MISSISSIPPI STATE UNIVERSITY™
DEPARTMENT OF AGRICULTURAL AND BIOLOGICAL ENGINEERING

Spring 2024

NEWSLETTER

Department of Agricultural and Biological Engineering

A letter from the Department Head

As I write this letter, we just finished spring break and are on the downhill slope for the semester. I recently met with ABE's Advisory Board, updating them on department activities, etc. They toured the new Agricultural Autonomy Institute, which grew out of ABE and now resides in the Pace Seed Technology Building. As usual the direction and ideas they provided were invaluable. Key issues I sought their advice on were student recruitment and resource development.

One example of resource needs is "high-impact learning experiences." Our graduates will have a bigger vision and be better prepared for the world after college if they experience locales, people, and events outside the confines of our beautiful Mississippi. I want to encourage them to go to conferences like ASABE and BMES, study abroad, etc. To facilitate these activities, we need resources to help the students afford them. For example, we are hosting six students from Harper Adams University in the UK for two weeks in April, and I'd like for six of our students to visit there for two weeks in summer 2024; $8,000 to 10,000 would cover this need. For all high-impact learning experiences, we need about $50,000 per year. Two other needs involve expenses for our senior design courses and a new annex building. First, I'd like to make $1000 available per senior-design team to purchase materials and components for their design projects. Together, these students need about $15,000 annually. While we are happy to receive gifts of any size, large gifts can endow a fund for the purpose of producing the needed amount every year, in perpetuity. Along the lines of large gifts, we have essentially outgrown our building and hope to build an annex on the space north of the current ABE building. A large gift could help make that a reality.

Regarding student recruiting, we've adjusted our curricula to attract students and are creating videos to advertise our programs, but now we must take the message to the audience. We have ideas for doing that, but please help us spread the word, and reach out to me if you need information or want to connect us with a prospective student.

Our ABE family marches forward, advancing Engineering and Technology for Human Well-Being. Since the fall 2023 newsletter went out, Aysha Mann (B.S. BME 2022; M.S. student under Dr. Taebi) won best M.S. paper at ASME's Int. Mech. Eng. Congress & Expo. Kari Oppedal and Emma Van Epps (BME seniors) were inducted into the Bagley College of Engineering (BCoE) Student Hall of Fame. Hugh Beckham (1988 AETB grad.) was honored as a College of Agriculture and Life Sciences Distinguished Alumnus. Tindall Morrison and Christy and Matthew Oswalt were honored as BCoE Distinguished Alumni. Robert Hester (1986 BE grad.) was elected President of the American Physiological Society. John Clemmer (B.S. BE 2008, MS BE 2010) and Blake Forte (B.S. BE 2014) were 2024 inductees to MSU's Reveille 25 for high-achieving young alumni. Finally, Wes Lowe (ABE Assistant Professor) received Mississippi Farm Bureau's Annual Research Award.

Wishing you all the best in 2024!

J. Alex Thomasson, Ph.D.
ABE Department Head & Professor

Alumni Spotlight

Dr. Amanda Penny

Dr. Penny is a native of Port Gibson, Mississippi, and she graduated summa cum laude from Mississippi State University with a Bachelor of Science in Biological Engineering (BE) in 2000. She earned her Doctor of Medicine degree from the University of Mississippi School of Medicine in 2004, graduating cum laude with a membership in the Alpha Omega Alpha medical honor society. She completed her pediatric training at the University of California, Davis, where she served as Chief Resident. In 2008, Dr. Penny joined the Children's Medical Group in Jackson, Mississippi, where she currently practices. She is married and has three sons. Dr. Penny enjoys reading, exercise, and travel in her spare time. She is also a member of ABE's Advisory Board.

We asked Dr. Penny, "how do you believe Mississippi State University's BE program contributed to your readiness for furthering your education and achieving your professional goals?"

"Mississippi State University's BE program honed my critical thinking and problem-solving skills. Not only did my engineering foundation prepare me for the demands of medical school, but it also continues to be a cornerstone of my practice as a pediatrician. The BE program equipped me to analyze and solve complex problems. I've found that these capabilities are fundamental skills required in my daily practice as a physician."

We also asked, "were there any particular projects, research endeavors, or mentors that significantly influenced your decision to be a pediatrician?"

She recalled her fellow students more than anyone else. Originally enrolled in the mechanical engineering program, she quickly realized that it was not aligned with her interests and goals. During this critical juncture, her friends in the BE program played a vital role in helping to guide her decision. Their encouragement and insights ultimately led her to transition into the BE program, which proved to be an excellent fit for her aspirations and career trajectory. Recalling her senior design project, she says, "it pushed me to think outside the box. We built a left-field lounge for a student in a wheelchair who wanted to go to MSU baseball games. We created an innovative solution by apply the fundamental engineering and design principles we had learned.

Outside of class, Dr. Penny was an Orientation Lead and was involved in the Student Senate, Roadrunners, and Greek life. So we asked her, "given your extensive experience in multi-tasking, including academics and numerous service activities, can you share insights about how to manage stress while dealing with the demands of education, service activities, and ultimately a demanding job? In addition, do you have advice for current students who may be navigating similar challenges?

She answered, "be passionate about what you are doing." Additionally, she advocates for proactive stress management, suggesting activities such as exercise, spending quality time with family and friends, engaging in hobbies, and practicing meditation. Furthermore, she encourages the active involvement in various service activities, emphasizing their role in fostering a holistic approach to both personal and professional growth.

~ Amanda S. Penny, M.D.
Pediatrician, Children's Medical Group

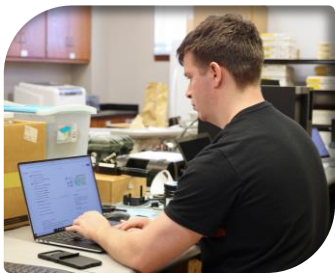
New Research Grants

Chen, Y., **Zhang, X.**, and Co-Is. Collaborative Research: NRI: Perception-Aware Soft Robot Manipulation and Bipedal Locomotion for Fresh Market Caneberry Harvestting. USDA-National Institute of Food and Agriculture. 11/2023 – 11/2027

Martins, V.S., Sparks, E., **Paz, J., Aires, U.**. Satellite-based Virtual Buoy Observation Network as water quality support tool for Oyster sustainability in Mississippi Sound. U.S. Department of the Treasury. 07/2023 – 12/2025.

Lowe, J., Chesser, D. and Co-Is. Development of an Automated Tactical Tillage Tool to Mechanically Control Weeds in Row-crop Production Systems. Cotton Incorporated. 01/2024 – 12/2024

Drewry, J., and Co-Is. Effects of Combined Sprinkler and Cool Cell Systems on Cooling Water Usage, Water and Feed Consumption Rates, Bird Performance, and Inhouse Environment of Commercial Broiler Barns. United States Poultry and Egg Association (US PEA). 01/2024 – 01-2025



Faculty Spotlight

Dr. Amirtahà Taebi

Dr. Amirtaha Taebi, who joined the faculty of biomedical engineering in 2021, is leading the way in the development of non-invasive diagnostic methods and personalized treatments for cardiovascular diseases. His laboratory is engaged in numerous research projects aimed at creating cost-effective and accessible cardiovascular monitoring techniques, some of which leverage the ubiquity of smartphones. In partnership with the MSU's Physician Assistant Studies Program, Nemours Children's Hospital, and the University of Alabama at Birmingham, Dr. Taebi's team is striving to bring their innovative solutions to the real world, transforming them into practical monitoring tools for cardiovascular conditions such as heart failure and congenital heart diseases.

Dr. Taebi's work has led to numerous publications in journals and conferences, as well as patents. One notable example is his team's proposal of a unique contactless cardiovascular monitoring method. This method, based on seismocardiography and chest videos recorded by a standard smartphone, holds the potential to provide a low-cost and widely available solution for remote monitoring of cardiovascular activity. In another study, his team investigated how chest vibrations could be used to accurately estimate crucial cardiac parameters such as cardiac time intervals, heart rate, and heart rate variability.

Dr. Taebi's innovative research and commitment to enhancing the diagnosis and treatment methods for cardiovascular diseases are making a significant impact in the field of biomedical engineering. His work stands as a testament to the transformative power of technology in healthcare, paving the way for improved patient outcomes.

Dr. Xin Zhang

Dr. Xin Zhang is the Principal Investigator (PI) of the Sensing and Automation in Agri-Systems (SAAS) Lab in the ABE department. She is working on multiple research projects related to agricultural robotics and digital agriculture. One project, funded by the USDA NIFA/NSF National Robotics Initiative (NRI), focuses on the robotic harvesting of caneberries (e.g., blackberries, raspberries, loganberries, etc.) for the fresh market. Collaborating with a Georgia Tech team, the SAAS Lab will focus on developing an efficient machine vision system for accurate berry detection and localization. Furthermore, Dr. Zhang is working on robotic cotton harvesting, a project funded by Cotton Incorporated. This project aims to develop a fully automated robotic system that can autonomously navigate cotton fields, detect and localize cotton bolls, and perform cotton-picking tasks automatically before moving on to the next plant.

Dr. Zhang will also start working with MSU's Agricultural Autonomy Institute (AAI) and Center for Advanced Vehicular Systems (CAVS) to develop high-fidelity agricultural environments through the MSU Autonomous Vehicle Simulator (MAVS). The new version of MAVS will be called AG-MAVS, and it will create a virtual environment benchmark for testing autonomous agricultural ground vehicles. In addition to Dr. Zhang's research role, she also teaches multiple courses in the department and serves on the University Data Science Committee (UDSC). She is currently a member of the American Society of Agricultural and Biological Engineers (ASABE) and the Club of Bologna (COB), the latter of which is a world task-force on the strategies for the development of agricultural mechanization.

Student Spotlight

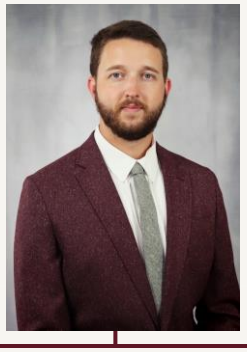
Undergraduate students

Emma Van Epps, a BME senior from Memphis, is an MSU Presidential Scholar who is also pursuing a minor in microbiology. She plans to focus on cellular-level tissue engineering, a field she became fascinated with when she began undergraduate research in Dr. Priddy's lab, where she currently 3D prints biodegradable bone scaffolds. Outside the lab, Emma is a soprano in the Schola Cantorum choir and serves as campaign director and former president of Students for a Sustainable Campus. Her research and leadership experience at MSU facilitated her recent election to the Bagley College of Engineering Student Hall of Fame. After graduation, she will pursue a Ph.D. in biomedical engineering at Yale. Emma is truly grateful for the opportunities MSU has afforded her and intends to remain a Bulldog after graduation.

Jessie Green, a BSE junior from Athens, AL, found an affinity for biology courses during high school and became passionate about understanding and enhancing ecosystems. She says, "it was always a part of who I am, and I love learning how to help our ecosystems and their inhabitants thrive. This semester, Jessie is a Coastal Engineering Student Intern at Cypress Environment & Infrastructure in Ocean Springs, Mississippi, where she is working on multiple important projects and getting real-world experience while still in school. Beyond her academic pursuits, Jessie is a Bagley College of Engineering Ambassador, an intern for the University Christian Student Center, a member of the MSU Enneagram Club, and a participant in MSU's chapter of the Society of Women Engineers (SWE). Looking ahead, Jessie envisions entering the workforce upon graduation, continuing to be involved with environmental and/or coastal engineering.

Nick Cohea is an AETB senior from Yazoo City who selected the Precision Agriculture concentration because of his deep roots in the Mississippi Delta and the importance of agriculture there. During his time as a student in ABE, Nick has worked on various research projects under two professors. His project with Dr. Paz has involved how artificial intelligence and machine learning models perform in forecasting rainfall, streamflow, and groundwater levels. Under Dr. Lowe, Nick has done hands-on work in the ABE machine shop, helping graduate students who are focused on improving implements for planting and spray applications. Nick says, "Mississippi State is not just a place but a whole family that helps us learn from and teach each other both inside and outside of the classroom." Looking ahead, Nick plans to start his career in the agriculture industry while furthering his education by pursuing a graduate degree.

Graduate students



Luke Tucker, a BME doctoral candidate from Tupelo, is studying new localized treatments for bone infection that include chitosan (a cellulose analog) as the basis to reduce pain, antibiotic use, and time in hospital. In addition to his research, Luke serves as Graduate Student Association President, where he represents MSU graduate students on university legislative bodies. He was invited to speak at the Mississippi IDeA/EPSCoR conference, has been a multi-time finalist at the three-minute thesis competition and a winner at MSU's Graduate Research Symposium in the poster and oral categories. Luke is currently participating in the Preparing Future Faculty program to ready him for a professorial career at a highly research-active university. Upon graduation Luke will continue his novel antimicrobial research as a post-doctoral researcher at North Carolina State University.

Rejane Paulino, a BSE graduate student under Dr. Vitor Martins, is from Ceara, Brazil. She has a background in environmental engineering (B.S.) and remote sensing (M.S.), and joined ABE as a Ph.D. student in fall 2023. "Jane" was awarded an MSU Graduate Recruitment Assistance Fellowship in recognition of her academic and research achievements. Her research is focused on implementing new approaches to fusion of data from multiple satellite-based sensors in order to maximize the scientific value of remote sensing applied to aquatic systems. Jane's improving skills, supported by her Ph.D. program in ABE, will enable her in the future to address new research challenges with a view to solving problems related to water quality.

Jacob Meadows is a graduate AETB student from Ashford, AL, who grew up on a cattle and row crop farm. He graduated with his B.S. in AETB (Precision Agriculture concentration) in December 2022 and went to work for the department as a full-time Research Associate under Dr. Lowe. Jacob expects to complete his M.S. in December 2025. He currently leads day-to-day progress on several research projects including his thesis project, which focuses on design and development of a cover crop planter for intraseeding with cotton. When he completes this project, Jacob's results will enable USDA Natural Resource Conservation Service offices to carefully study the beneficial effects of earlier cover crop establishment for cotton producers across Mississippi.

Faculty Research

Advanced Plant & Soil Sensing Laboratory (APSS)

The Advanced Plant and Soil Sensing (https://apsslab.abe.msstate.edu/) lab lead by Dr. **Nuwan Wijewardane**, conducts research on applying advanced sensing technologies and for plant and soil sensing with the intention of developing novel sensors for field applications in agriculture and natural resources. The group has one postdoc, 5 graduate, and one undergraduate research student engaged in multiple research projects funded by USDA-Natural Resources Conservation Service (NRCS), USDA-National Institute of Food and Agriculture, Mississippi Agricultural and Forestry Experiment Station, and Mississippi Department of Agriculture and Commerce. The postdoc: Dr. Suraj Yadav, is currently working on the early diagnosis of nutrient deficiencies in row crops using UAV hyperspectral imaging to enable detection before visual symptoms occur. Yasas Gamagedara: PhD candidate, is pushing the mid infrared spectroscopy towards field applications where local NRCS field offices can utilize the technology to estimate soil properties in house eliminating the need for costly and time-consuming laboratory work. Another PhD student: Chamika Silva, is actively involved in developing spectroscopy-based plant and soil sensors coupled with robotic manipulators to detect nutrients in situ. Praveen Amarasinghe: PhD student, is investigating the possibility of using spectroscopic techniques to detect viral infections in sweet potatoes while Yican Yang: PhD student, is assessing the impact damages in sweetpotato packing lines and testing image based techniques for non-invasive damage detection. Caleb Whately: graduating this spring with MS, has been working on wetland soil identification using spectroscopic techniques as an alternative for the currently used time-consuming and subjective methods. Collectively, the team is working towards the mission of the APSS lab which is to enhance agricultural systems productivity through the application of novel techniques in sensing, data analysis, and control of crops and soil

Priddy Lab, tackling clinical challenges about our bones

Dr. **Lauren Priddy**'s lab studies surface-functionalized, load-bearing biomaterial scaffolds for improved bone healing, and hydrogel-based composite materials for enhanced delivery of antimicrobial therapeutics. Treatment of large bone defects and fixation of traumatic fractures represent significant challenges for orthopedic surgeons. To address this, we are designing and 3D printing polymer-based composite (blended with bioceramics or metals) scaffolds for augmenting bone regeneration and fracture fixation. We are also studying biodegradable metals such as magnesium, and leveraging hydroxyapatite coatings to modulate the degradation kinetics of additively manufactured porous magnesium scaffolds. To culture these scaffolds in a physiologically relevant environment, we have designed a bioreactor system which applies perfusion flow and compressive loading to study biomaterial degradation and osteogenesis. The long-term goal of this work is to engineer patient-specific biomaterials that mimic both the mechanical and biological properties of native bone tissue. Supported by Medtronic, Inc., we designed a drop weight benchtop device equipped with force and displacement sensors which replicates loading from cadaveric spine interbody fusion procedures, to inform implant design and surgical techniques. Difficulties in treating osteomyelitis, or the infection of bone, have been exacerbated by the rise of antibiotic resistant bacterial strains, particularly Staphylococcus aureus, and chronic infection remains a huge clinical burden. Using a biofilm forming strain of S. aureus, we have developed clinically relevant, implantbased, acute and chronic models of composite femoral and soft tissue infection in the rat. Leveraging these models, along with clinical veterinary cases and in vitro models of infection, we are evaluating biomaterials such as chitosan hydrogels and polymeric microparticles for local delivery of antimicrobial therapeutics including bacteriophage, fosfomycin, ionic liquids, and gold nanoparticles. The long-term objectives of this work are to explore how the presence of infection alters bone healing and to effectively codeliver antimicrobial and osteoinductive factors.

Our areas of *expertise*

Engineering for Precise Crop Production

Natural Resources Management

Autonomous Agricultural Systems

Precise Control of Animal Environments

Biomedical Sensors and Devices

Biomaterials and Biomechanics in Medicine

ABE impact

Over 390 undergraduate students
AETB: 98
BME: 286
BSE: 13

93 graduates in 2023
AETB: 27
BME: 59
BSE: 7

74 publications by our faculty in 2023

38 graduate students
AETB: 9
BME: 9
BSE: 20

~$4.3 million in research awards for FY 2023

Our students are finding jobs in their field of study within 6 months of graduation
AETB: 100%
BME: 94%
BSE: 100%

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