MOMENTUM

Spring 2020 • Alumni Newsletter

MECHANICAL, AEROSPACE & BIOMEDICAL ENGINEERING

BANDING TOGETHER

UT helps produce face shield components to protect medical professionals during the COVID-19 pandemic

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University of Tennessee Mechanical, Aerospace & Biomedical Engineering

On the cover: 3D printers are being used to produce the headband component of face shields to protect medical professionals in Tennessee.

From the **Department Head**

Dear Alumni and Friends of MABE,

Thank you for reading the spring 2020 issue of our alumni magazine.

As some of you may already know, during Matthew Mench's interim role as the Vice Chancellor for Research until later this year, I was asked to lead our department as the interim head. What an honor it has been to serve our students, staff, and faculty in this role.

We, as a nation, have had some challenges during these difficult times due to the COVID-19 outbreak. As you may imagine, many things quickly had to change on campus to keep our campus community safe. Within ten days, the entire university had to move all classes online, our students had to move off campus, and we had to adjust to the new reality of social/physical distancing, which meant staff and faculty having to work remotely. However, I am most proud of our students, staff, and faculty for stepping up to the plate and demonstrating their true Volunteer Spirit while getting through these uncertain times together. First, a big shout-out to our students for hanging in there and even working harder to come out of this crisis as better students and engineers. Second, I'd like to acknowledge each and every one of my colleagues for putting in countless hours to convert their classes to an online setting in such a short time. Thanks to their dedication, we are continuing to deliver classes with the academic rigor we always had in MABE. Finally, I'd like to thank our staff, who continue to work tirelessly to ensure that we are operating smoothly.

On a related note, the efforts of our students and faculty to help our state and local community has been inspiring. Our department has donated thousands of nitrile and isolation gloves, and facemasks to local hospitals. Faculty and students stepped up and worked night and day to print thousands of face shield bands to be used by medical professionals in Tennessee. They set up printers in their homes to help with the efforts (see page 6). They showed the Volunteer Spirit even through these uncertain times.

Although the pandemic hit, great things are still happening in the department and many are highlighted in this issue including Assistant Professor Dustin Crouch receiving an NSF CAREER Award (see page 2), and Associate Professor Subhadeep Chakraborty, Professor Xiaopeng Zhao, and UT-ORNL Governor's Chair Professor Uday Vaidya presenting their research to legislators at UT's Day on the Hill in Nashville (see page 13).

The Tickle College of Engineering and MABE have continued to expand our global impact and reputation. We had another record-breaking year in MABE, with research expenditures between UT and UTSI's MABE faculty topping $15 million and still growing. This achievement is a result of the collective effort of our tremendous faculty, staff, and students, and the successful implementation of strategic thrusts in manufacturing and hypersonics.

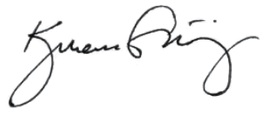
The U.S. News and World Report graduate school rankings were announced last month and our ME program moved up 11 spots to 33, the biggest climb among disciplines at UT, placing it in the top 26th percentile. Our AE program stayed at 28th among public schools and rose to 38th overall in the nation.

I want to thank you for your continued support, especially during these unprecedented times. The generosity of our alumni and friends enable our department's transformation, and its impact will be felt by the generations to come. We are grateful for all gifts, small and large, that have a direct impact on our ability to secure the resources needed to take our department even further.

Finally, please get in touch and let us know how you're doing. Also, keep sending photos and stories of your time on Rocky Top. We love to share your memories with the entire MABE family.

Stay safe and healthy,

Kivanc Ekici



Natural Prosthetics

By David Goddard. Photography by Randall Brown.

For the more than 2 million people in the US who have suffered an amputated limb or have had to have one removed for medical reasons, prosthetics have offered a solid, albeit limited, way of coping.

Now, a team, led by Assistant Professor Dustin Crouch, seeks to unlock what would be a game-changing jump in prosthetic devices by using technology that has so far largely only existed as fantasy: bionics.

The key component of the research is what are called muscle-driven endoprostheses (MDEs), which are a type of prosthetic that is completely implanted under the skin of a patient's body.

"We want to physically attach prosthetic limbs and appendages to the muscles that remain in the residual limb after amputation," said Crouch, who works out of the Department of Mechanical, Aerospace, and Biomedical Engineering. "Using the residual muscles and tissue will enable patients to do things that they cannot with current prosthetics."

Crouch's team is currently in the initial testing and design phase of the project, having started with prosthetic feet for rabbits.

Using synthetic tendons to attach muscles to a small prosthetic foot and ankle in the leg, the team will be able to get feedback from the foot via sensors and compare variables like strength and reflexivity to the movement of a natural foot.

The data will be used to improve designs for later models with the eventual goal of human-based implementation. At that stage, the team will once again start small before building up to full-size limbs, likely beginning with individual fingers or toes.

Crouch said he hopes the work has advanced to that level well within the next five years.

"The whole goal of this is to improve outcomes for people who have undergone amputation," Crouch said. "People have to change jobs, maybe even quit work altogether because of limb loss. This could drastically change lives for the better."

Many current prosthetics limit the variety of motions that patients can perform, one of the big things Crouch and his team most want to change.

For example, hand replacements have typically allowed patients to control the speed of motion when opening and closing the hand. Controlling and feeling the firmness of grasps or very fine finger motions are difficult or impossible with current prosthetics. By using the muscles that remain after amputation, the thought is that it would be possible to create prosthetics that approached the same mobility and dexterities as the original limb.

"Many amputees are able to remember how to control the muscles that used to be there, are able to 'feel' that control," Crouch said. "Humans have a remarkable ability to modify how they coordinate their muscles. One aspect of implementing this will be getting amputees to relearn how to coordinate their muscles to directly control their new devices. We want it to feel as natural as possible."

Another major advantage of the emerging technology is that it solves two complaints that often come up when people talk about their artificial limbs: weight and convenience. The approach that Crouch is exploring eliminates a lot of the bulkiness associated with many current models since muscles don't need batteries or motors to operate.

Additionally, having the new devices connected to existing muscle means people would have a more "natural" experience with their new appendage that's functionable at all times instead of having to remove and reattach it as needed.

Crouch said he knew that having other viewpoints—especially those from a medical realm—would help, so his teamed formed accordingly.

Professor and Head of the UT Large Animal Clinic Sciences David Anderson, Professor of Small Animal Clinical Sciences Cheryl Greenacre, and Clinical Veterinarian Bryce Burton, all from the UT College of Veterinary Medicine; and Stacy Stephenson, a doctor at UT Medical Center, are all assisting on the project.

As a sign of the importance of the work, the National Science Foundation selected Crouch for one of its prestigious CAREER awards, which go to up-and-coming faculty with ideas it deems important to humanity.

Driven to EXCELLENCE

By David Goddard. Photography by Steven Bridges.

Volkswagen, the University of Tennessee, Knoxville, and Oak Ridge National Laboratory have announced a partnership to create Volkswagen's first Innovation Hub in North America.

A little more than a decade ago, the Volkswagen Group chose Chattanooga as the location for its new US hub, bringing with it thousands of jobs and more than $1 billion in construction to date.

It would seem fitting, then, that Volkswagen would find research partners in some of Tennessee's leading institutions including the University of Tennessee, the UT Research Foundation, and Oak Ridge National Laboratory.

Together, the group announced the creation of a Volkswagen Innovation Hub at UT Research Park at Cherokee Farm, the first of its kind in North America. It joins Volkswagen's larger global innovation ecosystem that includes centers in California, Germany, and China, along with hubs in Spain, Israel, and Japan.

"Working with the University of Tennessee is a great opportunity to continue growing Volkswagen's engineering footprint in the North American region," said Wolfgang Demmelbauer-Ebner, executive vice president and chief engineering officer for Volkswagen's North American region. "This hub, along with other research institutions here, is an integral part of Volkswagen's global research and development efforts and can also directly contribute to vehicles in North America."

UT Interim President Randy Boyd was quick to note how the development paves the way for continued growth in the region, which is known for its strengths in the areas of advanced materials and additive manufacturing.

"The partnership between UT, ORNL, and Volkswagen strengthens Tennessee's position as a significant source of innovation and talent for the Volkswagen North American manufacturing base, especially at the flagship Chattanooga facility," said Boyd. "These types of partnerships are transforming the Tennessee Valley Corridor into a global innovation leader."

Drawing from Diverse Disciplines

The work—some of the most innovative applied research of its kind being done anywhere in the world—is being led by UT-ORNL Governor's Chair for Advanced Composites Manufacturing Uday Vaidya from the Department of Mechanical, Aerospace, and Biomedical Engineering. His team is focused on several research and development activities to support prototyping, develop a sheet molding compound, and evaluate materials and their properties for use in Volkswagen vehicle components.

Additionally, faculty in the Min H. Kao Department of Electrical Engineering and Computer Science and Department of Civil and Environmental Engineering are focused on wireless charging, developing better batteries, and materials characterization for lightweight composites, respectively.

"The collaboration is providing unique opportunities for our undergraduate and graduate students and researchers in advanced materials and additive manufacturing," said Vaidya. "Working alongside Volkswagen engineers and managers in this real-world experience is extremely valuable for their career paths."

Highlighting the partnership's impact on UT students, Volkswagen has awarded fellowships to doctoral students Andrew Foote, Nathan Strain, and William Henken as part of the agreement.

Volkswagen also is a member of the Institute for Advanced Composites Manufacturing Innovation (IACMI), which is supported by the US Department of Energy's Advanced Manufacturing Office. A team of IACMI undergraduate and graduate students and researchers led by Vaidya created a novel composite liftgate for the Volkswagen Atlas that reduces weight by 35 percent, with lower investment costs and an improved environmental footprint compared to a conventional part. Researchers from ORNL, Purdue University, and Michigan State University were integral collaborators on the effort.

Photo: UT ORNL Governor s Chair Uday Vaidya s team created a novel composite liftgate for the Volkswagen Atlas.

BANDING TOGETHER

By David Goddard.

One of the things that sets UT apart is a belief in the Volunteer Spirit. The notion that, when times are their toughest, UT students, faculty, staff, and alumni will rise to meet the occasion.

It shone through in March, when the coronavirus brought many aspects of life around the world to a halt, including the end of in-person classes at UT for the semester.

Post-Doctoral Research Assistant Bapi Bera and graduate student Frida Roenning helped print the headbands.

Mike Krause, executive director of the Tennessee Higher Education Commission, challenged universities across the state to help meet the demand for face shields. Schools responded in a big way, producing 10,000 through the use of 3D printing. For its part, UT printed 1,200 in the first three days of the effort, with another 5,000 (and counting) delivered by mid-April.

At UT, the Tickle College of Engineering, College of Architecture and Design, and College of Arts and Sciences all contributed to the cause.

"Seeing the way that UT, ORNL, and partners came together was unprecedented in both timing and result," said MABE's UT–ORNL Governor's Chair for Advanced Composites Manufacturing Uday Vaidya, who coordinated the effort.

Fabrication of the gear took place at a number of locations, including Vaidya's space at the Fibers and Composites Manufacturing Facility and Engineering Annex (FCMF), the college's Innovation and Collaboration Studio, and the College of Architecture and Design's Fab Lab.

On the initial run, people worked through the night to produce the gear, something that was replicated elsewhere, according to Interim Vice Chancellor for Research Matthew Mench.

"People took printers home with them so that they could work on the headbands every available minute," Mench said. "Helping the community and the state under a tight deadline is the absolute embodiment of the Volunteer Spirit."

From engineering, Vaidya was joined by fellow faculty members Doug Aaron, Brett Compton, Chad Duty, Caleb Rucker, and Matthew Young of MABE; Chris Wetteland of MSE; and FCMF's Vanina Ghossein.

More than a dozen students also aided the effort, led by Alex Stiles, a doctoral student in the Bredesen Center for Interdisciplinary Research and Graduate Education.

While the fight against Covid-19 continues in hospitals and medical facilities across the world, the efforts undertaken by those at UT show they aren't fighting it alone, and our Volunteer Spirit is with them.

Watch a video about this Volunteer effort at tiny.utk.edu/faceshields

MAKING CRITICAL DECISIONS

By David Goddard. Photography by Randall Brown.

The issue of school shootings and what to do about them is a polarizing topic, but one in need of a solution nonetheless.

MABE Associate Professor Subhadeep Chakraborty has taken on the heavy burden presented by that challenge, coming up with a system that seeks to improve outcomes in active shooter situations.

Developed along with researchers at Iowa State, Active Shooter Tracking and Evacuation Routing for Survival (ASTERS) uses technology to improve both safety and response times, aiding both school officials and first responders.

"What we've come up with is an application that monitors where suspects are, what direction they are going, and what the status of nearby rooms and spaces might be," Chakraborty said. "We already have technology for monitoring and communication, so we thought, 'Why not put that to good use?'"

In ASTERS, cameras could track the precise location of suspects and any potential victims and send that information through a secure app to police and medical personnel responding to the call, helping drastically reduce search times for both.

Additionally, the technology and app would help those within the school make better informed judgments about what their best course of action might be.

Chakraborty said the idea started with a focus on how decisions are made on the ground in real time.

"We've seen cases where students were actually running the wrong direction, heading straight for the gunmen before someone stopped them and turned them around," he said. "People can make bad choices under pressure, and being in that situation would be among the most stressful moments you can possibly imagine. Simply knowing exactly where the suspect is takes out a lot of the guessing that people have to do."

The ASTERS system would also take into account the makeup of the locations where students and faculty are when advising them. For example, if a class was in a room with solid walls and lockable doors, the system might advise them to shelter in place, whereas if they were in a common space like a library or in a room with partitioned walls, it might advise them to move elsewhere or even flee through a window, if available.

The project, which is funded by the National Science Foundation, has also received written support by UT police at both the Knoxville and Chattanooga campuses.

"It was very important to have their support," Chakraborty said. "It elevated the project in a way that showed law enforcement was on board with this idea. I'm very thankful for that."

Chakraborty said other areas where it was critical to gain support were schools and the communities they serve, noting that if they don't have buy-in, there's no way to implement the plan.

He noted lockdowns have sadly become increasingly routine, but that ASTERS—while it can't prevent such occurrences— could at least improve outcomes.

MABE Adds Online Advanced Manufacturing Certificate Program

By David Goddard. Photography by Shawn Poynter.

Advanced manufacturing is playing an ever-increasing role in the world's economy, and UT is answering the call with research and innovation.

Seven of the prestigious UT–ORNL Governor's Chairs, numerous other researchers throughout the university, and a growing list of courses and research are dedicated to advanced manufacturing or the materials that support it.

With that solid foundation, the college now offers a Graduate Certificate in Advanced Manufacturing, led by MABE Assistant Head of Undergraduate Programs Doug Aaron.

"We have experts in advanced materials, in polymers, in additive and subtractive techniques, and in metals," said Aaron. "We've had strong interest from some of our key industry partners on doing something like this."

Aaron's team has been working to develop the certificate since October 2017, when the idea was first floated. The program is designed to allow students to participate in a traditional way on campus, but also includes an online component using two-way video capabilities to cater to students with full-time jobs.

Students choose two courses from six electives in addition to required courses in mechanics of materials and advanced manufacturing. The goal is to have up to 50 students within three to five years. If the program meets those marks, it may become a full master's degree program.

"Taking on a full-time master's program is a commitment that a lot of people who are in the workforce can't really afford the time to take," Aaron said.

> "This certificate program is relevant for anyone from recent grads to people who've been working for years that are wishing they could add to their educational experience and maybe improve their employment."
>
> —Doug Aaron

The program is open to anyone with a background in engineering, with applications reviewed on a case-by-case basis. Aaron notes, for example, that someone who might not have had the best GPA but who has 10 years of practical employment would be considered with that experience in mind.

He added that the team drew on knowledge shared from the UT Space Institute, which has online courses and several faculty members affiliated with MABE.

To apply go to **tiny.utk.edu/mfg_gradcert**.

NASA Simulator Donation Tackles AIRCRAFT ICING

By David Goddard.

Flying in the United States has become increasingly safe over the years. In fact, flying on an airliner on average is overwhelmingly safer than driving in a car, but challenges still appear.

Icing, in particular, is a problem for which the Federal Aviation Administration and the National Transportation Safety Board routinely issue new guidelines and recommendations. It can occur in a variety of situations and can cause serious in-flight issues, impeding flight controls or even damaging the engines themselves.

As you would expect, measures to prevent or remove ice from aircraft are far easier to execute on the ground than in the air.

The UT Space Institute has been working to improve icing safety since the early 2000s, with a recently donated flight simulator from NASA giving the training and research a boost.

"Specifically, we train pilots for the effects of icing on aircraft handling characteristics and stall characteristics due to wing and tailplane icing," said Rich Ranaudo, who teaches the icing course with Borja Martos. "The combination of simulator training and technical classroom presentations by subject matter experts provides pilots and engineers with a comprehensive understanding and practical knowledge of how icing impacts aircraft performance and handling. Being able to simulate such conditions has an obvious and huge advantage over speculating or having to undergo such conditions in field testing."

Martos provides both classroom and simulator instruction through his company, Flight Level Engineering (FLE), by request. The simulator training focuses on dealing with these adverse conditions.

Since 2004, more than 200 engineers, pilots, and government and academic leaders have completed the course. Most attendees are pilots and engineers involved in development and certification of aircraft.

Martos joined Ranaudo more recently, having worked at UTSI for eight years and earning his doctorate in aerospace engineering from UT in 2014. The pair serve as instructors when demand for instruction reaches the point that a new session is warranted, typically about once a year.

They use the donated simulator, the Ice Contamination Effects Flight Training Device (ICEFTD) as part of the Icing Short Course, in addition to FLE's unique aircraft, an in-flight simulator with five degrees of motion. The simulator is the only known flight training device of its kind that allows pilots to experience true icing effects, because its capability was derived from actual flight testing and extensive wind tunnel tests.

Except for the Calspan Corporation, they are the only provider of these type of flight services in the United States.

Tom Ratvasky, an aerospace engineer at NASA's Glenn Research Center in Cleveland, Ohio, helped make the gift possible.

"NASA's icing research agenda had shifted into a different area, but we wanted to continue to use the ICEFTD," Martos said. "Tom had been our contact at NASA, and he and Rich have known each other for a long time. So, I called Tom and asked if NASA would donate the equipment to UTSI so that we could have broader access, teach short courses, and carry out research—and NASA said yes."

Martos credited UTSI Director for Continuing Education Becky Stines with helping to make sure everything fell into place, and the current icing research took off, no pun intended.

Interested parties can contact Borja Martos at **borja.martos@gmail.com** for additional information on the ICEFTD, training courses, variable stability flights, and research opportunities.

Making Connected and Autonomous Vehicles Safe and Reliable

By Kathy Williams.

As connected and autonomous vehicles (CAVs) are quickly becoming reality, critical questions are being raised about how safe and reliable these vehicles are.

Many manufacturers are selling vehicles with partial or conditional (Level 2 and 3, respectively) automation and testing more advanced vehicles on public roads, but regulated standardized testing to ensure that the vehicles are safe is largely absent.

With funding from the Collaborative Sciences Center for Road Safety, Subhadeep Chakraborty, associate professor in the Department of Mechanical, Aerospace, and Biomedical Engineering, is working to change that.

Chakraborty has teamed up with UT's Department of Civil and Environmental Engineering Professor Asad Khattak, and researchers from Duke University, and Oak Ridge National Laboratory to develop a comprehensive testing protocol that will standardize how to systematically and safely test Level 2 and 3 CAVs.

"Currently, there is no consensus about whether testing should exist at the state or federal level, what functions should be tested, how independent testing should occur, and what constitutes safe thresholds," said Chakraborty. "With a testing protocol, automated vehicles can be systematically tested and certified to be generally safe before being put on the market or tested on public roads."

The protocol will be designed to allow accelerated testing and identification of fringe cases and stress points where automated systems will be prone to failure.

"Essentially, we are trying to accelerate the pace at which CAVs can become more reliable and robust in their operations," said Chakraborty.

Virtual reality (VR), a 3D simulated experience similar to the real world, will be used in the research along with physical vehicles in the loop. This setup will combine virtual and physical worlds, with the car mounted on a steerable dynamometer providing all the dynamics associated with real driving, while the virtual world simulates synthetic sensor data corresponding to various situational context.

"It is difficult to train machine learning for an unexpected combination of events that do not easily fall in a class that artificial intelligence can immediately recognize and classify," said Chakraborty. "This problem is further aggravated by the fact that millions of miles need to be driven in all sorts of conditions before having the chance to encounter relatively rare events. With VR, we can develop these difficult driving situations for CAVs to negotiate, such as recognizing a pedestrian in dark clothing crossing a dark street."

Using VR will also provide a large quantity of realistic synthetic data that cannot be obtained otherwise. Khattak will provide statistical analysis of the data that can result in valid conclusions and influence policy making in the future.

The team will spend the next two years testing and collecting data. When the project is complete, the results will be used to provide safety certification standard recommendations that regulatory agencies at the state and federal levels and the private sectors can use.

Chakraborty looks forward to seeing this research impact the immediate future and one day being instrumental in preventing accidents.

A Mind of its Own

By David Goddard.

The quest for smarter, more self-reliant vehicles and machines has picked up steam in recent years, with autonomous devices seemingly within reach.

One of the keys to such technology is the need for machines to be able to learn the best ways to operate, with the goal of minimizing reliance on human input.

MABE Associate Professor Andy Sarles is playing a vital role in research seeking to improve such functionality by taking an approach notably different from past efforts.

"Artificial intelligence and machine learning most commonly use software and algorithms to operate, which, in turn, requires large amounts of data," Sarles said. "We want to use hardware to enable machines that learn on their own, without the need for human-guided training. That's our pie-in-the-sky goal, to have vehicle systems with autonomous brain-like computing."

This kind of processing is known as neuromorphic computing, which instead of software involves using hardware components, such as memristors, which are variable resistors that remember, to mimic the neurons and synapses found in the brain.

Sarles first began working on neuromorphic systems in collaboration with Associate Professor Garrett Rose of the Min H. Kao Department of Electrical Engineering and Computer Science and ORNL's Pat Collier in a recently completed NSF project that examined the use of soft biomolecular membranes as "wet-ware" mimics of neural synapses.

Using that work as a building block, the next big challenge for Sarles was finding ways to combine different molecules to engineer a property called plasticity.

"Synaptic plasticity in the brain is the way in which connections between neurons strengthen and weaken on demand, allowing for adjustable signal processing and communication. This is what gives us the capacity to learn, forget, relearn and remember over time," Sarles said. "We are studying materials that exhibit similar types of plasticity, and we hope this will allow for hardware that can compute, learn and remember."

In his bio-inspired wet-ware, he is developing materials that achieve voltage-activated plasticity via lipid membranes and ion channels—just like in real neurons.

By connecting those materials to solid-state circuitry, Sarles' team is creating hybrid neural networks that mimic how neurons communicate via action potentials at adaptable synapses.

Another advantage of the biomolecular approach Sarles is taking is the range of functions that can be obtained by combining various types of voltage-activated biomolecules, with each component measuring at a nano-scale level.

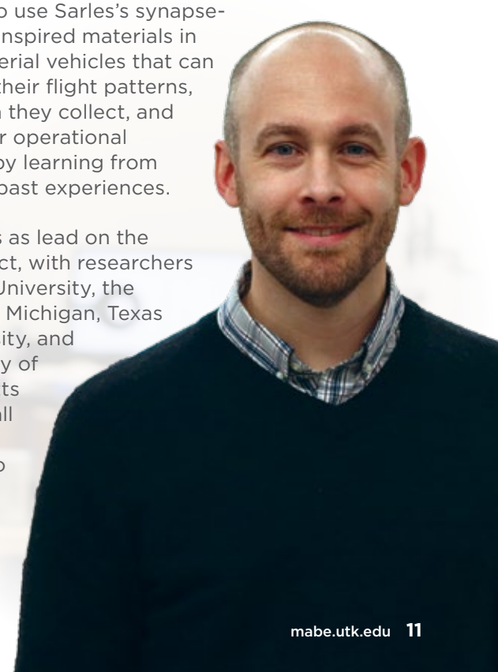
"It's a uniquely modular system, one where we can mix and match components to shape the outcome," Sarles said. "It gives us tons of control in tuning performance and developing better understanding of the underlying physics, especially when compared to more traditional oxide-based devices."

All of this comes with Sarles as part of a wider team working together across several universities as part of a Multidisciplinary University Research Initiative (MURI) grant awarded by the US Department of Defense.

The wide-ranging project, "Brain-Inspired Networks for Multifunctional Intelligent Systems in Aerial Vehicles," resulted in more than $7.5 million in funding from the Air Force Office of Scientific Research, with Sarles slated to receive $830,000 in support over five years.

The goal is to use Sarles's synapse- and neuron-inspired materials in unmanned aerial vehicles that can think about their flight patterns, react to data they collect, and improve their operational capabilities by learning from current and past experiences.

UCLA serves as lead on the overall project, with researchers at Stanford University, the University of Michigan, Texas A&M University, and the University of Massachusetts at Amherst all taking part, in addition to UT's role.



Hicham Ghossein, founder and chief executive officer of Endeavor Composites

Research Leads to Foundation of New Company

By David Goddard.

Advanced, lightweight materials continue to play an important role to the automotive industry, with technology and research providing new and improved resources in a constant drumbeat of innovation.

Such materials are important to vehicle manufacturers because they simultaneously reduce vehicle weight—in turn, improving gas mileage—while in many cases providing stronger, safer components than some more traditional methods.

Now, through research conducted by UT-ORNL Governor's Chair for Advanced Composites Manufacturing Uday Vaidya and Graduate Research Assistant Hicham Ghossein, those materials have undergone another evolution.

"Our new technique allows us to make carbon fiber nonwovens with minimal defects," said Vaidya. "Also, our process results in nonwoven carbon intermediates, cost less, and have better efficiency in manufacturing composites."

In basic terms, they take chopped carbon fiber as a source product and process them into mats of non-woven fibers.

They then take those mats and infuse them with resin, giving them panels with all of the advantages over current iterations.

Ghossein, like Vaidya, also works with IACMI—The Composites Institute, and is excited about what the project has turned into: Its own company.

"Thanks to the backing of everyone at the UT Research Foundation, we were able to not only apply for a patent for our method, but were also able to spin it off into our new company, Endeavor Composites Inc.," said Ghossein, who serves as president of the new venture. "We hope to really build this out and ramp up production."

Endeavor was founded as a result from significant support from the Innovation Crossroads program, which was founded by ORNL, the US Department of Energy, and TVA as a way to "help entrepreneurs create the next generation of clean energy companies." The program brings together research, experienced professionals, and economic and industrial opportunities to help ideas become reality.

Officially on the record as "Innovative Mixer for Fiber Dispersion in Wet Laid System," UTRF was able to grant them an 18-month, exclusive option on the technology.

Ghossein, who earned his doctorate from MABE in 2018, has already set lofty goals for the new company, including:

- Ramping up production of the new materials;
- Controlling and tailoring the orientation of fibers in the materials; and
- Testing the use of other materials within the design of the mats.

With those goals in mind, and having already demonstrated success, this could be just the beginning for his company.

MABE Faculty Represent at

UT Day in Nashville

By David Goddard. Photography by the University of Tennessee System.

UT System President Randy Boyd tries the brain-controlled drone exercise that Xiaopeng Zhao (not pictured) demonstrated at UT Day on the Hill.

In February, departmental faculty got a chance to meet with Tennessee's elected officials during the annual "UT Day on the Hill" event in Nashville.

Professor Xiaopeng Zhao demonstrated his brain-controlled drone, which is part of his research into combating Alzheimer's and related diseases.

By training the brain to guide the device, Zhao and his team gain a critical understanding about brain waves. Their amount of knowledge grows with every use of the drone, as every new user means a new calibration of brain waves.

"It was a great opportunity to inform the legislators about the impact of Alzheimer's disease on the nation and to the state," Zhao said. "I explained how research on brain-computer interface can help patients of Alzheimer's disease as well as their family and caregivers."

Associate Professor Subhadeep Chakraborty talked about his ASTERS project (read the full story on p. 7), which uses cameras and other technology to help first responders know where potential shooter suspects are and help school officials track where students, faculty, and staff are and inform them of their best course of action.

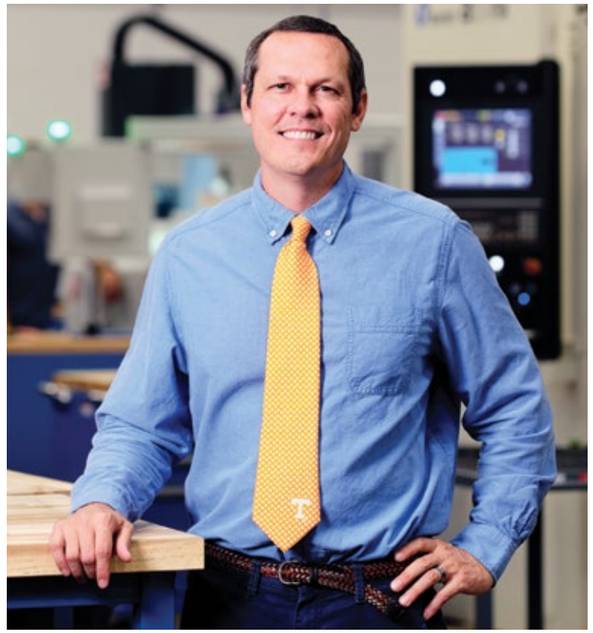
"The opportunity to meet with our elected leaders actually meant a lot to me, since the nature of the project makes it really important to combine technical expertise with human factors and policy making," Chakraborty said. "It not only gave us a platform to showcase the exciting research we are doing, but also gave me an opportunity to get some insight into the legislature's viewpoint about the practical and legal constraints in implementing the ASTERS system at large scale."

UT-ORNL Governor's Chair for Advanced Composites Manufacturing Uday Vaidya also spoke highly of the event and the chance to speak to officials.

"It was an excellent forum for our researchers and students to interact with Tennessee's legislators and share the excellent research and development work they are engaged in," Vaidya said. "The UT composites team presented its work related to the Volkswagen composite lift gate project. The various stages of the materials development, design, characterization, and manufacturing of the product were highlighted."

Vaidya also said that they highlighted the strength and spirit of collaboration between UT, IACMI—The Composites Institute, ORNL, and industry partners.

Faculty News



Professor and ORNL Joint Faculty Member **Tony Schmitz** was recently awarded a five-year, visiting professorship at Technical University Wien in Vienna, Austria. The position funds a portion of Schmitz's time to collaborate with TU Wien faculty and students in advanced manufacturing. Financial support is provided by the Austrian Marshall Plan Foundation to encourage collaboration between US and Austrian university faculty.

Schmitz also received the Best Oral Presentation Award of 2019 at the 34th Annual American Society for Precision Engineering (ASPE) Meeting for his presentation, entitled "Machine Learning with Updating for Milling Stability." The annual meeting is the premier precision engineering conference in the US that brings together nationally and internationally renowned experts in the field to present their research and exchange ideas.

Schmitz was also recently named as of the 20 most influential professors in smart manufacturing by **SME.org**.

In December, Department Head **Matthew Mench** began serving as the interim vice chancellor for research and engagement. A national search is currently underway and Mench will return to his role as department head upon hire of the next vice chancellor. Associate Department Head **Kivanc Ekici** stepped up to serve as interim department head in Mench's absence.

Professor **Jay Frankel** officially retired from the university on February 29 after more than 26 years of research, teaching, and service. On March 1, he started his new position as Department Head and R. Myers Endowed Professor of the Department of Mechanical and Aerospace Engineering at New Mexico State University in Las Cruces.

Frankel began his career at UT in 1993 as an associate professor. During his tenure, he taught many classes including engineering analysis, advanced engineering analysis, and advanced topics in thermal and fluid science.

He is an AIAA associate fellow, recipient of two AIAA TN awards, and is well-known in the aerospace community.

Over the span of his professional career of 34 years, teaching students, working with staff, and collaborating with the faculty has led to creative endeavors and brought Frankel great personal satisfaction. He greatly appreciates and treasurers the close friendships he built with his peers, staff, and students while at UT.

Frankel, known for his sense of humor, patience, humanity, and professionalism will be missed by everyone in the department. A retirement celebration was held in his honor on February 14 at the Sunsphere.

Frankel received an award for his 26 years of service at UT during his retirement celebration at the Sunsphere.

During the UT Research Foundation's annual awards in December, several groups and individuals from MABE were recognized for their efforts. MABE faculty and alumni were noted for having the following technology licensed last year:

Interim Vice Chancellor for Research and Engagement **Matthew Mench**, for Tamper Evident Lock Box (TEL BOXX).

Associate Professor **Andy Sarles** and alumnus **Graham Taylor**, for Novel Methods for Measuring Parameters of Cell Membranes.

Mench, Associate Professor **Chad Duty**, and Rosenberg Associate Professor of Practice **Matthew Young** were also recognized for their patent for Tampering Detection Clamping Box for Ingress/Egress Lines.

(L–R) Matthew Young, Matthew Mench, and Chad Duty received awards from UTRF for their Tampering Detection Clamping Box for Ingress/ Egress Lines patent.

Graduate Student Competes in Mountain Bike World Championship

By Kathy Williams. Photography by Zach Faulkner.

Riding a bike as fast as possible down a mountain is not something most people enjoy, unless you're Frida Roenning.

Last fall, Roenning, A MABE graduate student, put her biking skills to the test as she competed in the UCI Mountain Bike World Championship and World Cup races. This was her first time competing in the championship, the biggest and most important race of the year for competitive mountain bike racers.

Roenning represented her home country of Norway in the elite women's downhill category, held at Mont-Sainte-Anne in Canada, one of the most technical venues to race with the course spread across a ski mountain.

"I was chosen to represent Norway after I had a couple of good results earlier in the season," Roenning said. "I qualified in the top 15 out of over 40 riders at the World Cup in France in July, and since I did well there, that qualified me for the championship race."

One other female rider representing Norway competed in the junior women category.

With over 300 female downhill racers ranked in the world, making it to the championship race is a big accomplishment. Roenning ended up competing against the 30 best riders in the world.

"Most downhill courses at this level are very hard just to ride, they have huge jumps, and hard technical features that are scary, but also very cool when you figure out how to do them," she said. "We all get an individual starting time and then the person with the fastest time wins. I really like this concept because the most challenging part is to figure out how you can ride down the track as fast as possible."

Roenning finished 16th, completing the 1.8-mile course in 5 minutes and 29 seconds.

A week later, she went on to compete in the World Cup race in Snowshoe, West Virginia, a race she has competed in several times, but first time at this location. She was sponsored by her hometown cycling club, Lillehammer CK.

The World Cup is similar to the World Championship, but different in that you must have enough points to qualify rather than being selected by your country's cycling federation.

"At World Cup, you are still competing against the fastest people in the world, but there are seven of these races total during the season," said Roenning.

She completed that 1.24-mile course in 4 minutes and 4 seconds, finishing 13th against 20 riders.

Roenning is planning to race in some of the World Cups this year. Until then, she'll be busy working on her research and completing her master's degree in mechanical engineering.

BME Student Starts Club for Pre-Health Engineering Students

Writing and Photography by Kathy Williams.

(L R) EMED s board member Drew Richard and founder Christopher Forsyth

Thanks to Christopher Forsyth, there is a new club on campus for engineering students who are interested in pursuing careers in health care.

Forsyth, a senior in biomedical engineering, founded the Engineers in Medicine Society (EMED) last year to provide support, resources, and opportunities to pre-health engineering students. Fellow classmates Drew Richard, Nicole Kowalski, Alexander Barrett, and Emily Gable are helping Forsyth with his efforts and serve on EMED's board.

"Some of my pre-health friends and I saw a need for more resources for engineers wanting to go to medical school," Forsyth said. "While there are other pre-health clubs on campus, none of them really catered to the unique position engineering students are in. By starting the club, we saw the opportunity to create a community of pre-health engineering students to share and learn from each other's experiences."

EMED is open to all pre-health students from all engineering majors. Nearly 50 students from across the college have already joined, with the majority of members being biomedical, but with mechanical, chemical, and nuclear engineering students also taking part.

"EMED has the potential to unite students across many engineering departments who are planning a career in medicine," said Lecturer and Faculty Advisor Sara Hanrahan. "This society provides resources to students who are in the arduous process of applying to a health professional school, gives them access to practicing healthcare professionals in the community, and presents them with unique service opportunities."

Forsyth wants to bring resources directly to EMED members and is already planning events for physicians and medical schools to come speak to the group.

"Perhaps the most important benefit of the club is helping members find a community where they can get guidance from peers about the pre-health process," said Forsyth.

In the fall, EMED put together a Medical College Admission Test study group to help students prepare for the entrance exam and held application workshops this spring. They also provided hands-on training to their members, including a Stop the Bleed training event and CPR training this spring.

"While pre-health students volunteer often, EMED hopes to host volunteer events that will have a larger impact in our community," said Hanrahan.

Members will be connected with local volunteer programs and encouraged to get involved. Plans are in the works to partner with the RAMutk club and join them in their travels to Remote Area Medical Clinics around Tennessee.

Forsyth is happy to see the club become successful and knowing he is helping his fellow classmates is rewarding.

He'll be graduating this year and is in the depths of the medical school application process. He wants to become a physician and utilize his engineering background for device design and medical problem solving.

No matter where he ends up, he has laid a solid foundation for EMED, and will be helping pre-health engineering students in the years to come.

For more information on EMED visit **emedutk.org**.

Dean's List Fall 2019

Summa Cum Laude

Aerospace Engineering

Cameron Alexander
Hayden Allen
Samuel Bender
Christopher Busic
Adam Cash
Ethan Cerrito
Abigail Chubb
Jakob Cielo
James Cooper
Patrick Dietrich
William Dingler
Jonathan Dixon
Andrew Duncan
Lorenzo Franceschetti
Anne Gosnell
Hannah Hajdik
Trenton Henderson
Ian Hunt
Cooper Jenkins
Samantha Kautsch
Ryan Kelly
William Kobler
Ashley Kulikowski
Matthew Lamanilao
David Lee
Tyler McCoy
Spencer McDonald
Matthew McVey
Michael Moore
Jackson Muncy
Samuel Pankratz
Sang Park
Akaash Patel
Neil Patel
Raj Patel
Mya Pinson
Logan Ransom
Chapel Rice
Caleb Ross
John Sarappo
Edward Self
Harrison Shay
Matthew Sherrod
Joshua Stephenson
Zachary Sulfridge
Guy Waggoner
Charles Wallen
Caleb Weatherly
Nicholas Webber
Andrew Wilcox
Jeongmin You

Biomedical Engineering

Sara Aboeleneen
Alexandra Anthony
Gerald Backus
Adison Baker
Alexander Barrett
Taylor Berger
Jordis Blackburn
Robert Borkoski
Samantha Bratcher
Laura Bretscher
Tessa Brooks
Matthew Charles
Michelle Claxton
Benjamin Collins
James Corbitt
Chance Cuthbert
Lainee Darrow
John Deinhart
Zachary Dossett
Joshua Duzan
Aaron Eimers
Omar Elkhayyat
Gehrig Elkins
Kyle Fagin
Madeleine Fitts
Christopher Forsyth
Emily Gable
Sydney Garrett
Kelsie Hartley
Carter Hatch
Carson Helton
Anna Herline
Megan Hines
Elizabeth Jelinek
Lauren Jennings
Youngju Jeon
Annie Keller
Seth Kenny
Caitlyn Kicza
Elizabeth Klavon
John Klepzig
Lance Knipper
Nicole Kowalski
Jack Krimmel
Matthew Kushnir
Samantha Lange
Mitchell Langley
Jack Leoni
Dylan Marler
David Mashburn
Alicia Matavosian
Abigail McCord
Delaina McDonald
Kyle McDowell
Courtney Mobbs
Bradley Moore
Deep Patel
Tatum Perry
Jessica Pierce
Solomon Price
Andrew Ray
Carl Reeves
Stephen Ricketts
Connor Rigsby
Noah Robison
Benjamin Savitz
Emily Schulman
Curtis Schunk
Skylar Simpson
Kaitlin Smith
Cayden Stafford
Luke Stanley
Dan Stedham
Carli Stewart
Riley Toll
Christian Waksmunski
Gideon Wall
Gavin Warrington
Lauren Williams
Dalton Winchester

Mechanical Engineering

Remoun Abdo
Spencer Aitken
Sean Amato
Rachel An
Alexander Arbogast
Demiana Barsoum
Dana Bjorn
Benjamin Black
Bradley Bloedorn
Benjamin Bolinsky
Samuel Botto
William Botts
Michael Bowman
Carter Breeding
Nathan Brummette
Michael Buckley
Michael Burnside
Caleb Cain
Courtney Cartwright
Dakota Cauthen
Carter Chapman
Zane Chapman
Elijah Charles
Patrick Cole
Connor Cooke
Gregory Corson
Jordan Cummings
John Dallas
Khoa Dang
Michael Davis
Peyton Davis
Tanner Davis
William Davis
Alexandra Defilippis
Daniel Dirscherl
Colton Duckworth
Ryan Durkee
Jared Elrod
Zackary Emery
Robert Garibay
Aaron Gerhard
Corinne Gerhold
Aniket Ghare
Kellen Glasscock
Isaac Grant
Jacob Groothuis
Jonathan Gustafson
Mitchel Haendel
Clark Hall
Jackson Hardeman
Justin Harmon
Grant Hay
Jeremy Hensley
Clifton Herring
Jacob Hickerson
Jade Hills
Kailyn Hoaglund
Dalton Houser
Jacob Hromi
William Hunter
Camryn Hurley
Mohammed Husain
Zaky Hussein
Joshua Johnson
Xavier Johnson
Eric Johnston
Benjamin Jones
Landon Karp
Cheyanne King
Conor Koesterman
Kurtis Kuipers
Robert Kuykendall
Isabelle Laffer
Mariah Lafond
Ariel Lane
Rebecca Laughon
Seunghyun Lee
Brooks Leftwich
Christopher Leonard
Cally Link
Isaiah Linkous
Heather Lueckenhoff
Mallory Marchal
Joseph Mathes
Ellen Maye
Matthew McAmis
Zebulon McReynolds
Guzman Melara
Truman Melton
Garrett Mesmer
Clamon Moody
Noah Morrison
Ian Murray
Eli Nahom
Heather Nevills
Kevin Nguyen
Zachary Nolan
Grayson Northern
Theresa Palandro
Nathan Paul
James Pearce
Celeste Pelletier
Konnor Porter
Holly Robbins
Kiel Russell
Sebastian Sanchez
Matthew Sharp
Allison Shaver
Connor Shelander
Micah Shirran
Samantha Shoffner
Ashton Simpkins
Rebecca Sphar
Eilish Stanek
Carter Sutton
Richard Swan
Samuel Swayne
Riley Tavassoli
Samuel Thomas
Barrett Tillman
Mitchell Trotsky
Parker Trulove
Zachary Tucker
Ronald Wade
John Ward
Luke Welch
Jonathan West
Christian White
Robert White
Tanner White
Cole Wilder
Steven Williams
Eli Wilson
Sophie Wood
Carson Wright
Gustavo Yonemoto
Preston Young
Jonah Zahn
Daniel Zetterberg

Magna Cum Laude

Aerospace Engineering

Adam Cain
Brian Coulter
Nicholas Crowder
Iliane Domenech
Will Dorsey
Jackson Dye
Grayson Foster
Matthew Freake
Kenta Funada
Samantha Golter
Jack Haag
Jacob Hale
Mitchell Herb
Gavin Jones
Joshua Kincaid
Benjamin Klenck
Ashlyn Kozlowski
Jeffrey Martell
Hunter McCauley
Daniel McPartland
Caleb Morgan
Jamison Murphree
Benjamin Pham
Carson Plyler
Samantha Ramsey
Fred Robertson
Joseph Rutherford
Tyler Sussmane
Colby Warden

Biomedical Engineering

Nicole Beautz
Abigail Billings
Kalani Carter
John Clendenin
Katarina DeCamp
Reis Dos
Joshua Garretson
Tony George
Jordan Grant
Brooks Hoddinott
Mykenna Horchak
Zachary James
Matthew Jansen
Kinley Koontz
Sydni Lollar
Ryan MacNicol
Claire McClain
John McDearman
Sarah Meeks
Ivy Milligan
Tyler Morris
Caleb Noe
Charles Nussbaum
Shannone Paik
Luke Pollack
Andrew Richard
Kaitlyn Stephens
McKayla Torbett
Carmelo Venero
Marina Vlasyuk
Daniel Woods
Lawand Yaseen

Mechanical Engineering

Christopher Allsop
Brenten Arnold
William Arnold
Connor Bihlmeyer
James Bowman
Jesse Buckley
Brandon Burchell
Addison Cable
Wilton Chapman
Conan Curry
Hunter Davis
Amy Dickey
Abigail Digsby
Jordan Dowdy
Harrison Eller
Daniel Ervin
Eric Evans
Vincent Gambuzza
Alison Gerstner
Grayson Gregory
Caleb Heffner
John Heilig
Derek Holstein
Lee Howell
Brandon Hunt
Caleb Hurst
Luke Ihrig
Andrew Johannesen
Fernando Karg
Matthew Lamsey
Justin Lee
Daniel Locke
Luke MacDougall
Case Martin
Robert McDermott
Travis McGowan
Joshua McMurray
Mitul Mistry
Sheridan Monroe
Brandon Mooney
William Moxley
Jason Ozment
Mason Phillips
Andrew Pitsenberger
Wade Price
Seth Rogers
Benjamin Rubera
Daniel Salyer
Richard Sample
Heidi Seuss
Thomas Simunovic
Brandon Solsbee
Elise Stepp
Jenna Stevens
Elliott Thurman
Eric Vercellone
Murphy Vidal
Alfred Waddell
Steven Wilmoth
Gennick Yoshioka

Cum Laude

Aerospace Engineering

Matthew Bolyard
William Dycus
Andrew Farris
Jesse Groves
Benjamin Isbell
Sreya Kumpatla
Ethan Long
Nathan Pool
Colter Russell
Caleb Saiyasak
Ryan Strydom
Matthew Trainer
Alicja Zeligowska

Biomedical Engineering

Fisher Adkisson
William Austin
Hannah Bowman
Javen Calhoun
Daniel Charlonis
Lesly Chavez
Ethan Connor
Tristan Davenport
Kayla Dixon
Sydney Dobbs
McKenzie England
Ashley Handy
Alexander Haug
Braxton Heard
Ainsley Holliday
Danuel Howard
Stone Isaacs
Anna Jones
Michael Kennedy
Patrick Kennedy
Claire Kimbell
Richard Kuehn
Natalie Ledezma
Logan McGhee
Nidhi Menon
Jessica Motto
Kiara Myers
Liam Naumovski
Sean Osborne
Thomas Paterson
Jamie Pouncey
Tyler Reynolds
Matthew Rowe
Haley Savastano
Katherine Wallace

Mechanical Engineering

Hesham Ahmad
Jacob Anderson
Makenzie Baird
Samantha Bell
John Bradley
Jack Brandon
Erin Brown
Andre Bucks
William Buttrey
Amy Carpenetti
Riley Chambers
Ian Collins
Creighton Couch
Isaac Counts
J Davenport
Austin Davis
Mason Davis
Jacob Fowler
Hayden Galbreath
Mac Gasque
Joseph Gauspohl
Geoff Germino
Joseph Goble
Robert Hatmaker
Joseph Heimel
Ethan Holcomb
Ryan Knapp
Benjamin Koudelka
Dylan Lewis
James McBroom
Bradley McClure
Noah McFaddin
Daniel Melton
Brock Miller
Zachary Nance
William Norris
Mason Oliveaux
Donald Partin
Michael Patoto
Luke Randall
Matthew Redman
Joshua Richardson
Matthew Rogers
Meriah Senogles
Dylan Smith
Agnes Subramanian
Jiawei Sun
Heath Taylor
Benjamin Thieme
Reagan Toll
Olivia Trippeer
Ethan Vals
Beverly Wesh
Kendrick Williams
Sarah Wilson
Jackson Wilt
Xizhi Xia
Matthew Yarbrough
Connor Zabo

Student News

Doctoral student **Emma Betters** (ME) received a scholarship from the American Society for Precision Engineering that covered costs for her to attend their 34th Annual Meeting in Pittsburgh. Betters, who works in Professor Tony Schmitz's research group, received the scholarship for her paper, "Additive Manufacturing of Internal Features for Manipulation of Structural Dynamics."

"My personal research is on drilling dynamics in conjunction with KIMM as well as machining dynamics in the hybrid manufacturing process with ORNL," said Betters. "In the long term, I will be studying the location and geometry of sacrificial features to alter the dynamics of an additively manufactured structure to aid in machining steps."

Jake Childs

Doctoral student **Jake Childs** (BME) and Associate Professor **Caleb Rucker** received one of 16 Student/Faculty Research Awards from UT's Graduate School last fall for their project, "Concentric Precurved Bellows: New Bending Actuators for Soft Robots."

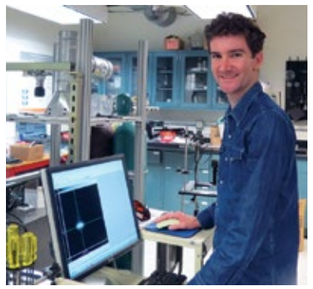
The award provides up to $5,000 in funding, which they will use to explore the use of 3D printing parts to improve the use of soft robots. This new generation of robots has great potential in applications ranging from colon cancer screenings to search-and-rescue robots that can burrow through rubble to rehabilitation exoskeletons that patients can wear.

Doctoral candidate **Cary Smith** (AE) won the 2019 Walter R. Lempert Student Paper Award in Diagnostics for Fluid Mechanics, Plasma Physics, and Energy Transfer.

Smith's winning paper, entitled "Single-Exposure Field-of-View Extension Using Multiplexed Structured Image Capture," was co-authored by MABE Undergraduate Research Fellow **Jacob Harrold**, UTSI Research Professor **Mark Gragston**, and Smith's advisor, Professor **Zhili Zhang**.

The award is presented each year by the American Institute of Aeronautics and Astronautics (AIAA) to honor the legacy of the late Walter Lempert, an outstanding scientist and engineer who had a profound impact on AIAA and the overall scientific community.

Smith's paper was selected due to its "high technical quality and outstanding contribution to innovative advancement of diagnostics for fluid mechanics, plasma physics, and energy transfer."



The $500 award and certificate of merit was presented to Smith at the AIAA Science and Technology Forum and Exposition (SciTech) in January.

A UT team is one of 10 finalists in NASA's annual Moon to Mars Ice and Prospecting Challenge, for their project plan, "This is Now a Drill." The team will be required to build a water extraction device that can drill through soil, find ice, extract and filter water, and provide statistics about the soil. The team is composed of MABE students **Jody Walker**, **Vu Nguyen**, **Gabriel Gonzalez**, **Shayan Shirani**, **Kai Feng Xin**, **Riley Chambers**, **Daniel Block**, and **Kiel Russell**.

Doctoral student **Jiaqi Wang** (ME) is one of nine students who received a Yates Dissertation Fellowship from UT's Graduate School last year.

"He is hard-working, a proven leader, an excellent researcher, and one of the best students I have worked with. This fellowship is well-deserved," said Wang's advisor, Assistant Professor **Seungha Shin**.

Wang's research focuses on accelerated multi-scale computation for mass and thermal transport in metallic materials. He completed his dissertation this spring.

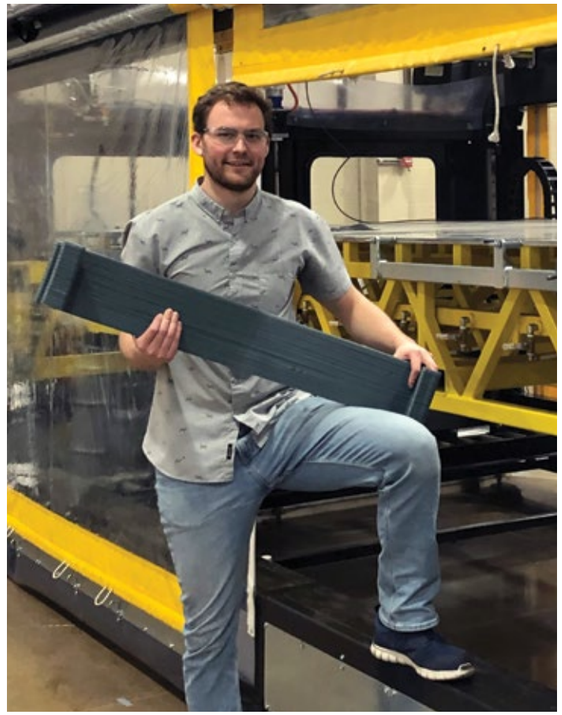
Master's Student **Stian Romberg** (ME) recently received recognition for his research in large-scale thermoset additive manufacturing. The research, being done in collaboration with the Polymer Materials Development team at ORNL's Manufacturing Demonstration Facility, has the potential to address some of the major shortcomings of thermoplastic materials in large-scale printing applications, including z-direction properties, print resolution, and cost.

Romberg's first-author conference paper, "Large-scale Additive Manufacturing of Highly Exothermic Reactive Polymer Systems," submitted to the Society for the Advancement of Material and Process Engineering (SAMPE), was selected for additional publication in the October 2019 edition of the *SAMPE Journal*.

This work studies the novel interactions between curing and exothermic behavior during the printing process and proves the feasibility of large-scale thermoset printing. Results of this research will enable more rapid adoption of the new technology for industrial applications.

Additionally, Romberg contributed significantly to a second conference paper, "Large-Scale Reactive Extrusion Deposition of Sparse Infill Structures with Solid Perimeters," led by ORNL's Chris Hershey, which received publication in the *Journal of Advanced Materials–2019 Best Papers Collection* for the Composites and Advanced Materials Expo.

This communication demonstrates a method to seamlessly transition from sparse infill to a fully dense, machinable surface. This innovation streamlines production of lightweight, large-scale tooling components, and further demonstrates the promise of large-scale thermoset printing.



As he pursues his PhD, Romberg plans to study the manufacturing challenges and mechanical properties of large-scale cellular structures. He hopes to identify more efficient and robust ways to create low density, high-performance structures for use in energy applications and composite tooling. Romberg is working under the direction of Assistant Professor **Brett Compton**. In addition to Hershey, ORNL team members include John Lindahl, William Carter, Alex Roschli, and group leader Vlastimil Kunc.

For a second year in a row, a team of engineering students won first place in the Academic Technology Bowl (ATB) at the National Society of Black Engineers (NSBE) Fall Region 3 Conference in Tampa.

Shannon Sharp and **Kassidy Boone**, both juniors in mechanical engineering, were part the team that competed in the "Jeopardy" style competition against other schools in the Southeastern Conference.

The team won the regional bid to compete in the ATB at the National Convention where they will be competing against teams from the other five regions for the national championship.

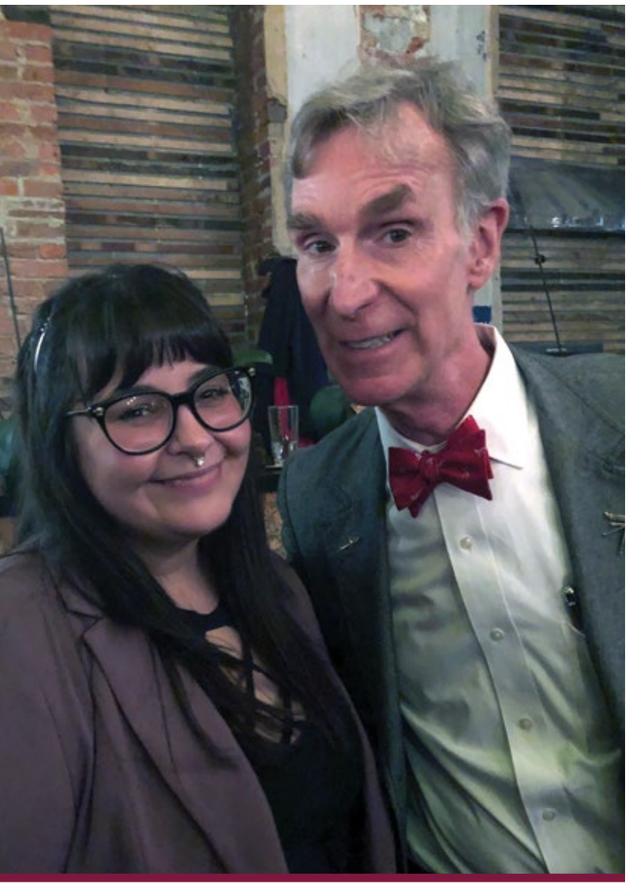
Other engineering students on the team included **Hunter Mann** (computer science), **Mubuso Nkosi** (chemical), and **Sydnee Ruff** (chemical).

(L-R) Hunter Mann, Shannon Sharp, Sydnee Ruff, Kassidy Boone, and Mubuso Nkosi

A Star-Studded
Scholarly Experience

By Kathy Williams.

Samantha Ramsey had an out-of-this-world experience last fall when she attended the 70th International Astronautical Congress (IAC) in Washington, DC.



Ramsey met Bill Nye the Science Guy at the 70th International Astronautical Congress.

Ramsey, a first-generation college student and junior aerospace engineering major, was one of a handful of students selected by the national section of the American Institute of Aeronautics and Astronautics (AIAA) to attend IAC as a diversity scholar.

An Adams Run, South Carolina, native, Ramsey had to go to work after graduating from high school in order to support herself, working for various nonprofits for eight years before she could enroll in college.

"Being a first-generation student and adult returning to college, on top of being a woman in engineering, can be extremely challenging," said Ramsey. "Being selected as a diversity scholar felt almost like an affirmation that, although I may not look like a typical engineering student, I do belong here and that all of my hard work is paying off."

Hosted by AIAA, IAC brought together more than 6,500 people from 70 different countries to celebrate both the 50th anniversary of the Apollo 11 mission and the international accomplishments and partnerships that have become the hallmark of space exploration.

Ramsey shared a table at a diversity luncheon with astronaut Buzz Aldrin, the second person to walk on the moon, attended a private party for the Planetary Society where she hung out with Bill Nye the Science Guy, had breakfast with astronaut Frank Culbertson, lunch with astronaut Sandy Magnus, and met the CEOs and presidents of aerospace engineering giants, including Boeing and Lockheed Martin.

"Attending the IAC was truly a once-in-a-lifetime experience," said Ramsey. "I was also able to connect with international industry leaders, professors at my top choices for graduate school, and even childhood heroes. I have come away completely overflowing with inspiration, and more excited than ever to continue my education."

Ramsey plans to use the knowledge she gained at the conference in research she's doing with the trajectory team at NASA Marshall Space Flight Center under the direction of Stephanie TerMaath, the Jessie Zeanah Faculty Fellow.

Ramsey also spent the summer as an intern on the mission design and analysis branch of the trajectory team at NASA Marshall Space Flight Center, where she studied the celestial mechanics of the earth–moon system and built a program to help automate the process of determining launch windows for future Space Launch System missions.

Although Ramsey isn't sure what the future holds, she aspires to attend graduate school, receive a doctorate in astrodynamics, and possibly study space law, all while continuing to press for diversity in engineering.

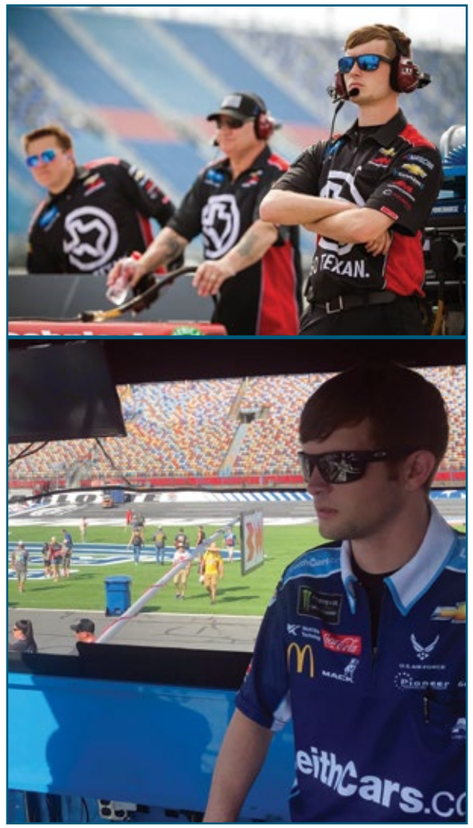
Alumni Twins Land Dream Job with NASCAR

By Kathy Williams.

Working for NASCAR is a dream come true for twin brothers Taylor and Tyler Patterson.

The brothers started working as race engineers for NASCAR shortly after they graduated in December 2018 with bachelor's degrees in mechanical engineering.

"Tyler and I came to the Bristol race so many times growing up and we would always look down from the grandstands at the infield and down pit road hoping that one day that would be us," said Taylor. "This past August, I was able to live out my dream. I was on pit road before the race and actually took a second to look up into the grandstands where we used to sit and thought, 'Man, I can't believe I'm actually down here now.'"



Tyler works in the Monster Energy NASCAR Cup Series for Richard Petty Motorsports No. 43 car driven by Bubba Wallace, while Taylor worked last season in the NASCAR Truck Series for AM Racing's No. 22 truck driven by Austin Wayne Self. This season, Taylor is working in the Xfinity Series for Stewart-Haas Racing's No. 98 car driven by Chase Briscoe.

As race engineers, they play an important role on their teams.

At the shop they run the pull-down rig, a machine that the car is rolled on every week before it's taken to the track that ensures the car is as low to the race track as possible without it hitting the track. They run computerized software that simulates a lap around the track and tells you how your car will react to certain changes. During practice and qualifying, they record notes and give input to the crew chief on changes that could possibly help make the car faster based on driver feedback.

During the races you can find them sitting on top of the pit box on pit road with the crew chief calculating fuel mileage and recording notes. They also look at photos from photographers placed around the track to see if there is anything out of the ordinary that would make them need to make adjustments.

Since the brothers work for different series, they don't run in to each other much at the track, but when they do it can be entertaining.

"We confuse a lot of people in the garage area when we are able to see each other," said Taylor. "It's funny because I'll have guys on his team come up to me and ask, 'Why did you change shirts?', or 'Why are you working for a truck team this weekend?', and the same thing happens to him. We have a good time with it."

During their junior and senior years at UT, Taylor and Tyler were part of the EcoCAR team and what they learned during that time has helped them be successful race engineers.

"Being on the EcoCAR team helped us learn more about vehicle dynamics and strengthening our CAD skills," said Taylor. "The EcoCAR project is a great way for students to gain hands-on experience to help prepare them for future careers in the automotive industry. I've had numerous people in the NASCAR industry tell me that the EcoCAR project is very impressive on my resume."

They also completed two summer internships with NASCAR while at UT.

"The internships definitely helped us land these jobs," said Taylor. "I feel like it would have been impossible to get these jobs without the experiences and opportunities we were fortunate to have by working these internships."

Around the Department

1: UTSI faculty, staff, and students wore matching shirts in celebration of the institute's 55th Anniversary.

2: Students now have a place to study and relax with the opening of MABE's new student lounge in Dougherty this past fall.

3: UTSI renovated its auditorium, now complete with new seating, carpeting, lighting, and an audio system.

4: MABE's business office staff turned in to characters from the movie *Hocus Pocus* for the college-wide office Halloween decorating contest.

5: Forty-six AIAA members traveled to Huntsville, Alabama, and toured the Marshall Spaceflight Center and Dynetics Inc. They posed for a photo in front of the SLS LH2 Tank used for structural testing at Marshall.

6: Several BME students and Assistant Professor Dustin Crouch traveled to Philadelphia, Pennsylvania, last October for the Biomedical Engineering Society Annual Meeting to promote MABE's BME program.

ALUMNI MEMORIES

Charles Bolen ('15 BS/AE) shared some photos from his days on Rocky Top.

Bolen helped paint the rock for the college of engineering during his freshman year in 2010. The crane in the background is during the construction of the Natalie L. Haslam Music Center.

(L–R) Bolen and classmates Matt Graves and Trevor Denton studying in Hodges Library in 2013.

Bolen (left) and classmate Alex Oakley were excited to finish their final exam before graduation.

Send Us Your Photos

Do you have any photographs from your time as a student at UT? If so, we'd love for you to share them with us. MABE is collecting old photos of research projects, lab and classroom spaces, students, faculty, staff, and campus. Please send digital copies to **williamk@utk.edu**. We look forward to rediscovering our past with your help!

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