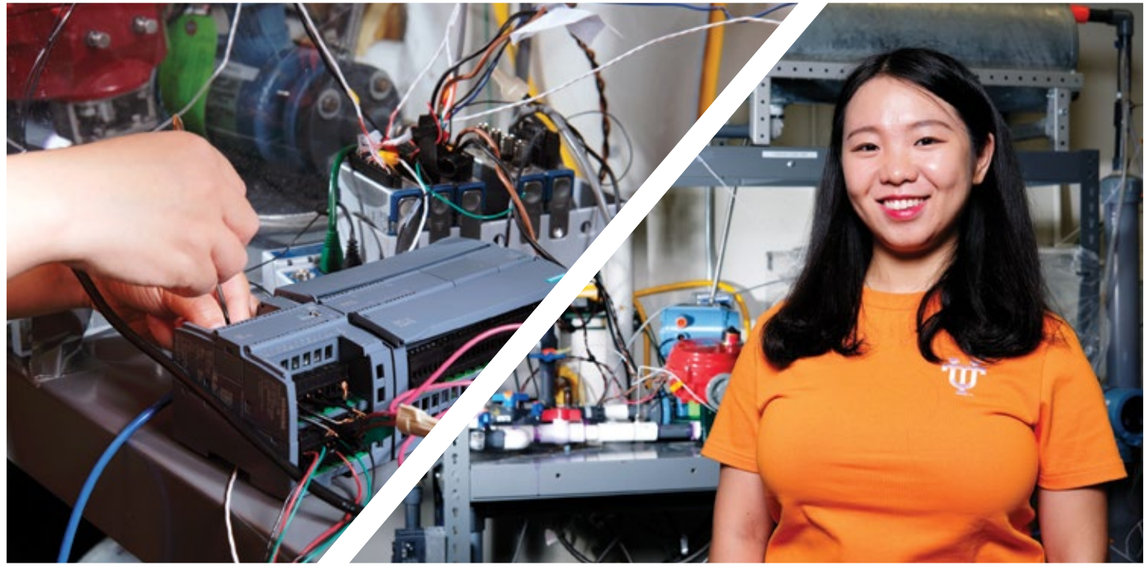
Light Water Reactor Breakthrough

ISE Assistant Professor **Anahita Khojandi** and Associate Professor **James Ostrowski**, along with NE's Southern Company Faculty Fellow and Assistant Professor **Jamie Coble** have teamed up on a DoE-backed project to further improve light water reactors.

Their idea is to create a framework for reactor maintenance based off informed planning, such as noting how different components break down in different rates in different areas, while at the same time reducing cost.

Their approach includes looking at both the overall, long-term cost of maintenance as well as week-to-week activities in order to find a solution through optimization modeling that satisfies both. Once created, reports could be updated weekly to show what the remaining repair and maintenance costs would be for a particular light water reactor in both the short and long term, and can be adjusted as the situation changes.





Doctoral Student Gains Recognition for Nuclear Cybersecurity

Fan Zhang, a nuclear engineering doctoral student, is researching a new approach for enhancing cybersecurity within nuclear power plants, and her findings have found a home with one of the most respected bodies in the nuclear field—the International Atomic Energy Agency (IAEA).

Zhang built a real-time cybersecurity test bed with a simulated two-loop power system, a supervisory control and data acquisition system to receive data and pass control commands to the system, and a local area network to simulate cyberattacks.

While current cybersecurity efforts use firewalls and network analysis to prevent attacks, Zhang's approach will also protect against attacks from within and data theft by using data coming directly from the plant sensors in combination with machine learning to detect when a cyberattack is ongoing or has occurred. These advances will give on-site personnel precious time to prevent severe damage, economic consequences, or potential loss of life.

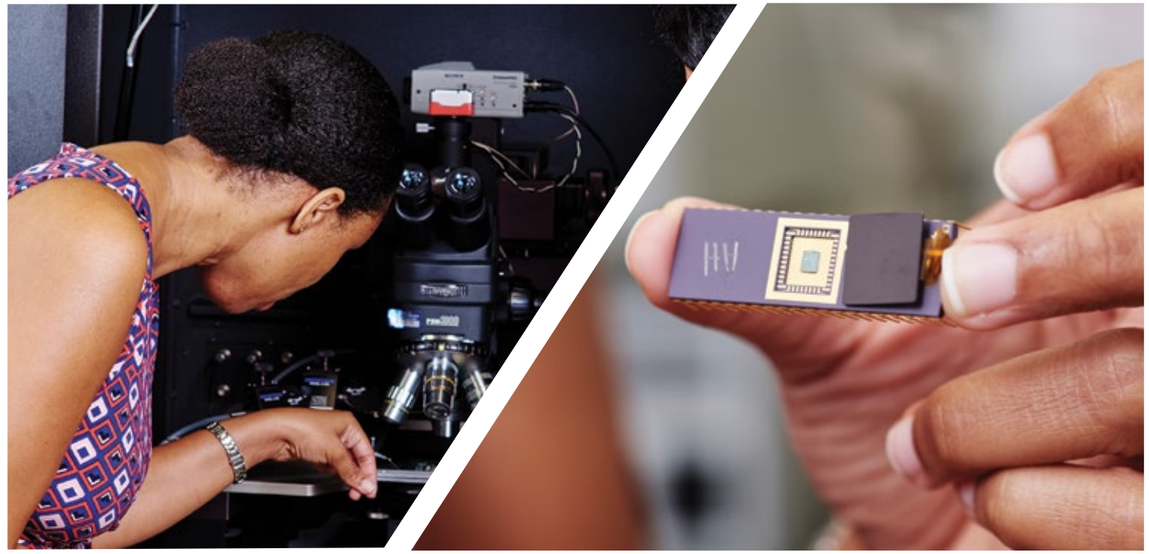
Stabilizing Concrete for Nuclear Energy

CEE Professor **John Ma** is seeking to better predict how and when concrete will fail due to Alkali Silica Reactions (ASR), a problem known as the "cancer" of concrete. That knowledge is of particular interest to the nuclear energy sector, where structural failure is simply not permissible.

In ASR incidents, concrete forms a gel that absorbs water, expanding over time and damaging the concrete.

To get a robust sample size, Ma ran a number of tests to simulate various conditions and designs and measure how the concrete reacted. After three years, the control chamber was removed and each of the test samples were studied. The data is now being analyzed with the hope of providing a better understanding of ASR.

Although this study is focused on the nuclear industry, the findings will be applicable to other industries as well.



Implantable Sensors Getting an Upgrade

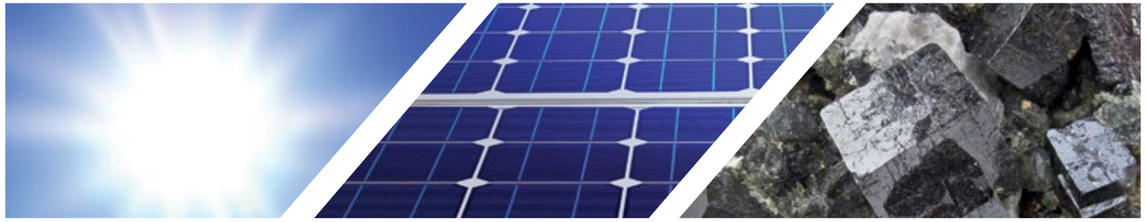
In recent years, EECS Assistant Professor **Nicole McFarlane** has developed new technology to help patients better monitor and treat lifelong conditions such as diabetes.

By delivering data from within the body in real time, the sensors will allow patients to have their bloodwork on hand, without the need for repetitive finger pricks. Eventually, they might also be able to deliver medication doses internally, something that would further reduce the need for breaking the skin.

Since first discussing the ever-evolving technology in 2018, McFarlane and her team have made a couple of interesting new inroads in improving the devices.

First, they are working to incorporate upgraded signal processing and readouts on their single-photon avalanche diodes (SPADs), sensors that are quicker and use less power than other similar technology.

They are also taking steps to improve the device by integrating a microprocessor in the sensor, making it a “smarter” device.



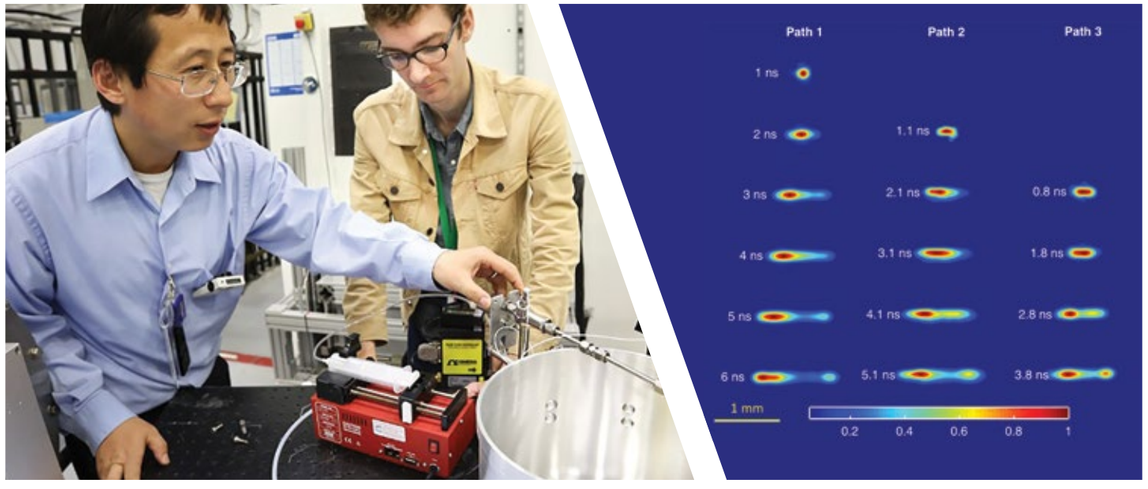
A Deep Dive into Solar Energy

One of the most promising developments in solar cells centers around what are known as halide perovskites, which have proven to be very adept at taking in solar energy and holding its charge for longer periods of time than other cells.

MSE Professor **Bin Hu** is taking a fresh look at these cells and their properties, with a focus on how their structural makeup affects their performance. In particular, Hu is interested in their spin-orbit coupling, which involves studying the movement of particles at the atomic level.

To put it in basic terms, the strength of the spin-orbit coupling—the movement of a spinning particle within a magnetic or electrical field—affects potential output: the stronger the bond, the more power possible, with the reverse also true.

In recent years, perovskites have rapidly become one of the best materials for solar energy, offering great hope for improved performance over other materials that have long been the standard.



How Fast Was That?

Hypersonic speeds, by their very definition, pose a challenge to measurement and instrumentation. That could soon change, thanks to MABE Associate Professor **Zhili Zhang**.

While his focus has always been on developing cutting-edge imaging and sensors, Zhang and his collaborators—including recent MABE graduate and current UTSI Research Professor Mark Gragston—have helped increase the use of lasers to track objects flying at many times the speed of sound, developing the Multiplexed Structured Image Capture (MUSIC) system in the process.

MUSIC uses advanced cameras set to take a series of images with coded markers to indicate where the object was at a set point in time. By combining those images through computations, the resulting picture shows how quickly the object passed various points, leading to an understanding of its speed.

In addition to having a high rate of accuracy, MUSIC holds an advantage over other similar devices by costing much less.

Forging A Path

By Cameron Hale. Photography by Steven Bridges.

Like many students, I would occasionally day-dream in class, and I remember one day when we were discussing the Iron-Carbide phase diagram and forging in my Introduction to Materials Science class. Naturally, my mind began to wander to blacksmithing, and the idea stuck with me for days, weeks, even months. I began to look up forging videos, ordering books on blacksmithing, and even doing quick sketches until one day my sophomore year, I impulse-bought a small gas forge online.

At this point, I'd had no experience and no other equipment, but I began to purchase the minimal amount of equipment for the cheapest I could and started to make knives in my garage out of pieces of scrap steel. I then joined the Clinch River Blacksmithing Guild, which meets every month in Knoxville and allowed me to see, in person, what a professional blacksmith looks like. However, their emphasis on bladesmithing was weak and I was still curious.

After a few months, I decided I'd ask around the MSE department to see if anyone else was into blacksmithing and Senior Lecturer Chris Wetteland directed me to fellow student Cullen Pearson. Cullen had been forging for years and was enthusiastic about someone else sharing the interest. He also discussed the frustration of not having any good groups or outlets to forge at in Knoxville. Around the same time, there was some hype about the Minerals, Metals & Materials Society (TMS) conference, specifically their bladesmithing conference, and I expressed interest in it. Cullen suggested that we assemble a group here and compete, which I loved.

We spent the next semester or so getting all the administrative and technical aspects sorted out and finally created the Bladesmithing Club at UT! The goal was to participate in TMS and submit a blade that UT could be proud of, while simultaneously creating a place where students who are interested in metalworking could try it out. The reception was massive, and around forty students showed up to our first meeting. With the help of Fuad Accawi, a master bladesmith who works in Oak Ridge, we were able to forge a beautiful blade for TMS, winning the Most Beautiful Blade Commendation at the conference.

LIVING ON THE EDGE:
Taufer Strengthens UT Expertise in Computing's Next Frontier

By David Goddard. Photography by Shawn Poynter.

EECS Department Head Greg Peterson, Michela Taufer, and Jack Dongarra.

Just as a high-performing computer needs the right parts in order to work at its best, a high-performing department requires the right people to excel.

At UT, that right mix of people have helped make the Tickle College of Engineering a leader in the world of high-end computing, according to Dongarra Professor Michela Taufer, a globally respected expert in the field.

In fact, that's what attracted her to UT in the first place.

"There is a very strong, very broad group of researchers here, covering many aspects of computing," said Taufer, who works in the Min H. Kao Department of Electrical Engineering and Computer Science. "A lot of places can claim to excel in one area or another, but we have people who are experts in machine learning, in computing speed and power, in computing hardware, in many areas. High performance computing goes well beyond supercomputing, and we are helping lead innovation in this arena."

Speaking of the edge, Taufer said that the next advancement taking place in computing is through what is called edge computing.

Whereas cloud computing involves information and data being stored in a centralized location, edge computing involves bringing those files and figures closer to where they are being used.

An increasing number of industries are using data and edge computing in a cycle of innovation: companies use their available data and information to help make starting decisions, then use the resulting data gathered after those first actions to influence future improvements.

It's a cycle of continuous change and improvement.

"Edge computing and integration of data into decisions is the next big thing," Taufer said. "So much of it is based on simulation, gathering analytics, plugging data into real systems, conducting analytics on those results, and using simulation to further hone in on the next round of changes."

Edge computing holds particular value in areas where even the slightest improvement in performance could make big differences.

Changing technology has broad impact

Take energy, for example. When used in conjunction with wind turbines, edge computing can better predict times of need, the best angle for blades to be pointed, which turbines to activate, and even the best path to route the produced power, all using the cycle of data gathering and use that Taufer described.

"Traditional computing won't be replaced, but will be added to through things like edge computing or quantum computing," she said. "Because we have people with expertise in those areas, UT can really be out in front."

And that leadership impacts humanity in a number of ways.

Through the cyclical data, analysis, and implementation process Taufer and others at UT are stressing, surgeons can figure out the best way to operate on the brain before making the first incision; farmers can get a better idea of what and where to plant; and automotive engineers can design safer, more efficient vehicles, all of which are processes where failure results in a negative outcome for humans.

With so many potential areas affected by groundbreaking computing techniques, scientists like Taufer and her colleagues are in high demand, but she revealed another way UT is unique.

"Our motivation is the impact we can have on society" Taufer said. "We're here to serve our community for the betterment of all, not for profit. Our payoff is energizing and integrating the next generation of researchers into that spirit of our department."

She said it is exciting to see students come to UT with new ideas and watch faculty use their own expertise to help their pupils explore, develop, and push the boundaries of computing.

Taufer's department is particularly well positioned because it has faculty with advanced knowledge of several areas of key importance to computing, including applications, libraries, and hardware.

Gaining positive attention

People beyond her department have taken notice, as well. UT and the University of Illinois are the only two universities in the US to be part of the multi-national Joint Laboratory for Extreme Scale Computing (JLESC). In fact, JLESC held its annual workshop at UT this April, bringing experts from national laboratories and universities from around the world to Knoxville.

As a highlight of her role in pushing the boundaries of computing, Taufer is serving as chairperson of SC19, the International Conference for High Performance Computing, Networking, Storage, and Analysis held in Denver, Colorado, this fall.

One of the topics she hopes to address is the need to seek partnerships and cooperation outside traditional areas. Supercomputing has typically been a small, narrowly focused community, but collaboration with other fields is key to the growth of the field.

"It is important to remain curious, to see possibilities and incorporate new ideas," Taufer said. "UT trains students to think like that, get to what is important, and understand the big picture, and work toward the future."

For Taufer and her colleagues, that future is limited only by their imagination.

Computer Science is Served

What is the new technology?

The latest sign of the strength of UT's collaboration with IBM came with the company awarding the university a POWER9 server stack like the kind used on the Summit supercomputer housed at Oak Ridge National Laboratory. Summit is made up of a warehouse-sized room of many dozens of server stacks working in collaboration to make calculations at incredible speeds, while UT's server stack will allow its use as a learning tool for faculty and students at a scaled-down size.

How many other institutions have one?

UT is one of the first universities in the world to have a server stack like the kind used on Summit, with the University of Miami recently announcing a similar development.

Where is it located?

It is housed in the Claxton Complex, near the Innovative Computing Laboratory, an institution led by UT Distinguished Professor and ORNL Distinguished Scientist Jack Dongarra—who is also playing a vital role with the new server stack—placing it where UT and the college already have an established computing presence.

Why did IBM pick UT for this?

IBM and UT have a track record of collaboration, including several recent grants and programs being started by the computer giant for UT's benefit and educational outreach, including a particular focus on big data and supercomputing. Fisher Distinguished Professor and computing pioneer Mark Dean is an IBM fellow and holds three of the first nine patents related to personal computers. He helped jump-start the project while most recently serving as interim dean of the college.

Who else is leading the effort?

Dongarra Professor Michela Taufer and EECS Department Head Gregory Peterson are also playing key roles.

How will it be used?

While the benefits of working with a server stack of the world's fastest computer are enormous to UT students and faculty, IBM also gets something out of the agreement in the form of feedback and suggestions that will help guide the development of Summit's eventual replacement.

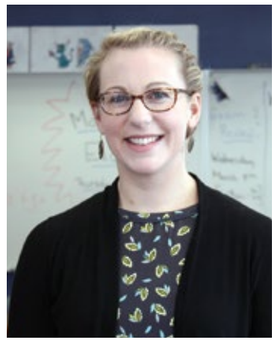
Engineering Certificate Program Offers New Approach to Education

By David Goddard. Photography by Randall Brown.

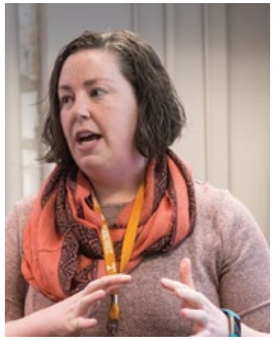
Engineers tackle intricate, interdisciplinary challenges such as those presented in the National Academy of Engineering Grand Challenges as part of their everyday work.

Those problems range from energy production and delivery to better healthcare, and everything in between, requiring educational approaches as numerous as the issues at hand.

There is a growing demand to train more engineers with diverse backgrounds and skills who are able to provide new perspectives in solving those complex issues, so the Tickle College of Engineering has launched an Engineering Education Certificate program to help meet those needs.



Courtney Faber



Rachel McCord

"While current education practices have been successful in a number of ways, research suggests that engineering educators need to use new ways of engaging students in the practice of engineering, both inside and outside the classroom," said Courtney Faber, research assistant professor and lecturer in the Cook Grand Challenge Honors program.

Faber serves as coordinator for the program, with Rachel McCord, lecturer in UT's Engineering Fundamentals program, also helping with the new offering.

The program is open to alumni as well as graduate students who have completed their bachelor's degree across any number of sciences, technological, engineering, mathematics, or education fields. Students can pursue the graduate certificate without being fully committed to a master's or doctoral program.

The program is already garnering attention from students eager to add value to their degree options.

"I am planning to apply to a graduate program so that I may eventually teach," said Collin Pekol, who is majoring in materials science. "If I am to teach effectively, I should be familiar with different models and methods of teaching, and I can use the theories I learn to become an overall more effective teacher."

For Ryan Kelly, an aerospace engineering major, the classes are an opportunity to gain perspective that are both vital yet lacking in some professors' resumes.

"This course offers certain insight that I wish some of my professors had," Kelly said. "I believe that an instructor should be knowledgeable both of the material they teach as well as how to actually teach it."

The four-course series will include three required courses and a final option, between three elective courses, offered over the course of two years.

By designing the course in this way, students will be able to tailor their experience in the program toward curriculum development, engineering education research, or general preparation for an academic career.

Additionally, current UT graduate students can choose to complete one or two of the courses without pursuing the full certificate.

> **"Faculty advisors do an excellent job of preparing students for the research portion of a future academic position," said McCord. "We believe this certificate will continue to add to that education by offering instruction in theory and pedagogy, and that participation in this certificate program will help our graduates be more competitive in the academic job market."**

McCord added that similar programs are well established at other peer institutions and that they were glad to offer this opportunity to UT students and establish the university's presence in the growing field of engineering education.

Sisters Help Each Other

Stay Charged for Electrical Engineering

Writing and photography by Randall Brown.

From left, Diane, Frances, and Christine Garcia.

The Garcia sisters enjoy a unique support system as first-generation college students: they have each other.

Before eldest sister Frances completed her master's degree this past December, the trio studied electrical engineering together at UT. Younger siblings Diane and Christine are still on campus, embodying the spirit of "familia," the supportive community approach promoted by the Society of Hispanic Professional Engineers (SHPE), which all three have been involved with. Their close family connection enhanced their experience all the more.

"There were definitely advantages," said Christine. "I knew how professors taught the classes because my sisters had taken the class before, and they also had notes and tips. They definitely helped me gear my study habits to be more successful."

"The main advantage I saw was having backup," agreed Frances. "If I was stressed, bored, had something exciting to share, or wanted a friend to go to the gym with I could just hang out with them."

"It helps that we're all three in electrical engineering, Hispanic, and female," said Diane. "And we're family, so everything is relatable. When I'm thinking something and laughing, Christine is probably thinking the same thing and laughing."

The sisters' strong relationship helped them engage socially, from playing intramural soccer together on campus, to participating in groups like SHPE, Systers: Women in EECS, IEEE, and the Campus Entertainment Board. Earlier, they all enjoyed pre-college summer programs at UT.

"I always knew I wanted to do engineering, through programs like INSTEP," said Diane.

"The same summer that Diane did INSTEP, I did the MITES program," said Christine. "That was our first experience with UT engineering. Frances got to go to the Tennessee Governor's Academy for math and science when she was a junior in high school."

These introductions inspired them all to pursue engineering at UT, which has included a commute from their home in nearby Lenoir City.

"It helped all of us, because commuting is hard," said Diane. "But since we were all in the same ballpark, we all went home to the same home every night, we would make sure we were all on track. Now we don't carpool, because our schedules are a lot more different."

Frances blazed the trail as the first to graduate and now works as a microelectronics engineer at NSWC Crane with the Navy and Department of Defense in Indiana.

"To some degree I felt a sense of leadership and responsibility to guide my sisters into making advantageous academic choices," she said. **"I would try to help out with homework questions they might have or studying for exams whenever I could."**

"She definitely set the groundwork for us in understanding what's expected to be successful," said Christine. "It was hard transitioning from high school to college, but she definitely helped that transition go smoother since she experienced it before we did."

Diane and Christine both work at Einstein Bros. Bagels, offering them a good third space to commune over electrical engineering. They use Facetime to talk daily with far-off Frances. Both are already planning their summer.

"I'm going to do an internship this summer with US Cellular," said Christine. "I've done undergraduate research on power systems, so this will expand the umbrella of what I've done, because that's more telecommunications."

"I'm looking, for this coming year, to get a co-op," said Diane, who is working through the office of Engineering Professional Practice for that. "I am interested in the automotive industry."

Through studies, soccer, or careers, the Garcias' family bond and Volunteer Spirit should continue to serve them along whatever paths they decide.

WomEngineers Day
Continues to Inspire, Embolden Students


Barbie Bigelow

By David Goddard.
Photography by Jessica Tezak.

WomEngineers Day returned to UT for its third installment on April 13, bringing together students, speakers, and invited guests for a day designed to help engineering students of all genders navigate leadership, inclusion, and work-life balance.

"It was great to see all the people come out for this year's event," said Jess Ossyra (ChemE, '19), who helped plan and coordinate the conference. "We had a lot of interesting and important discussions, ones that should continue beyond the scope of just this particular gathering."

The conference—one of the first major events in UT's newly-opened Student Union—kicked off with a breakfast and keynote address by Barbie Bigelow (MS/CS '85) and included workshops, networking opportunities, panel discussions, and breakout sessions. More than 200 people took part.

The ever-popular breakout sessions offered three topical choices per session. This year, those included negotiating salaries, career planning, overcoming bias, and communication skills, among others.

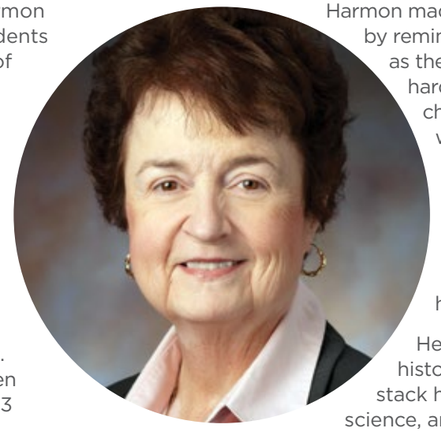
WomEngineers Day, held biennially, began in 2015 after students at the time attended a national conference and noticed the level of support other engineering colleges were giving their students.

Although the number of women studying engineering at UT has steadily grown in recent years and is on par with the national average, the college is still behind where it wants to be, so events like WomEngineers Day prove doubly important by not only helping students with personal growth, but also by building a sense of community that can lead to better retention and both personal and professional success for students both before and after graduating.

Patty Harmon Lit the Torch for SWE at UT

By Randall Brown.

Alumna Patricia (Patty) Stone Harmon (BS/ME, '78) and a few fellow students launched the UT student section of the Society of Women Engineers (SWE) in 1978 with an exhibit at that year's Engineers Day. They presented a history of women in engineering at UT, starting with the first woman to graduate from the college in 1944.



"The main focus of the project is to show what women in engineering have done," Harmon told a Knoxville Journal report at the time. In 1978 there were around 36 women graduating from the college, with 113 freshman women enrolled.

Harmon started thinking about SWE after becoming an officer of another student group, the Society of Engineering Science. She was aware of SWE on a national level, and thought it should be established at UT. Professor William Snyder, then head of the former Department of Engineering Science and Mechanics and later dean of engineering, encouraged her efforts.

"I mentioned it after class one day and several other female engineering students just said, 'Let's do it,'" said Harmon.

The number of women seeking engineering education and careers has steadily increased since she and her colleagues launched SWE at UT. Harmon is happy to see the rise at Pratt and Whitney, where she has worked for 40 years, and all around. She does her part to see that it continues.

"I have done countless STEM events, and co-chaired Girls in Aviation Day as part of my responsibilities as a founding member and past president of the Women in Aviation, International Connecticut Chapter," said Harmon. "I would like to see every girl and all young women be encouraged to consider engineering as a career."


The Knoxville Journal Friday, April 21, 1978 B-3

Members of the proposed UT section of Society of Women Engineers put finishing touches on their display, "History of UT Women in Engineering," to be presented today in conjunction with UT Engineers Day. Society members from left to right are Bonnie Gaines; Sarah Stone, president; Robbie Woods, vice president; and Jon Worley, treasurer.

UT exhibition to display feminine engineering skill

By ROSEMARY BATES
Journal Reporter

"Knowledge is the backbone of successful creativity. But stored, or securely filed in the attic, knowledge is of little value," the late Nathan W. Dougherty once said.

In keeping with its former dean's philosophy, UT's College of Engineering will display its knowledge today from 9:30 a.m. to 3:30 p.m. for Engineers Day with over 30 exhibits planned.

One exhibit, housed in room 414 of Ferris Hall, will focus on women in engineering and UT women engineering graduates.

"The main focus of the project," explained UT senior engineering student Sarah Stone, "is to show what women in engineering have done."

"We (UT's proposed section of the Society of Women Engineers) sent questionnaires to the 119 women who have graduated from UT College of Engineering since 1944," she continued, stating, "1944 was the first year for women to get a degree in engineering from UT."

Of the questionnaires returned, 90 percent of the graduates are actual engineers with the majority working for Union Carbide.

"In 1944," said Stone, "there was one woman engineering graduate and she graduated in Civil Engineering."

"In 1978 there should be 36 graduates," she said, "and currently there are 113 freshmen women enrolled in engineering."

UT being founded in 1874, engineering was not adopted into the UT curriculum until 1838 when a surveying course was offered. In 1877, a program in civil engineering was added and presently there are 11 different engineering majors.

Other displays to be presented today include automatic tape recorder control, a laser exhibit, electronic ping-pong, fish listening, and solar apple drying.

The College of Engineering will also offer six departmental tours during the day.

Concluding activities at 7 p.m. is an honors banquet for students in engineering. Presentation of the Nathan W. Dougherty Engineering Award and the M.E. Brooks Award are among highlights planned for the banquet.

Harmon made it through her engineering classes by reminding herself that she was "as smart as the average bear," and simply working hard at it. Her interest formed in her childhood when a lamp stopped working in her family home.

"I asked my mother if I could fix it," said Harmon. "She took me to the hardware store, we bought some new parts and wire and I fixed it. I fixed a lot of things around the house after that."

Her mother and an eighth-grade history teacher encouraged Harmon to stack her high-school courses with math, science, and a foreign language to be ready for any major she might choose. Her uncle, the late Knoxville physician Vernon H. Young, piqued her curiosity with a slideshow of artificial joints.

"I thought it was cool beyond measure," she said. Her goals solidified when her West High School class attended Engineers Day at UT. "In Perkins Hall, I saw a display for biomedical engineering—artificial hip joints and other joints. From that day on, I would list biomedical engineering as my intended major."

Her major shifted over time to engineering mechanics. She gained experience as a research assistant and freshman engineering statics and dynamics lab instructor while at UT. These jobs helped prepare Harmon for a career in building jet engines at Pratt & Whitney, where she has worn many different hats: structural analysis and testing, electronic controls, project management, material review, and more. She was even the first woman to serve as a field representative for the Air National Guard.

"I've had many roles, because I never wanted to do the same things over and over," she said. "Instead, I always looked for different areas in which to learn new things."

Through her unstoppable drive and spirit, Harmon continues to learn, teach, and shine a light on the possibilities for future Engineering Vols.

1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1. *A look at "The Hill" at East Tennessee University, which would become the University of Tennessee in 1869.*
2. *Students clean up campus in 1912 during an event that would became Engineers Day.*
3. *Ayres Hall is seen in this 1920s photo, which shows the original Morrill Hall at left, a YMCA building next, and Science Hall at right.*
4. *Ferris Hall in the 1930s.*
5. *UT Space Institute Director Bernhard H. Goethert speaks at its launch in 1967.*
6. *Dignitaries celebrate the opening of the Min H. Kao Electrical Engineering and Computer Science Building.*
7. *John D. Tickle stands with former Chancellor Jimmy G. Cheek, former Dean Wayne T. Davis, and former UT President Joe DiPietro in 2016 when the college was named in Tickle's honor.*
8. *An artist rendering of the new Engineering Complex.*


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University of Tennessee Turns 225

By David Goddard.

The Tickle College of Engineering has played a key role throughout the university's history. Here's a closer look at that legacy.

When the settlement of White's Fort was renamed Knoxville and made the capital of the Southwest Territories in 1791, two of the 64 half-acre lots that were surveyed were reserved for a future school.

In 1794, Blount College, named for William Blount, the first governor of the territory, brought that school to life, effectively creating the first public university west of the Appalachian Mountains.

Following a suggestion from former President Thomas Jefferson, the institution—now named East Tennessee College—purchased 40 acres of land in 1820 that is now known as "The Hill."

Surveying, the first engineering-related course, was offered in 1838, and by 1840, civil engineering had been added. From 1877 through 1895, engineering at UT became much more formalized, with bachelor degree programs in mechanical engineering and undergraduate and advanced degrees in civil and mining engineering, as well as the creation of an electrical engineering program.

Finally, in 1905, the courses were grouped together in the newly-minted College of Engineering with Charles Perkins serving as dean.

Many familiar aspects of the college began in the following years, including the first Engineers Day in 1912, the creation of the Engineering Professional Practice program in 1926, and the construction of Ferris Hall—now the college's oldest building—in 1930.

Doctoral programs in chemical engineering and metallurgy were established in 1951, with nuclear engineering—the oldest of its kind in the nation—added in 1957.

The last half century has seen the expansion of programs and disciplines, including the creation of the Minority Engineering Scholarship program, an aerospace engineering discipline, and the UT Space Institute. Research partnerships with labs such as Oak Ridge National Laboratory and Y-12 were also strengthened, while the construction of several new buildings continues to expand and improve the college's high-tech facilities.

Finally, in 2016, the college itself was renamed the Tickle College of Engineering.

While much has changed in the 225 years since the university was founded, the college has played—and continues to play—a large role in its journey.

Elsewhere in 1794

January 15: Congress changes the US flag to 15 stars and 15 stripes with the addition of Vermont and Kentucky. It would revert to 13 stripes in 1818, while updating with one star for each state.

February 11: The first US Senate session open to the public

March 27: Construction begins on the USS Constitution, nicknamed "Old Ironsides" for its role in the War of 1812. It is still on display in Boston Harbor.

July 28: French revolutionary leader Robespierre is executed, marking what is generally is accepted as the Reign of Terror where more than 15,000 people were executed in little more than a year.

October 4: President George Washington becomes the first—and to date, only—sitting president to lead troops into battle, helping end the Whiskey Rebellion.

November 19: The Jay Treaty is signed by the US and Great Britain, effectively ending British claims to the Northwest Territory, now the states of Ohio, Indiana, Michigan, Illinois, Wisconsin, and parts of Minnesota.

LIGHTING THE WAY

Although many disciplines fall under the broad umbrella of engineering, they all have the inherent common core of impacting and improving lives, from medical devices to manufacturing, from energy to the environment. Here, we take a look at several ongoing. innovative projects within the college and the various ways they are helping out society.

In the Great Smoky Mountains National Park, UT engineering professors and students are taking adventurous steps to ensure the quality of our water and air is in check.

A Lab with a View

By Andrea Schneibel.
Photography by Shawn Poynter.

At first glance, there is nothing particularly striking about John Schwartz's workstation. It's nestled high up on a ridge on the North Carolina side of the park, just southeast of Clingmans Dome. In one spot, a few white buckets collect water from the tree canopy. In another area, he manually cleans sediment out of a flume to ensure the quality of water samples.

And yet, the work that he and his students do at the Noland Divide Water Quality Station has implications in the everyday lives of millions of people: they monitor the levels of acids and other contamination present in the water that flows through the park.

Schwartz, director of the Tennessee Water Resources Research Center and professor of civil and environmental engineering, started working on this project 20 years ago when he first arrived at UT, but the project's beginnings can be traced back to 1991. The university, along with Oak Ridge National Laboratory, had begun participating in a federally funded program called the Integrated Forest Study, an international collaboration to explore the "effects of atmospheric deposition on forests' nutrient cycles," according to the DoE.

Since then, UT students and professors have been collecting and processing water samples every two weeks, and the research has morphed in a number of ways in an attempt to find answers to new questions.

"Imagine all the samples that we have collected for 28 years, every two weeks," said Schwartz. "That's a wealth of information."

Located on the line that divides Tennessee from North Carolina, the Noland Divide Trail sits at an altitude of about 4,000 feet. It is this height that makes it an ideal place to capture all sorts of pollutants coming from as far as the Midwest, says Schwartz.

"Power plants in Georgia, coal mining... All of these places emit chemicals that need to be checked periodically to better understand their effects on the diverse and fragile ecosystem that is the Smoky Mountains."

For this purpose, Schwartz and his students manage three collection points in Noland Divide.

The first one is known as the through-fall bucket site. Here, a series of buckets collect the water falling from the tree canopy. This gives researchers an idea of the pollutants that travel in the air and make it to the park.

At the second point, the team collects samples from a stream that travels through a flume, which provides detail on how the pollutants that travel via air are processed on the ground.

The third station is known as the open site. It's a small platform that holds a weather station in a clearing surrounded by trees. It has an automated water collection bucket with a lid that opens when rain is detected. Because the water doesn't touch tree leaves, the ground, or come from water streams, the information collected here acts as a baseline for the rest of the samples and gives scientists an insight on how much acid deposition clouds can carry.

It might seem like an underwhelming setting, but the data obtained here is very important. The quality of the water found in the park can tell researchers several things about the current state of the environment, including the very air we breathe.

In fact, Schwartz explains that there was an evident decrease in the levels of pollutants present in the park's waters between 2005 and 2008, when the Tennessee Valley Authority started using softer coal to fuel their operations and converted some of their plants to natural gas.

"Documenting these changes and trying to explain how and why they occur is vital," he said.

Very little of this work would be possible without the help of Schwartz's graduate students.

A mission for adventure-seekers

Schwartz's students find the research exciting and interesting, but say that the real treat is having the national park serve as their very own office, a perk that comes with breathtaking views.

To get to the sites, students drive about 90 minutes from the Knoxville campus, then hike about a mile through thick forest on what it is mostly an unmarked trail. To avoid drawing attention to equipment and experiments, the trail to the research station is unkept—in some places, the trail is overgrown with grass more than 4 feet high.

"It's one of the things that drew me to this job," said Taylor Blackstone, one of Schwartz's PhD students and current caretaker of the research site. "But it is not for everybody. You kind of have to be a natural explorer to like this."

For Blackstone, the real payoff of her work is being part of something much bigger than herself.

"It's just so rewarding to have the opportunity to do this work with the University of Tennessee," Blackstone says. "Doing research that can have such an impact on communities everywhere, and being able to contribute to a better, cleaner environment is a privilege to me."

Designed to Serve

By David Goddard.

The college's inaugural Senior Design Showcase took place April 25 at Thompson-Boling Arena. Hosting more than 125 teams from all disciplines, the event revealed the impactful work our seniors are doing for local non-profit organizations, small businesses, and others. Watch videos of the projects listed below as well as several others at **tiny.utk.edu/design**.

1

TRACE (Biosystems)

Josh Benavidez, Lindsay Brown, Macy King, and Bailey Langford designed a semi-automated method of removing floating garbage and debris from waterways through the use of specially designed skimmers and conveyors to lift the trash into bins. Once there, a sensor will alert city workers that there is trash to be collected.

2

Baker Creek Preserve Springhouse Restoration (CEE)

Charlie Cianciolo, Laura Ferrer, and Matthew Howard worked with Legacy Parks Foundation on the restoration and improvement of a historic springhouse on Baker Creek Preserve, an urban wilderness area in South Knoxville. The design uses a stormwater catchment system to reduce sediment downstream.

13

Bonecrusher (MABE)

UT's Department of Anthropology, including the world-famous Body Farm, asked Carter Breeding, Daelyn Greene, Nicholas Poker, Ryan Smith, and Zachary Ziegler to develop a way to better research blunt force trauma. The resulting "bonecrusher" simulates such damage to bones, helping them study patterns associated with breaking bones.

14

Craft Beer Production (CBE)

Balter Beerworks, a Knoxville brewpub started by biosystems engineering graduate Will Rutemeyer, challenged a team of Jake Jolley, Jess Ossyra, Seth Anderson, Adam Soper, and Justin Holliday to optimize dissolved oxygen in the company's beer, helping improve shelf life.

15

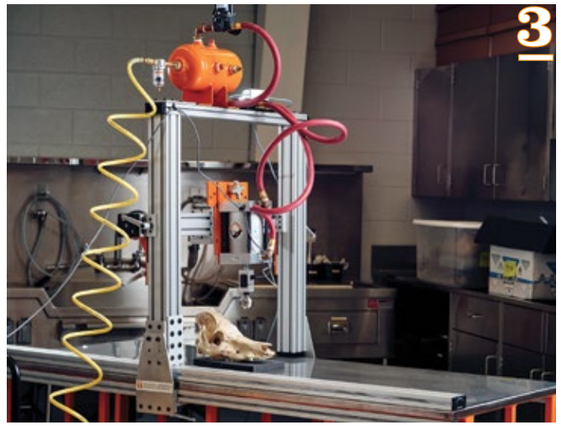
ICS Machine Safety Switch (EECS)

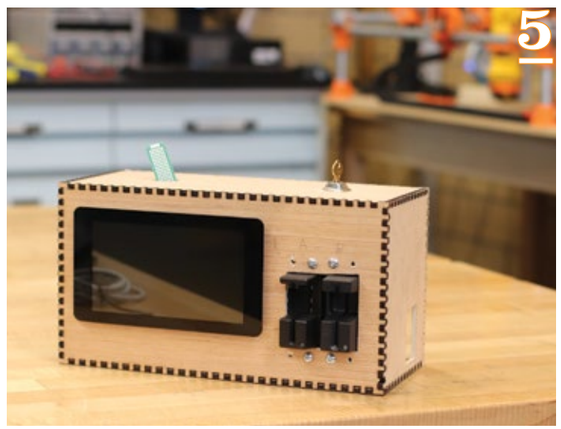
Michael Foust, Matthew Hoffman, Michaela Shoffner, Jonathan Redington, Jonathan Bueckman, and Feng Li tackled a safety-related issue for the college's Innovation and Collaboration Studio. The team designed a card-scanning system to ensure only permitted, trained users can activate and therefore use the heavy equipment and machinery available to students working on projects and prototypes.

16

T&T Scientific Inventory Tower (ISE)

T&T Scientific, a local biomedical company founded by a pair of MABE graduates, challenged Wesley Smith, Megan Reding, and Emily Lynch to come up with an inventory management system. The resulting design integrates inventory with replenishment and storage systems, as well as standardizing practices.





Engineering *for the Human Experience*

By Randall Brown. Photography by Shawn Poynter.

Professor Rupy Sawhney is a real people person. His open, friendly demeanor, and welcoming voice inspire engagement whether chatting about the weather or discussing the effectiveness of systems engineering approaches.

His systems approach and research seek to better integrate engineering with the needs of the people involved.

"Sawhney is an exemplary faculty member who always focuses on the human being," said John Kobza, head of the Department of Industrial and Systems Engineering. "Whether it is the community member or worker whose environment and quality of life are improved by his research, the student he mentors, or the faculty colleagues he partners with to move the department forward."

Beyond his teaching duties, Sawhney works with area industry and maintains multiple nonprofit and pro-bono projects, including participation with the Knoxville mayor's council for disability initiatives. He happily shares credit with a community of collaborators.

"I have a group around me that helps me, so all of this is not just me doing it," said Sawhney. His team within the Center for Advanced Systems Research and Education (CASRE) works to increase the effectiveness of systems while helping the people involved maintain quality in their lives as an integral criteria of the systems' design.

"Part of it is that people say the number one place where people get under stress is at work," said Sawhney. This mental stress can take a toll, and result in health crises such as opioid use, drug and alcohol abuse, and depression.

"So, what we've come up with is a research compliment of a model that is much more compassionate."

Five pillars support this model. The research seeks to establish a "system design with a soul," an alternative operational model that focuses on systems, reliability, and human motivation and behavior. That first pillar is reinforced via real-world testing—using industry as a laboratory and bringing together parties in a symposium to share ideas. That is followed by the development of innovative educational models, building an international community through participation, and offering socially responsible support to local and regional communities.

"It's better integrating engineering with people—more of an integration with the social aspects, the psychological aspects of humans," said Sawhney.

The CASRE team presented research earlier this spring to show how they were able to increase the productivity of a facility by around 70 to 80 percent, yet allow the 200 to 300 employees there to actually work less. They have also developed multiple teaching opportunities that work with their model.

These collaborations with community and industry—and the pro-bono work with area non-profits—allow for a "living laboratory" element to the ongoing research.

"Our courses that we teach within ISE are part of that process," said Sawhney. "So, our students are getting material that's not out of a book, but it comes from a very unique experience."

It all adds up to an expression of the Volunteer Spirit than enriches both the education of Engineering Vols and numerous lives beyond campus.

Engineering *Electrical Equality*

Writing and Photography by Randall Brown.

Chien-fei Chen holds a unique position in the spectrum of UT engineering research. She is an environmental sociologist, a research associate professor in electrical engineering, and serves as the director of education and diversity for CURENT, an NSF and DoE Engineering Research Center.

The sociological approach of her work helps add a human element to CURENT's overall focus on improving the world's power grid.

"My research centers on bridging the gap between social and technical sciences in energy efficiency issues regarding energy justice, energy policy, pro-environmental behavior, and renewable technology adoption," said Chen.

She pursues both formal and informal field work, including personal observations, reading, and discussions with local residents and researchers from different countries.

"I want to build on this experience and have an impact on academic and underserved communities such as low-income communities," she said. "Energy inequality or poverty is one of the most pressing issues in a modern community."

Her work drew widespread attention this year when she was selected as one of 20 Fulbright Global Scholars from across the country. Her proposal, "When East Meets West: An Interdisciplinary and Cross-Cultural Research on Energy Justice and Renewable Technology Adoption for Future Smart Communities," focuses on energy needs and uses across social lines.

"This research will focus on low-income communities in China, the UK, and the US," said Chen. "I will conduct an integrated analysis of social, behavioral, environmental, and technical impacts by using qualitative and quantitative methodology and integrated analysis and modeling rooted in social-psychology, engineering, and computer science."

Her goal is to better understand the complexities of social practices and technology adoption across cultures, while improving strategies to solve energy-efficiency problems, combat global energy-inequality issues, and inform public policy.

"Renewable energy technology is growing fast, but it also raises pressing justice issues related to equity and fairness," said Chen, noting the strong and increasing interest throughout academia, industry, and policy makers in these areas.

"The Fulbright will allow me to extend my current interdisciplinary collaboration by focusing on cultural and energy behavioral differences between the eastern and western societies, especially among the vulnerable communities," she said.

"More importantly, understanding people's daily energy practices and barriers in the western and eastern societies could influence local policymaking as well as cultural understanding."

Fighting an Epidemic

A new device aims to reduce hospital expenses when caring for patients with a history of IV drug use.

By Kathy Williams. Photography by Shawn Poynter.

As hospitals across the country see an increase in patients addicted to heroin and other injectable opioids, they're also facing new treatment challenges: patients with a history of intravenous drug use who bring illegal drugs into the hospital to inject directly into their vascular access lines, which transport the drugs directly to their heart. Such behavior can cause an infection resulting in prolonged hospital stays, surgery, or even death.

"This leads to high costs for the hospital due to such infection rates counting against the hospital, which can reduce the hospital's medical reimbursement," said Matthew Mench, head of the Department of Mechanical, Aerospace, and Biomedical Engineering in UT's Tickle College of Engineering. "Many in this patient population are uninsured, and the hospitals keep them in the facility for longer periods of time thereby losing a tremendous amount of money."

The University of Tennessee Medical Center (UTMC) was one of the hospitals facing the problem.

"At the quality improvement meetings at UT Medical Center, I heard many times that we were having problems with patients and their families accessing their IV lives with substances brought into the hospital," said Mitch Goldman, assistant dean for research in the Graduate School of Medicine. "So my first thought was 'Why don't we just stop them by putting the access points in a box with a lock?'"

Realizing in 2016 that there was nothing on the market to help, Goldman came to Mench to try to solve the problem.

Mench began devising a concept for a transparent tamper-evident box that closes around the vascular access line interface using a pin connection. With feedback from nurses, he 3D-printed a prototype then spent several months refining the design. Associate Professor Chad Duty and Rosenberg Associate Professor of Practice Matthew Young helped perfect the design by adding a key innovation: an internal chamber to catch the ends of the colored pins, showing clear visual evidence of tampering.

With the help of the UT Research Foundation (UTRF), the device, named the TEL BOXX, went to market in September 2018 and is now used in 11 hospitals across eight states.

"The fact that it has gained acceptance is an example of true teamwork in translational medical research—confronting a problem, looking for solutions, testing the solutions, and bringing them to clinical use," Goldman said.

The invention is the only product available that can be used while the vascular access line is being actively used to administer medication. It covers any interface points that can be tampered with, does not crimp or leave residue on the line, and can deter some patients from tampering with the line.

"A high-risk patient, who we always suspected of tampering with the line, left the facility within a couple of hours," said a nurse in Pennsylvania. "The box sent a clear strong message to him to keep away from the line."

"Evidence of tampering is all the facility needs to document suspected injecting, somedical reimbursement rates may not be affected," said Mench. "It also allows the hospital to free up space by transferring these patients from the hospital to a skilled nursing facility or ambulatory clinic so the patient can get daily medication as an outpatient."

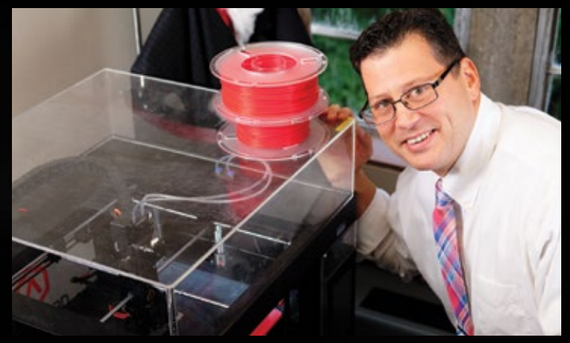
"It is a team effort working towards commercialization of the TEL BOXX from its inception, addressing a current and relevant market need," said UTRF Vice President Maha Krishnamurthy.

Having the TEL BOXX be successful is a satisfying feeling for Mench and aligns with everything he loves about his job—being creative and helping people.

"The TEL BOXX is a device with real market value and it allowed me to do some inventive engineering, which I love," said Mench. "Most importantly, as an engineer, I always want to impact humanity in a positive way."

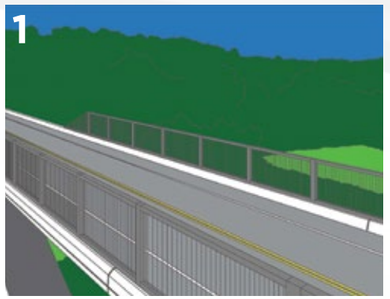
The product portfolio has since been expanded to include several different sized boxes, each one tailored to meet a specific need to provide evidence of tampering at a controlled access point. UTRF already has two issued patents with another four pending, and the next-generation design is in the works. The new design is based on customer feedback and will be much less expensive to produce, more comfortable for the user, and easier for medical staff to use.

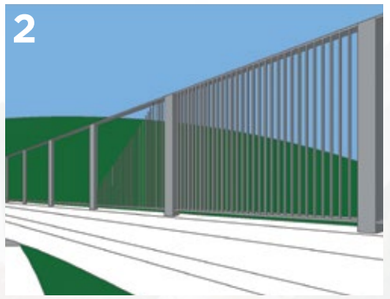
In the meantime, Krishnamurthy and Mench are looking to partner with a medical supplier to manufacture and sell the TEL BOXX in the hopes that the device could soon be helping hospitals refocus on patient care and recovery.

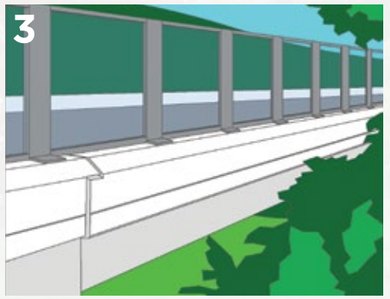


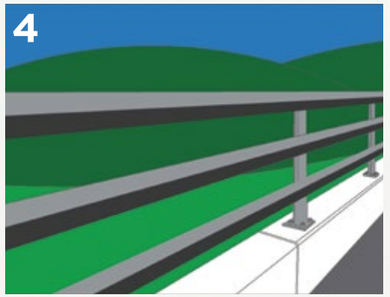
Natchez Trace Bridge Update:
Students Submit Designs

By David Goddard.









The National Park Service approved $1.2 million in federal funding in August for a feasibility study of designs meant to improve safety on the Natchez Trace Parkway Bridge, moving a senior design project in the Department of Civil and Environmental Engineering one step closer to possible implementation.

Working in response to a request from the Natchez Trace Bridge Barrier Coalition and under the guidelines of the NPS, the team developed four designs that seek to curb suicide attempts from the bridge.

“Instead of broadly trying to cover a number of proposals, we now hope to focus on providing designs as they relate to the impact on safety, material constraints, and the look of the bridge,” said CEE Senior Lecturer Jenny Retherford, faculty advisor on the project. “For example, a design might offer the best protection but be cost prohibitive, or might be the least obstructive on sight lines but at a loss of strength.”.

The four designs the team had previously explored are:

1: Cable Barrier Concept: Includes rectangular sections of metal featuring vertical cables along the span

2: Fence Barrier Concept: Much like a standard property fence, features metal strips spaced far enough apart to still allow a view of the valley

3: Plexiglass Barrier Concept: Instead of spaced metal planks, uses plexiglass to completely cover areas between posts without obscuring any of the view

4: Standard Highway Barrier Concept: Likely the easiest to implement, features the same three-decked barrier seen along many interstates.

The double-arch bridge, just outside of Franklin, Tennessee, is one of the most famous sites on the nearly 450-mile-long route, but has seen more than 30 suicides where people jumped to their death from its span.

Railings on the sides of the bridge—built at only 32 inches so as to not impede the view from cars—are believed to be a factor in the ease at which attempts can be made, thus making them a focus of UT’s project.

Tennessee politicians helped the cause get to this point, with both chambers of the Tennessee General Assembly unanimously passing a bill declaring the bridge to be a danger, and Gov. Bill Lee speaking out in favor of new barriers.

Man With A PlanA

(L–R) Clare Remy, Westena Anderson, Dru Rainer, Grant Kobes, Buddy Swan, Eli Charles, Craig Wiley

When industrial engineering student Grant Kobes founded UT’s competitive robotics team in the fall of 2017, his vision was two-fold. First, he sought to provide an opportunity for engineering students across all disciplines to practice the engineering design process first-hand. His team now accomplishes this objective with world class precision in the college’s Innovation and Collaboration Studio. His second goal was to increase interest in STEM among students in the Knoxville community through competitive robotics.

“I want to get young students onto the Tickle College of Engineering campus where they can collaborate with each other using all the incredible resources that UT offers,” said Kobes.

What started as part of Kobes’s four-year project through the UT Honors Leadership program has rapidly expanded over the past two years to include students from multiple engineering disciplines and various years of study.

“The most unexpected result of participating in competitive robotics is discovering a new interest or talent a student was never aware of,” Kobes revealed. “I love watching my teammates challenge themselves in new ways, whether it be creating a novel part in CAD or learning to use a new machining tool in the ICS. When our team began two years ago, I was the only member with robotics experience. Now, we have a room full of capable designers, builders, and programmers.”

In addition to competing, Team YNOT gives back to the community through volunteer work at robotics events around the state.

“Our team members serve as either judges or referees for the competitions, helping things to run smoothly for participants,” he said.

Over the past year, several members of Team YNOT received service medallions through UT’s Jones Center for Leadership and Service for their individual contributions of over one hundred hours of community service, largely at Vex events. The team is also dedicated to mentoring younger teams from around the state.

“Our goal is to forge relationships with these gifted young engineers who will make perfect candidates for the engineering program at UT in the near future,” Kobes explained. “VEXU is a natural progression from middle and high school robotics programs. Kids who excel in this discipline in secondary school are very excited about the opportunity to continue their robotics careers at the college level,” Kobes admitted. At present, UT has the only VEXU team in the state.

Grant and the team have made a name for UT in the short two years of their team’s existence, qualifying for the annual Vex Robotics World Championship and bringing home a coveted award from the event both years.

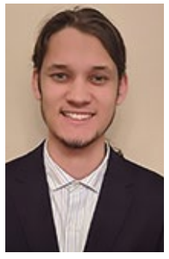
“The most exciting part of Worlds is connecting with teams from around the globe that we regularly collaborate with during the season,” shared Kobes. “It is gratifying to see our designs and strategies utilized on robots from many nations; however, the most gratifying moment is welcoming middle and high school teams from around the state of Tennessee that we have mentored to their first world championship!”

Student Notes

Recent ISE graduate **Joey Reilman** (BS/ISE, '19) had a standout performance at the 2019 Southeastern Conference Swimming and Diving Championships in February. Reilman finished the four-day meet with five total medals, including a win in the 200 backstroke with a personal-best time of 1:38.97. He added a silver medal in the 200 freestyle and a bronze medal in the 100 backstroke, setting school records in both events. Reilman's final two bronze medals came representing UT in both the 200 and 400 freestyle relay events.

UT placed fourth at the 2019 Southeast Regional Steel Bridge Competition, held in March. Student teams from across the southeast were challenged to design, fabricate, construct, and load test a roughly 1:10-scale model steel bridge that must be 20 feet long and be able to withstand a load of 2,500 pounds. Team members from CEE included **Andrew Shahan**, **John Stanford**, **Peyton Mize**, **James Hegedus**, and **Francisco Lemus**. CEE Assistant Professors Tim Truster and Mark Denavit served as faculty advisors.

Ian Greeley



Carl Edwards

Rising seniors **Ian Greeley** (MSE) and **Carl Edwards** (CBE) were named as 2019–2020 Goldwater Scholars this past May. The most prestigious undergraduate STEM scholarship in the United States, it is awarded to college sophomores and juniors who intend to pursue research careers in the natural sciences, mathematics, and engineering. Edwards is an honors computer science and honors mathematics major. He has done research at ORNL and through EuroScholars at the University of Zurich in Switzerland and plans to attend graduate school. Greeley also plans to attend graduate school and wants to conduct research in functional materials for energy storage applications. He has worked for two years at UT's Scintillation Materials Research Center studying novel scintillators (materials that exhibit luminescence triggered by ionizing radiation) for radiation sensors and imaging systems.

At this year's American Institute of Aeronautics and Astronautics Region II Student Conference in Cocoa Beach, Florida, UTSI student **Alicia Sherrod** took second place in the Masters Category on her paper and presentation entitled "*Simulation of Langmuir Probe Response to a Non-Maxwellian Plasma*."

Four engineering freshman were named to the 2019–2020 class of Haslam Scholars. The students include **Caleb Ellis**, **Sreya Kumpatla**, and **Jessie Li** from Tennessee along with **Leah Gutzwiller** from Ohio. Haslam Scholars receive scholarships to cover tuition, fees, and housing as well as funding to support independent research.

Alex Weber, Makenzie Swicegood, and Brad Bennett

EE students **Alex Weber** and **Makenzie Swicegood**, and CBE junior **Brad Bennett**, combined to earn a second-place prize in last spring's VolCourt pitch competition for Backdoor, a smartphone application to help pet owners track lost pets. The team received $1,000, office space in the UTRF Business Incubator, legal advice from Morehous Legal Group, and design services from Innovative Design Inc.

A team of MABE students competed at this summer's NASA Mars Ice Challenge. One of only nine teams chosen for the finals, members included **Brian Coulter** and **Alex Twilla**. This year's iteration of the competition was called Revolutionary Aerospace Systems Concepts—Academic Linkage (RASC-AL) Special Edition: Moon to Mars Ice and Prospecting Challenge. It highlights an area of great importance to NASA's future plans—the ability to make use of lunar or Martian water sources.

(L–R) Brian Coulter (Sr., AE) and Alex Twilla (Jr., CompE).

NE senior **Robert Corrigan** wrote about the role the American Nuclear Society (ANS) Student Conference has in shaping the future of nuclear. The piece was published in the April issue of ANS Nuclear Cafe. The article, entitled "*VCU Student Conference Empowers Tomorrow's Leaders*," examines both the 2019 ANS Student Conference and its impact on the industry's youngest members.

MSE junior **Logan White** recently won the 2019 Robert L. Snyder award, sponsored by the International Centre for Diffraction Data (ICDD). He will give an oral presentation at this year's Denver X-ray Conference. The title of his talk is "*In-Situ Synchrotron X-ray Computed Microtomography and Diffraction Investigation of Deformation and Fracture Behavior in a Laser Powder Bed Fusion Processed 316L Stainless Steel*."

Setting Sail on the Entrepreneurship

Writing and photography by Randall Brown.

The Engineering Entrepreneurship minor and related classes are designed to give students the skills to create economic value from their technological ideas. H. Lee Martin, professor of practice in the Department of Industrial and Systems Engineering, coordinates the program and teaches its key classes. Brooke Ballard is a chemical engineering major working on two minors: entrepreneurship and Spanish. They met to talk about the program from both the student and faculty side.

TCE: Professor Martin, what do you seek to accomplish with the entrepreneurial minor and related courses?

Martin: The very fundamental thing I seek to accomplish with these students is to inspire them. What I seek do to is expose them to area entrepreneurs that have actually matriculated through UT, many from the college of engineering, and let them see that the American Dream is alive and well right in our own community.

TCE: Brooke, how has the program enhanced your experience?

Ballard: It really helps to change the way you tackle problems. Not only do we have to think about "How do we solve this technical problem," but with entrepreneurship, "How do we make it feasible." That's probably the biggest thing: the different way of thinking and how to take an idea and make it profitable.

Martin: We want to say, "What's the value in making it work?" It brings in the economics of it, it brings in the marketing of it, it brings in finding the need and filling it. We're trying to broaden the engineers to have a little bit different perspective of what they ply their wares with.

TCE: Brooke, what are the best things you've derived from asking, "What is the value?"

Ballard: It helps me discern what solution would be best, for whatever the problem may be. Is it worth solving? Is there a different problem that needs solving more? Really not just, "here's a problem, let's solve it like this," but looking at it with different hats. Especially in a globalizing society, there are different perspectives, and to think globally is really a skillset that is needed for our future leaders.

TCE: What are some ways students would apply these lessons professionally?

Martin: There are two paths there. One might be called "intrapreneurship." It's being in a company and understanding how you work with all these different factions to gain cooperation and success. The other is to start your own enterprise. We focus in on writing small business, innovative research proposals to teach students—particularly technical students—the art and science of writing a funding proposal.

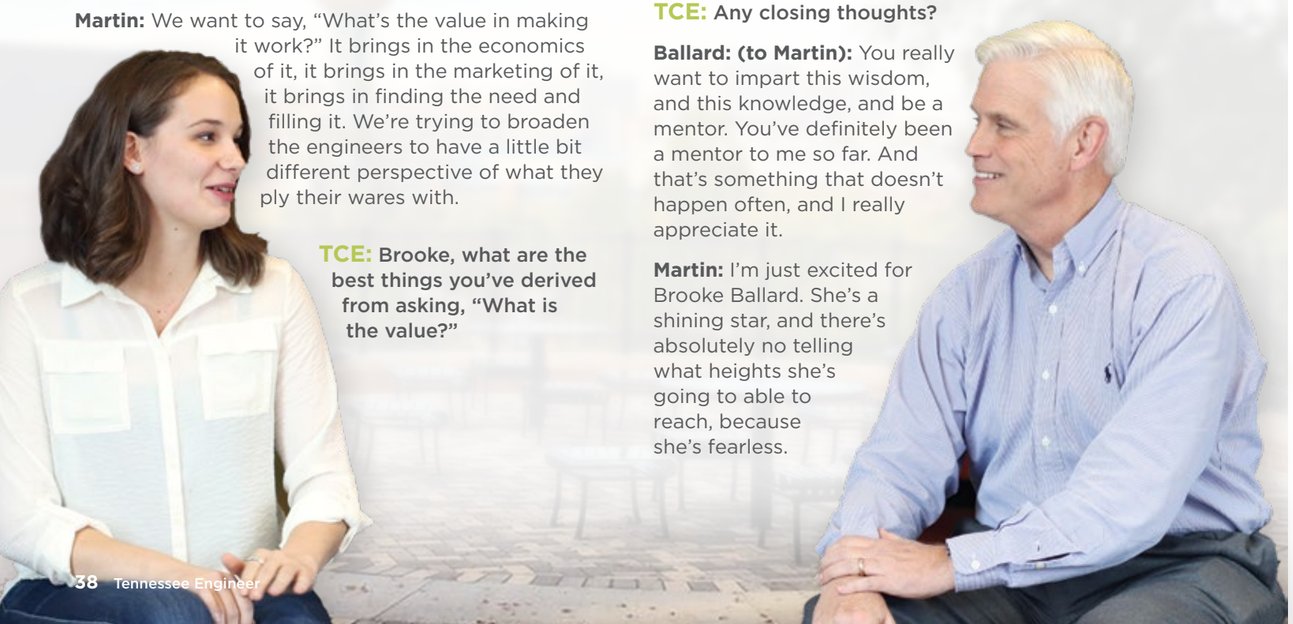
TCE: Brooke, is there a project in your current studies that you hope to tie in entrepreneurially?

Ballard: Yes. My plan after graduation is to be a project or a process engineer. Within that, economics is a huge part. With the entrepreneurial skills, I'll be able to think about it with more than just the numbers, but with the different types of benefit that can come from it.

TCE: Any closing thoughts?

Ballard: (to Martin): You really want to impart this wisdom, and this knowledge, and be a mentor. You've definitely been a mentor to me so far. And that's something that doesn't happen often, and I really appreciate it.

Martin: I'm just excited for Brooke Ballard. She's a shining star, and there's absolutely no telling what heights she's going to able to reach, because she's fearless.



Faculty Notes

Granger and Beaman Distinguished University Professor and Department Head **Bamin Khomami** (CBE) was recently elected as a fellow of the Society of Rheology (SoR). The SoR Fellowship status recognizes a history of distinguished scientific achievement, a significant technological accomplishment, and/or outstanding scholarship in the field. Khomami will be inducted at the Society Banquet during the 91st Annual Meeting of the Society, to be held this October in Raleigh, North Carolina.

Department Head **Veerle Keppens** (MSE) was named a Chancellor's Professor by UT Chancellor Donde Plowman, one of the highest faculty honors at UT. Keppens joined the department in 2003 and was named its leader in 2015. She earned her bachelor's and doctoral degrees from Katholieke Universiteit Leuven in Belgium in 1989 and '95, respectively, and has previously been awarded both Fulbright and Humboldt fellowships for her work.

Assistant Professor **Steven Abel** (MABE) was nominated by students to receive an Undergraduate Research Faculty Mentor of the Year Award. Recipients must have been nominated by multiple students and at least one of those students must have presented at EURēCA.

Associate Professor **Jon Hathaway** (CEE) received the Environmental Leadership Faculty Award from UT's Committee on the Campus Environment last spring. He was honored for his previous work with the UT Green Fee and the dedication he shows to students in bringing them into his work on water resources engineering. The UT Chapter of Phi Eta Sigma National Honor Society also recognized Hathaway for his exceptional contributions as a faculty member with their Outstanding Faculty Award. The award acknowledges a faculty member for going above and beyond in the classroom to make lasting positive impacts on students.

Professor **Garrett Rose** (EECS) received a grant for a project proposal called Reconfigurable and Very Efficient Neuromorphic System (RAVENS). The award is for $1.5 million over 3 years and is sponsored by the Air Force Research Laboratory. RAVENS aims to be an energy-efficient neuromorphic architecture specifically tailored for control and other spatio-temporal applications commonly implemented with resource-constrained computer systems.

The American Association for Crystal Growth has announced Assistant Professor **Mariya Zhuravleva** (MSE) as their president for the next four years beginning August 2. SMRC Research Associate Merry Koschan will serve as the secretary. The AACG was founded in 1969 and has approximately 600 members.

Professor **Ken Kihm** (MABE) was one of three faculty members to receive an Open Education Award from UT's Student Government Association due to his use of Open Educational Resources in the classroom. A comment from one of his student nominators included, "...it simplified the learning experience. Dr. Kihm is an excellent professor and tries to provide as many resources as he can to maximize success."

TCE's Office of Engineering Diversity Programs received a Bronze Level Award for the 2019 ASEE Diversity Recognition Program this summer. The program was created to publicly recognize engineering programs that make significant, measurable progress in increasing the diversity, inclusion, and degree attainment outcomes for their program.

Postelle Professor and Department Head **Wes Hines** (NE) was awarded the Arthur Holly Compton Award in Education at the American Nuclear Society's (ANS) annual meeting in June. This lifetime achievement award recognizes outstanding contributions to education in the field of nuclear science and/or engineering and is given by the Training and Workforce Development Division of ANS.

Professor **Rupy Sawhney** (ISE) was presented with the Educate Honoree President's Award by UT Interim President Randy Boyd in March for his significant impact on the educational experiences of students at all levels. Sawhney has developed academic programs for high school, undergraduate, graduate students, and industry professionals. He has encouraged countless young people to pursue a career in STEM.

Professor **Ozlem Kilic** (EECS) was named associate dean for academic and student affairs in May. She replaced Masood Parang, who retired in July. The position oversees a variety of programs, including undergraduate and graduate curricula and the offices responsible for the college's diversity, study abroad, advising, recruiting, and scholarship and fellowship programs, among others. Kilic comes to UT from The Catholic University of American in Washington, DC, where she founded the Electromagnetics and Remote Sensing Laboratory center and served as Associate Dean of the College of Engineering.

DEAN'S IMPACT

Will Last Far Beyond Year as Interim

By David Goddard. Photography by Shawn Poynter.

If you don't think that a lot can happen in a year, just ask Mark Dean. He recently wrapped up just shy of a year as interim dean of the Tickle College of Engineering, having made many positive impacts during that tenure that will resonate through the college for years to come.

While the role came unexpectedly to him, years of managing research organizations at IBM helped prepare him to lead his alma mater in its time of need.

"Running a college is a lot like being in charge of research at a major technology company like IBM," said Dean, who served as the John Fisher Distinguished Professor in the Min H. Kao Department of Electrical Engineering and Computer Science prior to the appointment. "There are seven leadership styles, and the key is knowing what style to leverage in a given situation. You have to be willing to listen and understand each situation, to support and answer to your stakeholders, and to compromise and get buy-in whenever possible."

He said that aside from the teaching component at a university, the experience of working with a large number of doctorate-holding team members, initiating cutting-edge research in answer to current problems, and helping fill the needs of those funding the research—whether funding agencies in academia or outside partners in the business world—were very similar and helped ease his transition to serving as interim dean.

In turn, Dean was able to more rapidly get down to the "nuts and bolts" of running a college.

As dean, he eagerly assumed opportunities for increased interactions with students and student organizations.

"When I came to UT from IBM in 2013, one of the biggest draws for me was the chance to work with students, to help them see new possibilities and to dream up new ideas, and to help shape their educational and career paths," Dean said. "I love working with students, interacting with them, and hearing their ideas. They are our future."

An added value of talking to students, according to Dean, is their tendency to speak their minds. Even if it can sometimes be blunt, hearing a student's perspective can lead to new ideas and solutions—something Dean particularly likes. He regularly encourages students to ask questions since they often bring up points that faculty haven't considered.

The importance of getting varying perspectives is driven home by Dean's observation on the impact that engineers have on the world.

"Other lines of work might impact a few hundred people's lives in the course of their career," Dean said. "But an engineer? An engineer, by default, is dealing with things like bridges and roads, power and water, aircraft and vehicles, computing devices and applications—the kinds of things that impact thousands if not millions of people. People depend on engineers to get it right, and to get it right the first time. The impact engineers have cannot be overstated, so it's critical that we consider as many ideas and views as possible."

Other projects Dean is proud to have accomplished during his tenure include:

- Creating a college-wide Senior Design Showcase
- Establishing a once-a-semester Dean's Open Forum with students, staff, and faculty
- Expanding the Summer Bridge program
- Integrating communications and marketing efforts at the college level
- Hiring two associate deans and several other college administrators

While he is happy with the legacy he leaves behind, Dean said that a scrapbook of memories contributed to by faculty, staff, and students from around the college will serve as a constant reminder to him of the work he did and the relationships he built during a "special year" in his life.

Alumni Notes

Five recent 2018 civil engineering graduates were recognized last fall for their aesthetic design of a timber transmission tower in a competition hosted by Aesthetic Competition Series. **Morgan Jenkins**, **Williams Kin**, **Matthew Livesay**, **Liliana Porras**, and **Trenton Wiles** teamed up to engineer a design that meets an aesthetically pleasing built environment. Their winning design was selected over other submissions by industry professionals. The prize came with $10,000, $1,000 of which the team donated to the 2019 SE-ASCE Conference UT hosted this past March.

Robert Wunderlich (BS/EE, '80, MS/CE, '82), director of the Center for Transportation Safety at the Texas A&M Transportation Institute, received a Public Service Award in April from the National Highway Traffic Safety Administration for his dedication to saving lives by championing data-driven traffic safety initiatives. He also recently received the Institute of Transportation Engineers' Burton W. Marsh Distinguished Service Award for several years of outstanding contributions to the advancement of ITE. He previously served as ITE's international president.

Isaac B. Mitchell (BS/ISE, '05) was elected president of the Board of Directors for the Institute of Industrial and Systems Engineers Society for Health Systems. In this role, Mitchell will advocate for the application of industrial and systems engineering principles in healthcare along with leading the organization's strategic efforts to improve health systems and patient outcomes. He currently serves as director of operations at DeRoyal Industries working on RFID-enabled healthcare solutions.

R. Michael Evans (BS/CE, '98, MS/CE, '00) was announced as president/CEO of Rembco Geotechnical Contractors, Inc., in August. Bivens had served the company as Chief Engineer since 2012.

Matthew Gordy (BS/ChemE, '18) was the lead author on a paper titled "H3PO4 Production Process Utilizing Phosphatic Clay as Feed Material," that was recently published in Mining, Metallurgy & Exploration. Gordy followed up on work that began as part of his 2018 senior design project. The article's co-authors are Robert Counce, Patrick Zhang, Rasika Nimkar, and Jack Watson.

Dwight Hutchins (BS/ChE, '86) was re-elected by the Board of Governors of the American Chamber of Commerce in Singapore (AmCham) as chairman for a record fourth term, making him the longest serving chairman of AmCham since its establishment in 1973. He will focus on US-China trade and hosting the Business Summit of Asian Chambers next year.

Tony Shipley (BS/IE, '69) was recently named chairman of the Angel Capital Association. He is also the founder and president of Queen City Angels in Cincinnati, Ohio.

Recent graduate **Annabel Large** (BS/ChemE, '19) is currently in Sweden on a 10-month collaboration between ORNL and the Swedish University of Agricultural Sciences in Alnarp. Large was named a 2019-20 Fulbright Scholar and upon returning stateside will tackle the joint bioengineering PhD program at the University of California at Berkeley and UC San Francisco.

NEW ENGINEERING COMPLEX CONSTRUCTION

1: By June 2019, multiple floors were underway and started showing the layout of the building.

2: The new foundation meets the southeast slope of The Hill, merging the latest in engineering technology with the most enduring Volunteer traditions.

3: Workers performed precision acrobatics in tandem with a mighty boom arm to pour the many support columns.

4: Workers prepare the complex lattice of rebar to hold the new building's substantial concrete foundation.

5: The groundwork was done and the new building's foundation began to take shape by May 2019.

6: These thick concrete walls will house new research capabilities for nuclear engineering.

In Memoriam

James Douglas Baird (BS/ME ’69),
January 13, 2019

Sidney Blalock (BS/CE ’61),
July 8, 2019

Raymond Leslie Boles
(BS/ChE ’62, MS/ChE ’65, PhD/ChE ’67),
May 22, 2019

James Brasier (BS/IE ’55),
April 12, 2019

Anthony Thomas Burgess (BS/CE ’92),
April 26, 2019

Gary Lee Cormany (BS/EE ’62),
May 28, 2019

Clyde (Pete) Wesley Craven
(BS/NE ’61, MS/NE’63, PhD/ES ’65),
June 2, 2019

Phyllis Underwood Cox (BS/IE ’85),
May 9, 2019

Charles Stuart Daw (PhD/ChE ’85),
July 2, 2019

Walter Howard Delashmit (MS/EE ’68),
February 14, 2019

Robert Hamilton Dilworth III (BS/EPh ’52),
April 13, 2019

William Patrick Ditmore (BS/CE ’55),
April 1, 2019

Paul D. Driscoll (MS/PolyE ’86),
March 26, 2019

William (Sonny) Dupree (BS/CE ’55),
May 5, 2019

David Eissenberg (MS ’63, PhD/ChE ’72),
March 30, 2019

Robert Jackson Guthrie (BS/ME ’51),
February 18, 2019

Clarence Hall (BS/EE ’63),
September 21, 2018

John Rickman Holland (BS/EE’ 60),
March 20, 2019

Richard Lea Humphrey (MS/ME ’61),
May 4, 2019

Robert O. Johnson (PhD/ES ’84),
March 25, 2019

Thomas L. Mayes Jr. (BS/EE ’49),
April 2, 2019

James Eugene McBride (BS/EE ’62),
December 8, 2018

Joseph Benjamin McCabe (MS/NE ’14, PhD/NE ’15),
May 24, 2019

Olie B. McCoin Jr. (BS/CE ’66),
April 12, 2019

Stanley Yates Merritt (BS/EE ’52),
May 8, 2019

Edward L. Milsaps (BS/EE ’53),
April 20, 2019

Robert T. Pope (BS/IE ’70),
June 4, 2019

Charles Joseph Shaw (S/E ’80),
April 25, 2019

Gene Clark Smelser (BS/ChE ’60),
May 10, 2019

Paul E. Stone (BS/ChE ’66),
February 22, 2019

James Victor Van Sandt (BS/EPh ’81),
March 15, 2019

Elliot Christopher Vaughn (BS/IE ’17)
August 6, 2019

Marvin Newton Willis (BS/EE ’76),
April 19, 2019

Lynn York (BS/ME ’59),
March 27, 2019

Joe E. Zimmerman (MS/EE ’66),
April 7, 2019

Tyler Matthew Zimmerman (BS/ME ’11),
March 15, 2019

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THE UNIVERSITY OF TENNESSEE, KNOXVILLE

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tickle.utk.edu

utk.tce
@utk_tce
@utk.tce
linkedin.com/schools/utk.tce

A new device aims to reduce hospital expenses when caring for patients with a history of IV drug use.

Page 32.