MOMENTUM

Spring 2021 • Alumni Newsletter

MECHANICAL, AEROSPACE & BIOMEDICAL ENGINEERING

Revolutionizing Prostheses

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On the cover: Assistant Professor Dustin Crouch developss a prosthetic that can be worn inside the body.

From the **Department Head**

Dear Alumni and Friends of MABE,

Thank you for reading the spring 2021 issue of our alumni magazine. I am writing to you as the MABE interim department head as Dr. Matthew Mench recently began serving as the interim dean of the Tickle College of Engineering until a permanent hire is made. Like my previous stint in the same role, I feel honored to serve our department.

It is hard to believe that it has been over one year since the start of the COVID-19 outbreak, but it is starting to look more promising as we try to get back to our regular daily lives. Like many of you, our department, college, and university had to overcome many challenges during this period. We had to move a majority of our classes online, mostly due to physical distancing requirements in our classrooms. Although this was not the ideal means of learning for many students and faculty, everyone adapted to the change and did their part to make the academic year successful. This fall, we will be going back to in-person classes, and we are super excited about it. One positive thing that came out of all of this was the realization of our ability to run online classes. As such, we are currently looking into the possibility of offering fully-online MS degrees in the near future to make our high-quality education available to more students.

The Tickle College of Engineering and MABE have continued to expand our global impact and reputation. Fiscal year 2019-2020 was another milestone for MABE, with research expenditures between UT and UTSI's MABE faculty exceeding $18 million. This achievement is a result of the collective effort of our tremendous faculty, staff, and students, and the successful implementation of strategic thrusts in advanced manufacturing and hypersonics. To support this growth even further we hired a total of six faculty members with another two starting this fall.

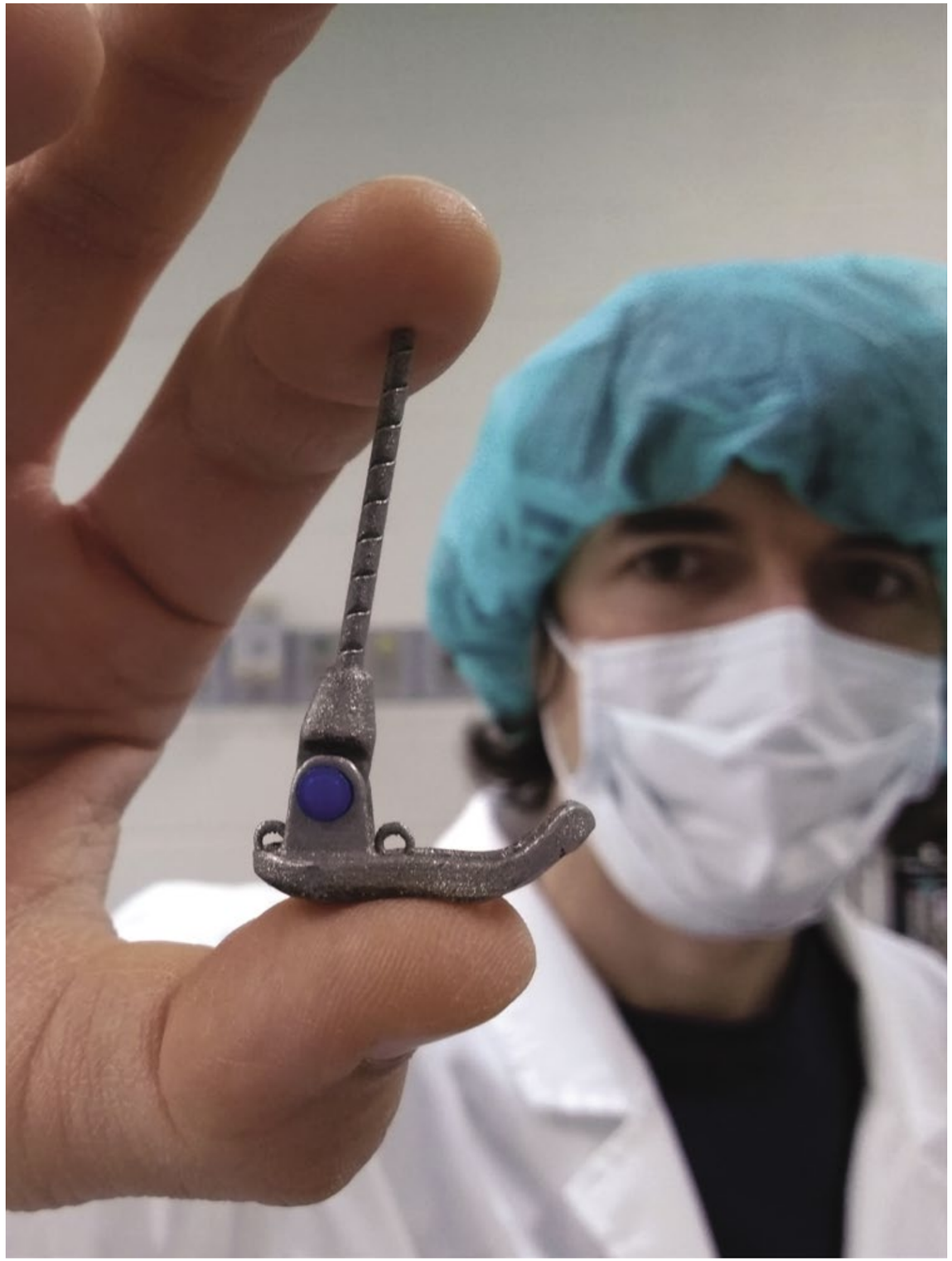
The U.S. News and World Report graduate school rankings were announced last month and our ME program is tied at 38th, placing it in the top 29th percentile among public universities. Our AE program rose one spot to 27th, and our BME program made the highest jump to 58th among publics this year. These rankings would not have been possible without the hard work of our students and faculty.

AE Assistant Professor Damiano Baccarella is our latest Young Investigator Program (YIP) award winner. It's impressive that it only took Baccarella one year after joining MABE to win this prestigious award. His three-year research program, which is supported by the Air Force, will investigate thermochemical non-equilibrium in high-enthalpy hypersonic wind tunnels. This marks the 11th NSF/ONR/AFOSR early career award by active MABE faculty members, which is a testament to the world-class research carried out in the department. Throughout this issue of the Momentum Magazine, you will find other success stories from our faculty and students.

None of these accomplishments would have been possible without your continued support. 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 ability to provide our students and faculty 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



Revolutionizing Prostheses

By Kathy Williams.

Even with the most advanced hardware and movement control technology, current prosthetic limbs still do not move and feel like a person's biological limb. One main reason for this is that current prostheses are worn on the outside of the body and have limited direct contact or physical interaction with tissues responsible for biological movement and sensation.

Assistant Professor Dustin Crouch is working to move prosthetics inside.

Crouch, who runs the Upper Limb Assist Lab in MABE, has been collaborating with the UT College of Veterinary Medicine and UT Medical Center to develop technologies and treatments with the hope of revolutionizing how prostheses are worn and interact with the body.

Crouch's research uses muscle-driven endoprostheses, a type of prosthetic that is completely implanted under the skin and physically attached to the residual muscles and bone, enabling patients to do things they can't do with current prosthetics.

To help further his research, the National Institute of Arthritis and Musculoskeletal and Skin Disease (NIAMS), an institute at the National Institutes of Health (NIH)—the nation's premier biomedical research agency—has awarded Crouch funding for the next two years. The project will be co-funded by the NIH National Center for Musculoskeletal Rehabilitation Research.

> **"The funding will support our long-term goal to develop limb prosthesis that can be completely implanted in the body so they can be physically attached to and controlled by muscles." Crouch said. "We hope this will restore more natural control and sensation of movement to people with amputation."**

Crouch's team is currently in the initial testing and design phase of the project.

"The function that a person has with an implanted, muscle-driven prosthesis will depend on many things," said Crouch. "One of them is how well the muscle can recover after amputation and reattachment to the prosthesis."

With the NIAMS funding, Crouch will investigate the effects of the prosthesis and the muscle reattachment timing on muscle recovery and limb function.

Crouch hopes that, in the near future, his research will make an impact in the lives of the more than 2 million people who have undergone an amputation or had a limb removed for medical reasons.

New Program Aims to SERVE Veterans

By David Goddard. Photography by Steven Bridges.

Tennessee has a long history of supporting the military, with the origin of the state's nickname, its flagship university, and schools across the state attesting to the willingness of its citizens to serve in the nation's military in times of need.

Now, the University of Tennessee has found another way to support its veterans through a new program initiated by a grant from the Office of Naval Research (ONR): the Shaping Experiential Research for Veteran Education program (SERVE), which aims to engage veterans in experiences that address research priorities of the US Navy and boost the number of veterans with graduate degrees in STEM fields.

SERVE is an extension of a similar ONR-supported program at the University of North Carolina, Charlotte, that has been successful in supporting veterans in that state. The two major components of SERVE include a focus on mentoring and summer undergraduate research experiences.

"One of the key components to this whole concept is the idea of establishing mentor-mentee relationships, which could also include active duty personnel and ROTC cadets," said program lead and MABE Research Professor Bruce LaMattina. "Those relationships, along with the hands-on research that our students conduct, will provide a valuable holistic experience for program participants."

Student research projects will start in the summer of 2021 and be chosen based on relevance to the military and from businesses that support military missions and goals. Participants will also have the chance to work on projects with Oak Ridge National Laboratory and Y-12, among others.

"This program is a win for the students, the Navy, UT, and our partners at the University of North Carolina, Charlotte," said LaMattina. "The Volunteer spirit is here at UT and this program will allow us to serve and prepare those whose own service protects our freedom."

SERVE was awarded $750,000 over three years from the ONR Navy and Marine Corps STEM Education and Workforce program.

"Veteran women and men are a growing national resource encompassing capabilities and experiences beyond those obtainable in civilian life," said Michael Simpson, director of education and workforce at ONR. "SERVE is a strategic partnership that will enable further development of select individuals, their mentors, their institutions, and national security."

"By involving veterans in STEM research, we hope that they will bring their experiences and willingness to serve to help the drive towards developing new and innovative future Naval capabilities," said Margo Staruch, a research physicist at the Naval Research Laboratory, which will provide research mentorship and guidance to SERVE participants. "I look forward to collaborating with the students to help them advance their own careers and advance potential new capabilities for our military."

LaMattina said the initial goal is to have nine or ten students enter the program per year, with two or three scholarships available when the program launches, along with two graduate research assistantships. Recruiting efforts to draw students into the program will be closely coordinated with UT's Veterans Resource Center and the Division of Diversity and Engagement.

Milling with Purpose

Response to Unique Course a Pleasant Surprise

By David Goddard.

Advanced manufacturing has rapidly gone from a concept developed and practiced mainly in research centers to establishing itself as a major influence on industry.

Its impact is being felt across Tennessee, which exports more than $30 billion in manufactured goods per year according to state figures, and particularly in East Tennessee, with centers at UT, ORNL, and elsewhere helping push the knowledge and applications of this new method of production.

Employers are understandably eager to have their workforce stay in tune with the latest advancements, and a program being led by Professor Tony Schmitz is helping them do just that.

"We set out with a goal of helping train workers in techniques and processes that are at the forefront of advanced manufacturing," said Schmitz. "We wanted to make sure that everyone from machinists to engineers to designers could benefit from the course, and we were hopeful that we might see a good response and interest in participating."

It is all a part of a larger initiative known as America's Cutting Edge (ACE), a US Department of Defense-sponsored effort sponsored by the Office of Industrial Policy's Industrial Base Analysis and Sustainment Program.

IACMI-The Composites Institute, ORNL, and Pellissippi State Community College are the other major players in the local version of the ACE initiative, which is specifically focused on training with computer numerical control (CNC) machining and computer aided manufacturing (CAM).

UT-ORNL Governor's Chair for Advanced Composite Manufacturing Uday Vaidya, who is IACMI's chief technology officer and also serves in MABE, is helping with the course as well, providing an additional opportunity for those taking part to gain materials knowledge from an additional expert in the field.

The response to the idea has exceeded even their wildest expectations, with more than 1,000 people from 41 states having signed up in less than 90 days after its initial launch.

One reason for the incredible interest is that the course is available to high school, community college, and university students, as well as people already making careers in various manufacturing-related activities, all drawn from across the US.

Another advantage of the course is that there is no cost to participate.

Critically, the first portion of the course is specifically tailored for online learning, making it the perfect offering during the ongoing pandemic.

"CNC and CAM play major roles in our course, with tutorials and instruction given that lead to the production of an example part over the course of several lessons," said Schmitz. "The critical role of vibration in the selection of CAM operating parameters is a key aspect of the training, including an app that enables participants to simulate the performance of machining operations on their computer."

This summer, a limited number of students will be able to complete in-person training with the various partners to complement the online instruction.

For his part, Vaidya will talk about some of the challenges that arise when machining is applied to fiber composites.

"It requires you to use different tools than you would in a situation that involved milling or drilling of traditional materials," Vaidya said. "We want to make sure participants have a chance to see the relationship between various materials and the techniques you might use to process them."

All of which should help the region, the state, and the country stay ahead of the curve when it comes to manufacturing.

Caresoft Tech Puts UT Auto-Designers

Behind the Wheel and Under the Hood

by Laura Tenpenny.

Those of a certain age may remember a certain fictional teacher, Ms. Frizzle, and her magic school bus. Said bus allowed Frizzle and her students to visit unseen worlds in precise detail—even the insides of the bus itself. Now, a generous gift from Caresoft Global will give engineering students a similar benefit.

Students will be able to view some of the latest, cutting-edge vehicles, including the Tesla Model 3, from exterior to rivets in virtual reality (VR). Ultimately, it will give students and faculty the chance to impact future automotive design.

> "This software takes us well beyond conventional book-and-lecture education format and trains our students on an industrially relevant platform for automotive design and simulation."
>
> —Matthew Mench, Interim dean of engineering.

Caresoft donated exquisite 3D CAD images and complete teardown data for a number of vehicles as well as an analysis application with the ability to upload new designs and run simulations to test them in real-world scenarios like a car crash. Users can perform assessments and benchmarking processes, comparing their designs against some of today's most technologically advanced vehicles.

"Industry-academia collaboration plays an essential role to innovation, and Caresoft is doing its bit so that teachers and students have the latest data and tools," said Prideep Subramanian, Director of Sales, North America at Caresoft Global. "The vehicles to come will be built in a modular, cost-efficient fashion that uses less materials and offers higher range of travel. Students can learn about these technologies and be prepared to contribute to future vehicles."

This robust technology, which will integrate mainly into the mechanical engineering curriculum, will open up high-level design testing and other opportunities, from senior design projects to potentially groundbreaking faculty research.

Alumnus, Rob Tiede (BBA '97), initiated this collaboration through his work with The Charlton Group, a privately held, international consortium with activities in multiple sectors, including transportation and technology.

"Charlton endeavors to improve the lives of Tennesseans with philanthropic ventures, advocacy, and educational support, such as this Caresoft-UT partnership," said Tiede. "As a UT graduate, it's a pleasure to help prepare future industry leaders from my alma mater."

UT is one of just a few universities worldwide to have received this product. Since its beginning in 2007, Caresoft has become a sought-after partner of auto manufacturers looking for answers to engineering problems, and dozens of their clients are using Caresoft's technology.

Now, engineering students and faculty have access to current technology of the automotive industry and the opportunity to put some Big Orange fingerprints on the future of automotive design.

Top photo: Digital-Twin of full vehicle, high energy scan and CAD cross-section in great detail, © 2020 Caresoft Global, Inc.

Hypersonic Research Gets a Boost

By David Goddard. Hypersonic lab photography by Sam Thomas.

With speeds in excess of five times the speed of sound, hypersonic flight holds promise as a way to improve a number of fields, national security among them.

The UT Space Institute in Tullahoma has been at the forefront of hypersonic flight for several years, and it just got a major boost to ensure it will continue to lead.

The Department of Defense (DOD) has chosen UTSI for a $500,000, 12-month award to help increase the speed at which hypersonic-related technology is developed and implemented. UTSI was one of only eight institutions so honored.

"Hypersonics is a top modernization priority for DOD," said Mark Lewis, acting deputy undersecretary of defense for research and engineering, in announcing the selections. "We are mobilizing government, industry, and academia to provide real capabilities to our warfighters. That begins at the basic research level as exemplified by these exciting university activities."

UTSI's hypersonics efforts are largely led by H.H. Arnold Chair John Schmisseur, whose work in the US Air Force spanned 23 years, including his initial look at theoretical hypersonic flows in 1992.

This latest funding is the continuation of a string of successes that Schmisseur has had since joining UTSI six years ago, including two different US Air Force projects related to airflow generated by and materials used in hypersonic flight; and the development of the Tennessee Aerothermodynamics Laboratory, which has one of the largest wind tunnels in use in academia.

"Hypersonics is an area of research that is important to national security, yes, but it's also important to our state," said Schmisseur. "Aerospace- and defense-related work are the fourth biggest part of our state's economy, so an investment in UTSI is also an investment in the state of Tennessee."

One of the largest wind tunnels in use in academia is housed at UTSI.

Each of the eight universities selected will work on a different area related to hypersonic flight, with UTSI's role being the development of a core curricula to help train a hypersonics-focused workforce, both for current professionals as well as future students.

It's all part of the DOD's plan to create a University Consortium for Applied Hypersonics, which it hopes to have fully functioning sometime this fall.

Jake Dvorak loads a donated YG 1 alu power end mill tool into a milling machine in the MABE Maker Lab.

YG-1 Makes Generous Tool Donation

To show their support for higher education and the research being conducted at UT, YG-1—a global leader in precision cutting tool design and production—donated over $120,000 worth of cutting tools to MABE.

"As a family-owned business, YG-1 strongly believes in helping to develop the future of manufacturing," said YG-1 Regional Sales Manager Cullen Morrison. "The strength of manufacturing in the USA and around the world depends largely on the knowledge and experience that the next generation of engineers and machinists will come to the market with and expand upon. With this donation of various products from nearly all of our offerings, we hope the students and researchers will get experience with this mass production level tooling that otherwise may not have been possible."

The tools will help Professor Tony Schmitz and his students with their machining research at the Machine Tool Research Center. They will use the tools to perform experiments to support machining research efforts and collect data for process modeling and validation.

Faculty Recognized for Cited Research

Having your work cited by peers as they conduct their own studies is a sign of quality, respect, and success for researchers around the world, regardless of discipline.

Stanford University has created a ranking of scientists based on the number of citations received throughout the course of their careers, coming up with a list of more than 150,000 people representing the top 2 percent of cited researchers in the world.

Of those, 54 current or former faculty members of the Tickle College of Engineering made the list, with 8 being from MABE.

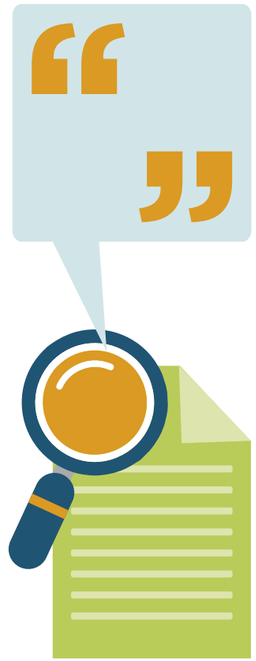
The citations stretch 56 years from 1964 through 2020.

MABE faculty to make the list are:

Name	Citation Score	Subject Field (According to the study)
Matthew Mench	3.875465867	Energy
Suresh Babu	3.848551838	Materials
Tony Schmitz	3.694875324	Industrial Engineering and Automation
Uday Vaidya	3.225393219	Materials
Kenneth Kihm	3.222164727	Mechanical Engineering and Transports
*John Landes	3.158810413	Mechanical Engineering and Transports
*Jay Frankel	3.098944456	Mechanical Engineering and Transports
Mohamed Mahfouz	3.063438756	Networking and telecommunications

**Denotes emeritus status*

MABE faculty also stood out with Doug Aaron, Brett Compton, Jim Coder, Zhenbo Wang, Babu, Mahfouz, Mench, Schmitz, and Vaidya making the single-year citation list.



Hacks of Life

One New Lab is Enabling Students and Community Members

By Laura Tenpenny. Photography by Yvette Gooden.

In the depths of Dougherty, a "life hacks" lab appeared just a few months prior to the COVID-19 pandemic. Its proper name is the Dr. H. Lee Martin 3D Prosthetics Laboratory.

> "The department and I provided initial funds to create a lab to support a student group involved in making prosthetic devices for simple common activities, and their results could then be posted online for others to use," said Martin, the lab's namesake. "Great idea!"

While open to all students, the lab's primary purpose serves the Life Without Limits student group, which comes up with "life hacks" in the form of prosthetics for folks in need. These designs are made available online, but the group also makes and mails devices to those without access to 3D printers.

"The lab has been outfitted with state-of-the-art 3D printers, which students are constantly using to make prototypes for refining their designs," said Associate Professor Chad Duty, faculty supervisor for the group. "It has enabled and inspired students to use their creativity and engineering skills to help others within our community and across the country. We're immensely grateful for Dr. Martin's generosity."

Martin retired in December, but for 20 years, he taught in various disciplines at UT. During that time, he gave financially to establish and support many programs in the college (most recently this new lab space), initiated an entrepreneurship minor for the college, and has served on the MABE Advisory Board for over a decade.

Through his involvement with the board, he helped integrate mentorship in the MABE curriculum.

"Helping students understand the value and process of finding mentors and utilizing them will serve these students throughout their lives," said Martin. "Seeing students grow and blossom, seeing them create ripples in the world, that's really exciting and the most gratifying for me."

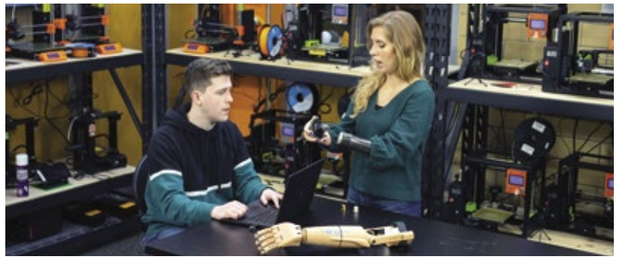
A bonafide entrepreneur, Martin has developed technologies and businesses that have created ripples all their own. Of particular note, his venture with iPix brought 360-degree video technology to the world. You have likely benefitted from it by virtually touring properties online when considering a new home.

And he loves seeing young engineers also begin to affect positive change, like they are doing through this new lab.

"To encourage students to think beyond themselves and serve others, that's just part of being a valuable part of the community, and it's important to the full rounding out of a person's life," said Martin.

Even during the pandemic, Life Without Limits has used the lab to make face shields for frontline workers and held a virtual workshop for "Amp Camp", a limb loss rehabilitation summer camp, where attendees were introduced to CAD and 3D printing.

"Engineers are problem solvers, and these are engineers with hearts to serve," said Martin. "Who knows what else will come from these students, Dr. Duty, and the lab."



If you would like to help the Life Without Limits group continue their efforts to improve the lives of individuals with a limb difference, get in touch by calling 865-974-2779 or email **engrdev@utk.edu**.

Acharya Adds Her Hypersonic Expertise to UTSI Programs

By Randall Brown. Photography by Laura Horton.

Ragini Acharya brings a wealth of academic and industry experience to her role at the UT Space Institute (UTSI), where she joined in August of 2020 as an associate professor in mechanical and aerospace engineering. Her addition to the UT hypersonics team strengthens programs for students, industry partners, and the community.

Her recent years in industry found her establishing a home in Madison, Alabama, where she worked as the hypersonic propulsion lead at Raytheon Missiles & Defense in nearby Huntsville. Acharya wanted to return to the academic and research side of engineering, but did not want to relocate her family. The opportunity to join the UTSI faculty was fortuitous and welcome.

"At this point of my career, the position at UTSI aligned with my research goals and proximity to my current residence," she said. "It enabled me to become faculty at a school with closely aligned research goals in hypersonic propulsion without causing disturbance to my daughter's schedule, especially with ongoing school."

The hypersonics expert also enjoys the scenic 90-minute commute to UTSI's Tullahoma, Tennessee, campus, where she focuses on a next-generation computational approach to research challenges. The research goal is to enable a truly predictive computational solution to complex problems in high-speed applications.

Acharya feels that her most significant technical contribution to this approach is in uncertainty quantification enabled high-performance computing (UQCFD). Her research supports national defense and security. She believes that her greatest impact is through the mentorship that she has provided and will provide.

"I have worked in development of high-pressure rockets, propulsion system for high-speed missiles, aerothermodynamics, ablation, and thermal protection system for high-speed missiles," she said.

Her industry background includes leadership roles with companies such as the Raytheon Technologies Research Center in Connecticut and CFD Research Corporation in Huntsville. Acharya's accolades for her work included election as an associate fellow of the American Institute of Aeronautics and Astronautics (AIAA), election as AIAA STEM outreach director in Huntsville, nomination for the Mead Award for work on the solid rocket modeling for United Technologies Aerospace Systems, and numerous best paper awards.

This foundation of experience informs connections beyond the classroom for her current position.

"It helps me to view the strategic impact of my research goals and how they support UTSI's strategic vision for academic leadership in key thrust areas for aerospace and defense research," said Acharya. "My industrial training has enabled me to view the 'big picture' impact of academics, shaped my vision of the academic research on supporting industry and government, and hopefully I incorporate this experience in how we train our students to be prepared for industrial leadership."

Outside of the research and academics of making rockets go faster, she enjoys the gentler pace of family-time activities around the region with husband Paul Palies, who will also be joining the UTSI faculty, and their 5-year-old daughter.

"We like fishing, swimming, hiking, and getting together with her friends on play-dates," said Acharya, who also likes to exercise skills outside of computational modeling. "I enjoy cooking a lot and am very good at it."

Faculty News

In March, Department Head **Matthew Mench** began serving as the interim dean of the Tickle College of Engineering. A national search is currently underway and Mench will serve as interim until the next dean is hired. Associate Department Head Kivanc Ekici is serving as interim department head during Mench's absence.

UT RESEARCH FOUNDATION
TECHNOLOGY MATURATION GRANT
2021

Associate Professor **Caleb Rucker** and Research Assistant Professor **Ryan Ginder** each have a little something extra to celebrate as they begin the new year—a Technology Maturation Grant from the University of Tennessee Research Foundation. The grant includes $10,000 in funding to assist them in advancing new technologies that are on the path to market and benefit society.

Rucker received the grant for his project, "Modular Soft Robot Grippers Using Concentric Precurved Bellows," in which he is developing technology to make soft robots bend and move.

The grant funds will allow Rucker and his PhD student Jake Childs to prototype and conduct experiments that assess the technology's suitability for various applications, as well as enable them to fabricate bench-top tested robots to showcase to potential industrial partners. They will also explore different manufacturing methods such as electroforming that can miniaturize the technology down to scales appropriate for minimally invasive surgery.

Ginder received the grant for his project, "Recycling of Wind Turbine Blades into Nonwoven Composites for Fuel Cells," and will use the funds to demonstrate nonwoven composites molded from recycled glass fiber mats with relevant additives, test and optimize nonwoven composites for mechanical and conductivity performance, and mold and validate the fuel cell composite bipolar plates in test operation.

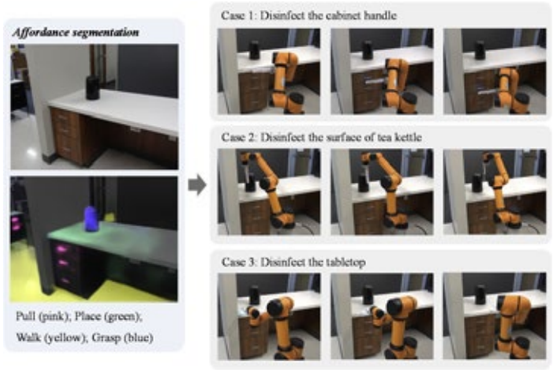
CE-AR
COMPUTATIONAL AND EXPERIMENTAL AEROSPACE RESEARCH LAB

Associate Professor **Trevor Moeller** has been named a fellow of the American Society of Mechanical Engineers (ASME), a prestigious honor given to ASME members who have been responsible for significant engineering achievements, had no less than ten years of active practice in their respective field, and at least ten years of active corporate membership in the society.

Moeller is director of the Computational and Experimental Aerospace Research Lab at the UT Space Institute in Tullahoma. His research interests include high-temperature gases, high-speed flows, rocket propulsion, electric propulsion thruster diagnostics, and developing and modeling probes for high-enthalpy flows.

The American Society for Precision Engineering (ASPE) has named Professor **Tony Schmitz** to their inaugural class of College of Fellows. This prestigious honor recognizes exceptional members of the society who have made outstanding contributions to the art and practice of precision engineering through original research, innovations, education and outreach, or service to the profession.

Schmitz, who served as the 2019 ASPE president, was officially inducted into the College of Fellows during the virtual ASPE Annual Meeting last October.



Professor **Jindong Tan**, along with Civil and Environmental Engineering Professor Qiang He and Assistant Professor Shuai Li, recently received the Best Paper Award from Building and Environment for their paper entitled, "Segmenting areas of potential contamination for adaptive robotic disinfection in built environments," published in October, 2020.

The research collaboration seeks to integrate robotic decontamination and infrastructure design, which could help mitigate the threat of pathogens like COVID-19 in buildings of mass gatherings such as airports, offices, and restaurants.

The research aims include:

- Developing a deep-learning method to segment areas of potential contamination
- Mapping potential contaminated surfaces in 3D to guide robotic disinfection
- Generating adaptive motion trajectories for complete and safe robotic disinfection
- Conducting simulations and experiments to validate the proposed robotic disinfection

In February, **Peng Zhao** joined the department as an associate professor of mechanical engineering and is located at the UT Space Institute in Tullahoma. Previously, Zhao worked as an assistant professor at Oakland University. He received his master's and PhD from Princeton University in 2011 and 2015, respectively. His research interests include combustion and reacting flow, advanced powertrain and propulsion systems, alternative fuels and chemical kinetics, numerical simulation and computational diagnostics, and thermal management and safety of lithium-ion batteries.

Assistant Professor **Damiano Baccarella** is one of 36 scientists and engineers across the country to be awarded the Air Force Office of Scientific Research (AFOSR) Young Investigator Research Program (YIP) award. The award provides Baccarella with a three-year grant totaling $450,000 to fund his research proposal, "Quantification and Mitigation of the Thermochemical Non-Equilibrium in High-Enthalpy Hypersonic Wind Tunnels."

This marks the first award for Baccarella since joining MABE in 2019.

> "It definitely means a lot to me to win this award," said Baccarella. "The High-Speed Aerodynamics program at AFOSR led by Dr. Sarah Popkin is the place where the major advances in the field of hypersonics are made. This award gives me the opportunity to become part of that community and be at the bleeding edge of hypersonic research."

Baccarella's experimental research project will investigate the effects of thermochemical non-equilibrium in high-enthalpy hypersonic wind tunnels. Non-equilibrium is a typical phenomenon occurring in hypersonic flows that complicates the matching of wind tunnel data with actual flight conditions.

This study aims to provide a better understanding of non-equilibrium and to develop strategies to quantify and possibly mitigate its effects. The completion of this work is expected to allow a closer matching between ground testing and flight data, enabling unprecedented research capabilities in hypersonics.

"This is a fantastic early career award for Dr. Baccarella and is an indicator of the world-class faculty we have been able to recruit into our AE program," said Tickle College of Engineering Interim Dean Matthew Mench.

Baccarella will be performing his research in his state-of-the-art Tennessee Hypersonics and Propulsion Laboratory (THPL), currently under construction and expected to be completed early next year.

Rice Helps Set the Pace for Stroke Recovery

By Randall Brown. Photography by Yvette Gooden.

Ashley Rice traded coastal sights for mountain life and physics for mechanical engineering when she chose her graduate-study path. A native of Aiken, South Carolina, she finished her undergraduate degree at the College of Charleston and arrived at Rocky Top to work toward her PhD with Associate Professor Jeff Reinbolt's research group.

The pace of life has stepped up along with the experiences of new territory.

"There's a lot more to do in Knoxville compared to Aiken, and the urban wilderness we have here is unbeatable," said Rice, who enjoys hiking and just getting outside whenever possible.

> "We want to know how to optimize a treatment so that participants maximally benefit and regain as much motor function as possible."
>
> —Rice

She admits missing having beaches nearby—and Charleston's famous cuisine.

"The food in Charleston is fantastic," said Rice. "But there's nothing quite like the mountains we have here, so it's a nice trade. I also like going to a large SEC institution where school pride and sports are so closely intertwined."

Another trade she appreciates is finding concrete ways to apply her background in more conceptual data.

"My favorite course in undergraduate physics was classical mechanics," said Rice. "I really enjoyed learning how equations—just a bunch of letters and numbers—can model real-world motion and systems."

Her fascination helps her wield the data to make a healing impact for people undergoing physical rehabilitation after a stroke.

"The opportunity to apply this to data collected from real people, while at the same time being able to contribute to improving rehabilitation efforts and treatment design, was something I was really excited about," she said.

Rice and team look to develop and customize predictive models to answer the question of how well a prescribed treatment will contribute to improving an individual stroke victim's motor-control capacity.

"Currently, we're working on musculoskeletal modeling of post-stroke gait," she said.

Metrics to judge post-stroke motor control vary person-to-person: Some people improve and some don't. The team uses multiple machine learning algorithms to match the metric with the person, based on pre-therapy baseline measurements of their walking ability.

"We can likely have a good model in place to figure out if this treatment will be suitable for this individual," said Rice.

Rice and colleagues performed hundreds of simulations and grouped results based on levels of motor-control capability.

"We're using a special statistical method to capture the time-dependent differences between each group," she said. "This information will tell us what aspects to target during rehabilitation, depending on which group the person falls in."

Rice's work with the Reinbolt group has given her valuable, and enjoyable, experience in the field.

"It's allowed me to dabble in a lot of areas, from biomechanics to modeling to statistics and beyond, so it's opened a lot of doors," she said. She has become particularly interested in statistics and machine learning, and how these help to extract information and draw conclusions from data. "I'm considering careers then in data science, where these techniques can be applied broadly to all sorts of data."

Rice's research contributions show off the Volunteer Spirit in one of the truest ways possible: applying science directly towards improving the human condition.

Graduate Research Assistant **Ryan Copenhaver** is a recipient of the American Society for Precision Engineering (ASPE) Student Scholarship. The scholarship includes a monetary gift, free registration to ASPE's Virtual 35th Annual Meeting last fall, and free registration for four tutorials offered during the meeting.

Copenhaver is a member of the Machine Tool Research Center (MTRC) that is led by Professor Tony Schmitz. Copenhaver worked in the center when it was located at the University of North Carolina Charlotte, and moved to UT with Schmitz and the MTRC in May, 2019.

Copenhaver's research focuses on a custom chip-breaking strategy called Modulated Tool Path (MTP), which ensures that discontinuous chips are generated in turning operations by superimposing sinusoidal oscillations in the feed direction of the cut. Specifically, his research involves predicting cutting stability using the input machining parameters.

Sreya Kumpatla, a sophomore in aerospace engineering, earned a scholarship from the American Association of University Women to attend their May 2021 conference.

Kumpatla, no stranger to being accredited with numerous awards, is a Peyton Manning Scholar and currently serves as an ambassador for the Tickle College of Engineering. She is also involved in many numerous organizations on campus. She currently serves as the aerospace engineering ambassador for the Society of Women Engineers on campus. Along with that, she is also the elementary education chair for the event Tomorrow's Engineers Today.

Kumpatla initially learned about the scholarship from one of her mentors, the college's Assistant Director of Advising Lisa Byrd.

"One day after class, she pulled me aside and asked me if she could nominate me for this scholarship, because of the great potential I had been showing in my organizations," she said.

Kumpatla was elated when she learned she had received the scholarship.

"It was a great feeling when I found out," she said. "It is a lot of support and faith that has been put in me, with this award because I never thought I would even get it in the first place."

While it is still up in the air if the conference will be occurring in person or virtually, Kumpatla remains positive.

"This scholarship is also something that is giving me hope," she said. "And something to look forward to as the unusual circumstances of COVID have impacted this school year."

Jeffrey Martell, a junior majoring in aerospace engineering, has received a Lockheed Martin STEM Scholarship, being one of only 200 students out of 6,333 applicants to receive the prestigious honor. Of the recipients, only 28 are aerospace engineering majors.

The scholarship provides Martell with $10,000 every year that he remains in school. The financial support gives him the freedom to pursue other interests and clubs on campus, allowing him to get more involved in the Volunteer Spirit in ways that he might not have gotten to otherwise.

Martell has held leadership positions in various clubs on campus including the media director of Engineers without Borders, vice chair of the American Institute of Aeronautics and Astronautics student chapter at UT, and over the past two years has also been active in multiple research projects on campus.

Martell loves being a Tennessee Volunteer and can often be seen around campus on game days or Big Orange Friday decked out in his orange and white checkerboard suit.

Martell hopes to obtain an internship this summer to gain some real-world experience in his field. After graduation, he wants to attend graduate school and obtain his master's degree.

"I could definitely see myself trying to work for some of the big guys in aerospace engineering, like NASA and Boeing," said Martell. "That is definitely a dream I have had for some time now."

Like many Volunteers before him, this scholarship has ignited the fire within Martell and will continue to drive him to excel in his undergraduate studies and into the real world of aerospace engineering.

Ringley Beats the Odds

By Kathy Williams. Photography by Yvette Gooden.

2020 was an unforgettable year for graduate student Jessie Ringley, but not for the obvious reasons.

Ringley marked the year with earning his bachelor's degree, starting graduate school, and building a world-record-setting engine, to name a few.

"I love science, and I love trying to understand the physics of the world around and in us," said Ringley. "Being a grad student at UT is training me to be a successful scientist, broaden my area of expertise, and learn things at a new level of detail."

Following high school, Ringley went straight into the workforce, landing a job in the manufacturing industry where he quickly caught on to the technical side of automation processes. He eventually began to outpace the learning curve of the engineers he worked with, and started writing programs to solve machining problems, which was usually a job for the engineers.

After nine years in industry, Ringley realized he was smart enough to be an engineer and decided he wanted to go back to school. In the summer of 2013, at the age of 27, he did just that. He enrolled at Walters State Community College and earned his associate's degree in mechanical engineering in the fall of 2017.

Earning that degree gave Ringley confidence in himself and motivated him to keep going further with his education.

In 2018, he enrolled in the mechanical engineering program at UT and was accepted with open arms, even though he didn't fit the description of a traditional undergraduate student.

During his junior year, he was introduced to the research side of engineering when he joined the Bioinspired Materials and Transduction Laboratory led by James Conklin Fellow and Associate Professor Andy Sarles. This allowed Ringley to expand beyond his mechanical engineering background and paved the way for him to accomplish his dream of becoming a research professor.

With support from his professors and a lot of hard work, Ringley completed his bachelor's degree in mechanical engineering last spring and was accepted into the graduate program last summer.

"I love this school, the professors, and the supporting staff, and owe UT a lifetime of gratitude for the multiple avenues of success it has given me," said Ringley.

He is continuing his graduate studies in the same lab, performing research that focuses on creating next-generation smart devices from biological materials using the droplet interface bilayer technique, which mimics the structure, composition, and transport properties of cell membranes.

Last fall, during his second semester as a graduate student, Ringley submitted his first journal paper for publication.

"This is my personal proudest accomplishment, as I have longed to give back to the scientific community that has taught me so much," said Ringley.

The understanding of materials, circuits, and combustion engines he gained during his undergraduate studies is also helping Ringley be successful with another one of his loves—building world-record-setting engines.

Ringley developed racing parts and go-fast solutions that he used to build a record-setting engine and turbo package for the Ecoboost 4-cylinder platform. In December, he set a record as having the first 4-cylinder Ecoboost to produce over 800 horsepower to the wheels with only 2.3 liters of displacement, and also holds the record for the fastest Ecoboost of any engine displacement in the world through the 1/8 mile with a trap speed of 118-mph. He is only tenths of a second away, in the quarter mile, from having the fastest Ecoboost of any displacement in the world.

The success of his cars has led to Ringley starting his own business building engines, which has exploded over the past year with the demand to build three to five engines each month.

"Despite the current economy, the faster I go and the more power I make, the more my business grows," said Ringley.

He doesn't have much free time these days, but Ringley has figured out a way to make it all work as he pursues his dreams. He hopes to set more world records with his engines this year as he continues his research and works toward his goal of becoming a research professor.

Beating the odds himself, Ringley encourages everyone to follow their dreams no matter the circumstances.

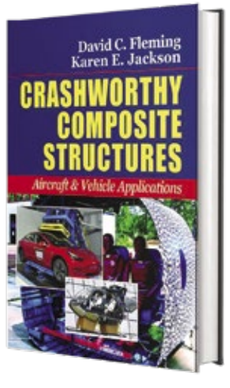
"Don't let anyone tell you going back to college is too hard, you're too old, you're too busy, or that it is too late," said Ringley. "If you want to become a scientist or have a love for science and engineering, embrace it and chase it. With determination and proper time management skills, you can do or be anything you want. I like to think we are the creators of our own life, so go make it happen!"

Alumni News

Jackson Retires from NASA, Co-Authors Book

MABE alumna Karen E. Jackson is co-author of the recently released book entitled, *Crashworthy Composite Structures: Aircraft and Vehicle Applications*, that investigates the design and implementation of effective crashworthy composite structures.

Jackson received her bachelor's degree, with highest honors, in engineering science and mechanics in 1981, and began her career as an aerospace engineer at NASA Ames Research Center after graduation. She transferred to NASA Langley Research Center in Hampton, VA, within a year of starting work. During her tenure at NASA, she earned her master's and doctoral degrees in engineering mechanics from Virginia Tech. She performed research in aircraft and rotorcraft crashworthiness, particularly focusing on nonlinear explicit transient dynamic finite element simulations of structural impact events, which resulted in over 165 technical papers. In addition, Jackson has received several major awards including the H. J. E. Reid Award for the best technical paper in 2003 and 2009 at NASA Langley Research Center. In 2008, she was presented with an Exceptional Service Medal by NASA and the Department of Defense. In 2010, she was named technical fellow of the American Helicopter Society (now called the Vertical Lift Society), and, in 2017, Jackson was awarded the prestigious AHS Nikolsky Lectureship, which is presented to "an individual who has a highly distinguished career in vertical flight aircraft research and development and is skilled at communicating technical knowledge and experience."



After 37 years of federal service, Jackson retired from NASA in 2018, and is currently working as a part-time contractor for NASA through the National Institute of Aerospace as a senior research engineer.

Emily Beckman Wins 20 Twenties Award

In 2020, MABE alumna Emily Beckman (BS '18) was recognized as one of Tomorrow's Technology Leaders: The 20 Twenties by Aviation Week Network in collaboration with the American institute of Aeronautics and Astronautics (AIAA).

The award recognizes students earning STEM degrees who are nominated by their universities on the basis of their academic performance, civic contribution, and research or design project.

Beckman was nominated for the award by Purdue University while pursuing her master's degree in aerospace, aeronautical, and astronautical engineering. Her research focused on modeling slosh in small-satellite conformal tanks.

"I was excited to receive the 20 Twenties Award," said Beckman. "I remember seeing the yearly winners when I was in undergrad, and never really expected to be awarded myself."

While at UT, Beckman was mentored by Professor and H.H. Arnold Chair John Schmisseur and Jessie Rogers Zeanah Faculty Fellow Stephanie TerMaath, who she credits for spring-boarding her career.

Beckman completed her degree at Purdue in December and is now working as a propulsion engineer on the Europa Clipper mission at NASA Goddard Space Flight Center.

Scholarship Honors Alumnus William G. Swann

Thanks to the generosity of Joe and Lisa Swann, the William G. Swann Mechanical Engineering Memorial Scholarship Endowment has been established for mechanical engineering students who are veterans or member of the Pride of the Southland Band.

The scholarship is named in honor of Joe's father and MABE alumnus William G. Swann, who received his bachelor's degree in mechanical engineering in 1968 after serving in the United States Air Force from 1962–66.

Joe also graduated from UT, earning his bachelor's and master's in civil engineering in 1993 and 1995, respectively. The first scholarship will be awarded to an eligible student next year.

Conference Room Named in Honor of Howard Chambers

Room 409 in the Dougherty Engineering Building is now the Howard E. Chambers Conference Room in honor of its namesake, Howard Chambers, who received his bachelor's degree in mechanical engineering from UT in 1964. After a long and successful career, Chambers retired from The Boeing Company in 2011. During his tenure, he held several positions within the company as he climbed its leadership ladder, including vice president and deputy program manager of the 787 Commercial Airplane Program, and vice president and general manager of Space and Intelligence Systems for Boeing's Integrated Defense Systems. Eventually, Chambers became Chairman of the Board of Boeing Satellite Systems International Inc., Boeing Satellite Systems Inc., and Spectrolab Inc. He also served as CEO of Boeing Satellite Systems Inc.

Chambers is a proud alumnus and over the years has stayed connected to MABE and the university. He has stayed active in the UT Alumni Association, even serving on its Board of Governors, and remains an active participant in its chapter in Southern California. He is an emeritus board member of the Tickle College of Engineering's Board of Advisors, and was an inaugural member of the UT Office of Research and Engagement's External Advisory Council. He received the 2002 Amelia Earhart Award for mentoring and was the 2009 recipient of the Nathan Dougherty Award, the college's top honor. In 2015, he received the University of Tennessee Alumni Service Award for his service to the university, and in 2016, he was inducted into MABE's Hall of Fame.

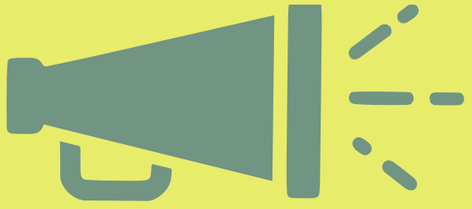
Wilmore Returning to Space

UT will once again have a presence in space in 2021, as NASA astronaut Barry "Butch" Wilmore has been bumped up to the flight crew of the inaugural launch of the CST Starliner, NASA's latest crewed vehicle. Wilmore earned his master's degree in aviation systems from UT Knoxville through the UT Space Institute (UTSI) in 1994.

The Boeing Starliner is a crewed capsule that can be fitted to one of four different types of rockets. Its look is reminiscent of the NASA's Apollo era, although slightly larger—it can hold up to seven astronauts as opposed to Apollo's three—and is designed to be reused on up to 10 missions.

Wilmore had been serving as backup for the flight since training for it began in 2018, but was moved to the prime crew after fellow astronaut Chris Ferguson bowed out of the mission.

"I'm grateful to Chris for his exceptional leadership and insight into this very complex and most capable vehicle," Wilmore said in a NASA release. "Having had the chance to train alongside and view this outstanding crew as backup has been instrumental in my preparation to assume this position. Wilmore joins Nicole Mann and Mike Fincke on the flight, which will test the Starliner's capabilities during a flight to the International Space Station on an as-of-yet unscheduled date in 2021.



Are you a MABE graduate and have some exciting news to share or want to give us an update on what you've been doing since graduation? We would love to hear from you! Send your news or update to williamk@utk.edu.

Hollis Applies a **Vol Mind** to Life-Improving Design

By Kathy Williams.

Chad Hollis (BS/ME '99) gets to spend his days doing what he loves—helping people improve their quality of life.

Hollis is vice president of research and development and co-founder of CrossRoads Extremity Systems, a foot and ankle medical device company he started with two colleagues in 2014.

Based in Memphis, the company designs, manufacturers, and distributes implant systems to treat a variety of foot and ankle problems, such as bunions, hammertoe, arthritis, and flatfoot.

> "I love to see the unfolding of a 'napkin-sketch' idea into a final device in the operating room that is implanted into a patient to help them achieve a better quality of life," said Hollis. "I have met many patients who are able to walk around, pain free, due to the skill of a surgeon using a device that started as a seed of a thought driving down the road."

Hollis's company is regulated by the FDA so all their products and processes must be cleared prior to proceeding to market. Currently, CrossRoads has a portfolio of over 100 patents and patent applications that cover about a dozen product lines.

Hollis found his calling in orthopedics after working as a project engineer for six years in consumer products at Black and Decker.

"One of my directors from Black and Decker moved away to orthopedics in Memphis and invited me over for an interview at Wright Medical Technology where I started my orthopedic career designing total knee arthroplasty devices and ultimately designing product for their emerging extremities division (foot/ankle and hand/wrist)," said Hollis.

He spent five years at Wright Medical Technology working as a product development engineer. The connections he made in the industry and the love he gained for orthopedics during this time led him to where he is today.

Hollis credits the great education he received at UT for giving him the confidence to navigate his career path without hesitation.

"I have worked with colleagues from many great institutions—Harvard, MIT, Cal-Berkeley, Stanford, etc.—and I have never felt that I wasn't prepared to compete with or contribute alongside them," said Hollis.

UT holds many fond memories for Hollis, including walking to class in the crisp fall air, home football games, and learning from some of the best minds in engineering. His favorite professor, Frank Speckhart, bridged the gap of science and practical application during his senior design class.

"Being a Vol For Life has afforded me a story to tell my kids—an example of a standard of excellence they can use to navigate their own choices in life," said Hollis.

In addition to leading a successful medical device company, Hollis is also a registered US Patent Agent for the United States Patent and Trademark Office. When he does have free time, he enjoys spending it with his wife of over 20 years, Summer, and their four children, Isabelle, Walker, Haddon, and Lucy.

ALUMNI MEMORIES

MABE alumnus George (Andy) Herndon (BS/ME, '69) sent in these photos taken during a home football game in 2007.

Tennessee fans gather at "Volunteer Village," an area near the Humanities and Social Sciences Building where pregame activities are held before home football games.

The Pride of the Southland forms the giant T while seniors on the team are introduced one at a time, a UT tradition for the final home game each season.

A look at the former skyboxes and press box on the western side of Neyland Stadium. The entire area was heavily renovated in 2010.

Then-senior defensive end Adam Gillem, from Knoxville, runs through the T for the final time.

A view from Neyland Stadium's middle concourse shows the Vol Navy, the building that is now the Wayne G. Basler Boathouse, the Norfolk Bridge, the Henley Bridge, and the Gay Street Bridge.

This view from the south end of Neyland Stadium shows the site that now houses the John D. Tickle Engineering Building and will soon be home to the Zeanah Engineering Complex. Berry Hall, Estabrook Hall, and Pasqua Hall can be seen at the left of the photo.

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 space, 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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Program Aims to SERVE Veterans

Veterans are engaged in experiences that address research priorities of our military while advancing their own careers.

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