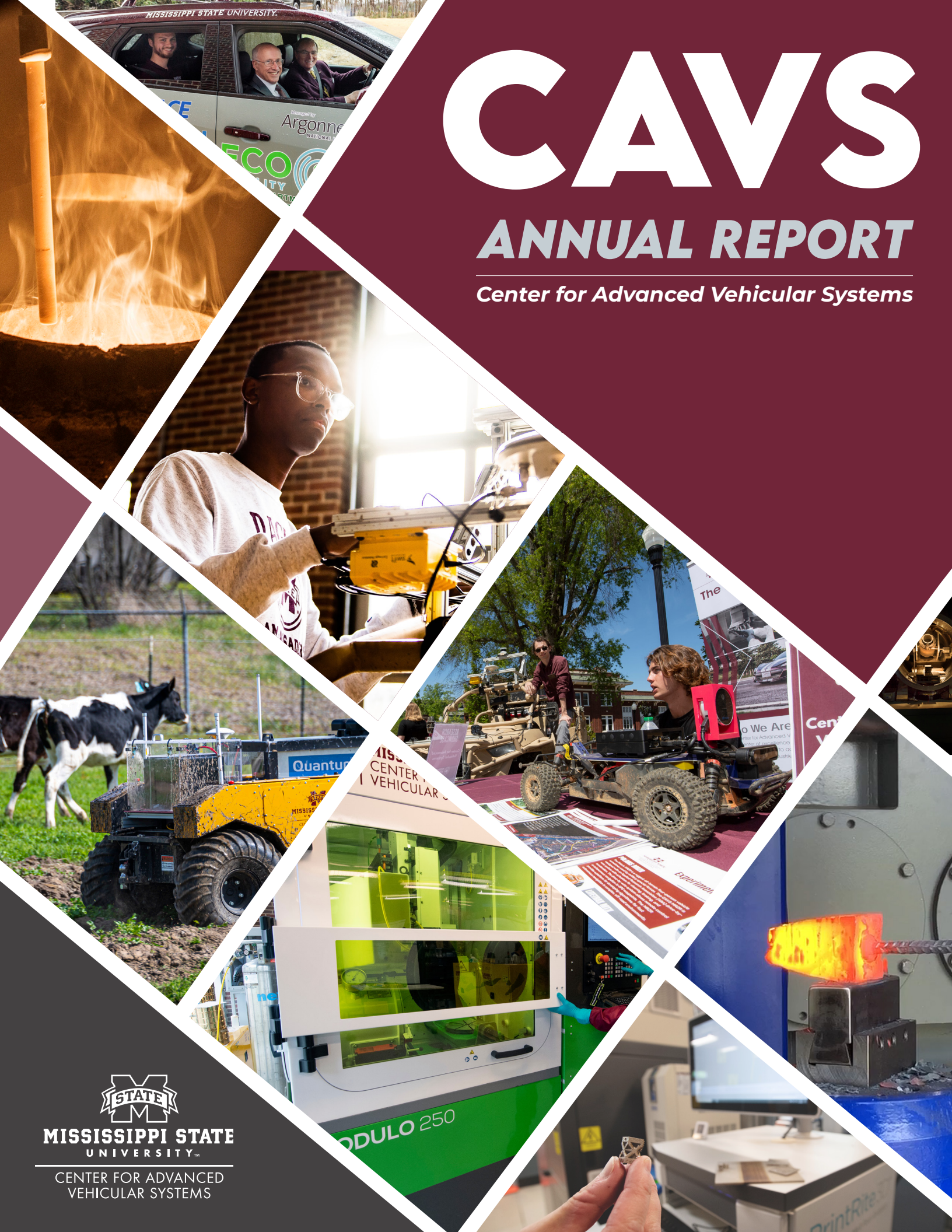

CAVS

ANNUAL REPORT

Center for Advanced Vehicular Systems

MISSISSIPPI STATE UNIVERSITY

CENTER FOR ADVANCED VEHICULAR SYSTEMS

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MISSISSIPPI STATE UNIVERSITY
CENTER FOR ADVANCED VEHICULAR SYSTEMS

HPC² HIGH PERFORMANCE COMPUTING COLLABORATORY MISSISSIPPI STATE UNIVERSITY

MISSISSIPPI STATE UNIVERSITY

MISSISSIPPI STATE UNIVERSITY JAMES WORTH BAGLEY COLLEGE OF ENGINEERING

TABLE OF CONTENTS

CAVS 2022-2023 Annual Report

FROM THE DIRECTOR

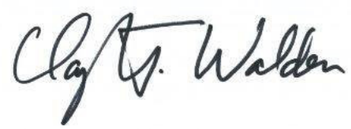
Clay Walden / CAVS Executive Director

"CAVS Extension reported outstanding project impacts from 56 different companies that reported almost $50 million in savings and 195 jobs created/retained."

I am so proud of the work the CAVS affiliated organizations (CAVS Research, CAVS Extension, Institute for System Engineering Research) have accomplished during the last few years. It's a great privilege to lead such a talented team of people that are making a difference in our state and impacting our nation. It's always a major challenge to try to capture all the highlights in an annual report. However, there are some results and initiatives that I want to draw particular attention to:

- Helped establish MAGNET, the Mississippi Alabama Georgia Networking for Electric Vehicle Technologies, a new regional electric vehicle partnership focused on developing the EV eco-system in concert with University of Alabama, and University of Georgia.
- Hosted the first ever Summit on Advanced Modeling & Simulation for Autonomous Ground Vehicles (SAMS AGV) and held Second Annual Athlete Engineering Summit. These highly successful events attracted engaged stakeholders and enhanced our reputation in these areas.
- Added to and expanded research agreements with the US Army Engineer Research and Development Center (ERDC), US Army Ground Vehicle Systems Center (GVSC), Army Research Lab (ARL), Air Force Research Lab (AFRL), Redstone Arsenal, Hyundai, Booz Allen Hamilton, Navy Surface Warfare Center at Carderock, ARAMCO, Leidos, Lockheed Martin, Steel Dynamics, Toyota, and Nissan, just to name a few.
- Established multiple multidisciplinary working groups to focus on creating new research opportunities. These groups include Hypersonics, Additive Manufacturing, Steel Research, Off Road Autonomy, Artificial Intelligence/Machine Learning, and HPC Computing Infrastructure.
- Worked with the Michael W. Hall School of Mechanical Engineering to renovate the Edwards Building into a modern Steel Research Center with additional testing capabilities.
- MAVS Software reached almost 200 users around the world including the establishment of commercial licenses and engagement with 9 different companies.
- Increased our international visibility through continued leadership in international organizations – NATO Working Group focused on modeling and simulation of autonomous off-road vehicles and leadership in the German based Association for Standardization of Automation & Measurement System (ASAM).
- Over the last several years our focus on internal operational improvements has freed up over 11,000 square feet in high value lab space and enabled the opening of new labs such as the Athlete Engineering Lab, Robotics Collaboratory, DRIVE Lab, Combustion Spray Chamber, Predictive & Conditioned Based Maintenance, and Machine Shop Expansion.
- CAVS Extension reported outstanding project impacts from 56 different companies that reported almost $50 million in savings and 195 jobs created/retained.

We are thankful for the results over the last few years and are looking forward to the next year. Please follow us on LinkedIn, Facebook, and Twitter.



Clayton T. Walden, Ph.D.
Executive Director
Center for Advanced Vehicular Systems

OUR MISSION

CAVS strives to be a world-class center of excellence for research, technology and education equipped to address engineering challenges facing US mobility industries. Utilizing high performance computational resources and state-of-the-art analytical tools for modeling, simulation and experimentation, CAVS will provide a distinctive interdisciplinary environment wherein next-generation engineers and scientists train alongside field experts to investigate, design and verify novel solutions in materials, propulsion and design for efficient human and vehicle mobility. Harnessing our broad impact research along with our state, national and international industrial alliances, CAVS will support economic development and outreach activities throughout the State of Mississippi.

OUR VISION

The Center for Advanced Vehicular Systems (CAVS) will be a global leader in interdisciplinary education and research for the development of engineering solutions that expand and enhance the design, technology, production, and infrastructure necessary for sustainable mobility.

2020-2023
TOTAL AWARDS
$105,952,660

MSU'S CAVS, ERDC PARTNER ON NEW PROJECTS TO BOOST AI-DRIVEN DEFENSE MANUFACTURING AND MAINTENANCE

By James Carskadon

Mississippi State University's Center for Advanced Vehicular Systems is leveraging its expertise in high-performance computing and advanced manufacturing to support next-generation defense capabilities through a partnership with one of the world's premier engineering and research centers.

The university recently was awarded three separate contracts totaling $8 million from the Vicksburg-based U.S. Army Engineer Research and Development Center with a focus on data analytics and visualization systems, additive manufacturing and artificial intelligence-driven predictive maintenance. The work will continue for three years up to a total of $24 million, contingent on available funding. With MSU's Center for Advanced Vehicular Systems as the lead for the project, the multidisciplinary research team includes faculty from across MSU's Bagley College of Engineering.

Clay Walden, CAVS executive director, said the projects work toward simplifying defense supply chains and getting parts to the front lines, or the "tactical edge," as efficiently as possible. With additive manufacturing, parts can be 3-D printed at remote locations, eliminating long supply chains and reducing the need for storage. The researchers will study the life cycle of 3-D printed materials and use those findings to develop artificial intelligence and machine learning algorithms for predictive maintenance.

"A lot of times there are parts that need to be replaced, but you have a long, complex supply chain involving different companies, and then you have to move the part through a contested environment," Walden said. "If you can use additive manufacturing, you can greatly simplify the process to where all you need is a printer, feedstock and computer-aided design software. That's why the Department of Defense is interested in additive manufacturing, and we're excited to utilize our expertise in conjunction with ERDC to help develop fully integrated solutions that can support defense missions."

Hottinger Bruel & Kjaer Solutions, which has an office in MSU's Thad Cochran Research, Technology and Economic Development Park, will serve as a technology partner on the project and support software development. MSU's Center for Cyber Innovation will work with researchers to embed cybersecurity elements into products that are developed.

Julie Jordan, MSU vice president for research and economic development, noted that dozens of graduate and undergraduate students will be involved in the project, giving them experience at the leading edge of manufacturing and computing.

"This line of impactful research is a testament to our ability to bring together innovative teams that are fully equipped to address national security research priorities," Jordan said. "We also are excited to once again partner with ERDC. Collaborations like this boost Mississippi's overall research and development capabilities and help set the stage for the technological innovations that can transform our economy."

The first project, titled "Data Analytics and Visualization System Infrastructure," will result in an end-to-end framework to address the growing need for a robust infrastructure for data analysis and visualization to support DOD computational science and engineering methods.

The second proposal, "Advanced and Additive Manufacturing," leverages MSU's high-performance computing capabilities to develop a system of testing and evaluating part quality in the additive manufacturing cycle.

The third proposal, "Advanced Maintenance," studies advanced manufacturing equipment performance and how AI can predict and improve product performance and reliability.

MSU and ERDC have collaborated on dozens of research projects in areas of mutual expertise and capability such as high-performance computing, materials science, military engineering, autonomous systems, cybersecurity, artificial intelligence and machine learning, among others.

Last fall, MSU expanded its presence in Vicksburg to provide local entrepreneurship support and enhance technology transfer efforts and research collaborations with ERDC and other federal partners. Additionally, ERDC is among the largest employers of MSU engineering graduates.

MISSISSIPPI STATE RESEARCHERS, LED BY CAVS, ARE PARTNERING WITH THE VICKSBURG-BASED U.S. ARMY ENGINEER RESEARCH AND DEVELOPMENT CENTER ON NEW PROJECTS TO SUPPORT ARTIFICIAL INTELLIGENCE-DRIVEN DEFENSE MANUFACTURING AND PREDICTIVE MAINTENANCE.

MSU SUMMIT DRIVES FUTURE OF AUTONOMOUS GROUND VEHICLES

By James Carskadon

A summit held at Mississippi State University is making a pathway for the future of autonomous ground vehicles.

PARAMSOTHY JAYAKUMAR, SENIOR TECHNICAL EXPERT AT THE U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND GROUND VEHICLE SYSTEMS CENTER, DELIVERS A KEYNOTE ADDRESS DURING MSU'S SUMMIT ON ADVANCING MODELING AND SIMULATION FOR AUTONOMOUS GROUND VEHICLES.

MSU hosted the Summit on Advancing Modeling and Simulation for Autonomous Ground Vehicles, bringing together experts from government, industry and academia to collaborate and learn more about the latest tools driving autonomous vehicle development.

"As computing capabilities advance, modeling and simulation is really driving the development of autonomous ground vehicles, especially for off-road and other challenging environments," said Daniel Carruth, associate director at MSU's Center for Advanced Vehicular Systems and the summit's lead organizer. "By bringing this community together, we can learn best practices and make connections that will ultimately benefit partners in defense and industry that have an interest in this technology."

The summit included several presentations from researchers within the U.S. Army on their work in the field and its significance to national security efforts. Bart Durst, director of the Geotechnical and Structures Laboratory at the U.S. Army Engineer Research and Development Center, said that autonomous ground vehicles represent a "tremendous force multiplier" that can keep soldiers out of the line of fire. However, it will take modeling and simulation to continue to advance the technology.

"Modeling and simulation optimizes not just ground vehicles, but every system that we are developing," Durst said. "To do multiphysics-based simulations and go through the virtual environment to test and evaluate allows us to look into problem sets we can't do in a physical test, and this allows us to really optimize those systems before we ever bend steel. That's critical. It optimizes the system, it saves millions of dollars and it accelerates the time scale like no one can imagine. We can do this today with supercomputing and other capabilities that you here know well."

At MSU, cross-disciplinary teams of researchers are developing autonomous vehicle capabilities for off-road environments, with much of the work focused on modeling and simulation. With a 50-acre off-road proving ground, CAVS scientists are able to validate autonomous systems in real-world situations. The MSU Autonomous Vehicle Simulator, or MAVS, provides the ability to evaluate the performance of autonomous perception and navigation software in real-time, allowing for faster development of the systems that drive autonomous vehicles.

MSU RECEIVES SMALL BUSINESS ADMINISTRATION FUNDING TO ACCELERATE VICKSBURG TECH COMPANIES

By James Carskadon

MSU'S TEAM IN VICKSBURG SUPPORTING ENTREPRENEURSHIP AND TECHNOLOGY TRANSFER EFFORTS INCLUDES, FROM LEFT, INSTITUTE FOR SYSTEMS ENGINEERING RESEARCH DIRECTOR REED MOSHER AND ASSOCIATE DIRECTOR PATTI DUETT, AS WELL AS OFFICE OF TECHNOLOGY MANAGEMENT SENIOR PROGRAM MANAGER TASHA BIBB AND CENTER FOR ENTREPRENEURSHIP AND OUTREACH SENIOR PROJECT MANAGER RYAN GILBRECH.

Mississippi State University is accelerating its efforts to support the development and growth of Vicksburg area technology companies with new funding from the U.S. Small Business Administration.

MSU has been named a Stage One winner for the SBA's 2023 Growth Accelerator Fund Competition, providing the university with a $50,000 cash prize to support the launch, growth and scale of research and development-focused small businesses.
The prize builds on initiatives MSU launched in Vicksburg last year with $650,000 in SBA funding and $1 million from the Mississippi Legislature. With the funding last year, MSU developed a presence at the Sen. Thad Cochran Mississippi Center for Information and Technology, commonly known as MCITy. The Office of Technology Management's Tasha Bibb supports tech transfer efforts in Vicksburg and the Center for Entrepreneurship and Outreach's Ryan Gilbrech provides entrepreneurship training and support.

MSU's proposal for the Growth Accelerator Fund Competition focuses on developing entrepreneurial training and resources for STEM-based entrepreneurs in Vicksburg, building on the collaborative environment in MCITy, including personnel with expertise in the research, development and commercialization of STEM-based technologies. The team will also position businesses to compete for federal Small Business Innovation Research and Small Business Technology Transfer programs, which are designed to encourage small businesses to engage in federally funded research and development. The university's Center for Entrepreneurship and Outreach, Office of Technology Management and Institute for Systems Engineering Research collaborated on the proposal.

"Small businesses are vital to growing our state's technology sector, and I am proud of our Vicksburg team's work to better position companies to compete for federal awards and grow STEM-based companies," said MSU Vice President for Research and Economic Development Julie Jordan. "Initiatives like this will help us maximize the economic impact of research activity taking place in the Vicksburg area and around the state."

ROBOT ROUNDUP: AUTONOMOUS CATTLE HERDING STUDIED BY MSU SCIENTISTS MAY BE GAME CHANGER

ADVANCED VEHICLE SYSTEMS

By Meg Henderson

It takes a team effort at Mississippi State's Bearden Dairy Research Center to produce 369,000 gallons of milk every year from 200 cows. A surprising new team member showing potential for herding large numbers of cows is a ground robot, equipped to navigate pasture and sense and direct herd movement.

Investigating the possible use of uncrewed ground vehicles for safer and more efficient livestock movement and management are scientists in the university's Mississippi Agricultural and Forestry Experiment Station, Center for Advanced Vehicular Systems and Raspet Flight Research Lab.

Principal investigator Marcus McGee, assistant clinical professor in the Department of Animal and Dairy Sciences, and co-PI Christopher Hudson, a CAVS research engineer, have conducted a series of trials at the MAFES Dairy Research Center with a Clearpath Robotics Warthog UGV fitted with cameras and sensors.

Manually operating the UGV to move the cattle, the research team demonstrated its effectiveness and now plans to apply for a U.S. Department of Agriculture grant this fall, studying how groups of UGVs move cattle and exploring building requirements for an autonomous cattle-driving system. Currently, the MSU experts are studying how herding principles might apply to robots, with a goal of creating a set of rules for autonomous herding vehicles.

"If you're designing a self-driving car, it follows the rules of the road which have been established over many decades," Hudson said. "We don't have rules for how one vehicle, let alone a team, should work to detect, see and move cows."

The animals' behavior around the Warthog during the trials has shown signs of acceptance and willingness to be moved by an uncrewed vehicle.

A CLEARPATH ROBOTICS WARTHOG UNCREWED GROUND VEHICLE EQUIPPED WITH CAMERAS AND SENSORS HERDS DAIRY COWS AT MSU'S BEARDEN DAIRY RESEARCH CENTER.

"To our surprise, the animals were calm around the Warthog and behaved the same way they would around a person on horseback or driving a four-wheeler," McGee said. "Young calves don't have the strong herd instinct that mature animals do, but we saw that in the presence of the robot, these calves moved along like a herd—not scurrying in fear but loping along together."

In addition to herding, a UGV could monitor the health of individual animals more frequently and with more precision than humans can, thus expediting medical treatment.

"An autonomous system equipped with cameras and thermal sensors could potentially detect illness or injury, and that data could help us identify which one needs to be separated from the herd and when we should notify the farmer or veterinarian," McGee said.

The scientists see autonomous UGVs as a game changer for the animals and the livestock industry, much like precision agriculture technology is changing how crops are grown and monitored. As with agriculture, livestock management relies on repetitive tasks performed at the same time each day, and these tasks lend themselves well to automation.

"Herding cattle can be a physically demanding and dangerous job, and it's getting more difficult each year to find people to do it," Hudson said. "We see this as an area where robots can make a positive impact as a workforce multiplier by doing the repetitive manual jobs. As the technology is expanded, the potential to create higher-paying technical jobs will evolve."

"In the next decade or so, we may see livestock producers working alongside engineers and computer scientists," McGee added. "Jobs in the industry's future will likely be very different from the ones we have today with increased adoption of precision livestock management."

While the end goal of autonomous herding lies on the horizon, these scientists see their work as building the foundation—the rules of the road—for the successful deployment of existing robotics technology in a livestock setting.

"At Mississippi State, we work together across disciplines to solve pressing issues, including the ability to augment skilled labor in the workforce," Hudson said. "Because of our excellence in agriculture, engineering and uncrewed systems, MSU is uniquely qualified to be a leader in this emerging field of research."

For more on the Department of Animal and Dairy Sciences in MSU's College of Agriculture and Life Sciences, visit www.ads.msstate.edu. Learn more about MSU's Center for Advanced Vehicular Systems at www.cavs.msstate.edu. The Raspet Flight Research Lab is found online at www.raspet.msstate.edu.

MSU ECOCAR TEAM WINS SEVERAL FIRST-PLACE NATIONAL MOBILITY CHALLENGE AWARDS

By Carl Smith

Mississippi State's EcoCAR team recently returned to campus with numerous awards from EcoCAR Mobility Challenge's Year 4 Competition, including top spots for overall project management, project status presentation and human-machine interface/user experience evaluation, and a MathWorks Model-Based Design Award.

The event was the culmination of a four-year challenge pitting 11 universities to improve a 2019 Chevrolet Blazer's energy efficiency, safety and consumer appeal through electrification, advanced propulsion systems and automated vehicle technology. Team vehicles went through a variety of tests and challenges, including technical inspections, dynamic testing events and ride-and-drive courses. Teams also were evaluated in six technical presentations that demonstrated the viability of their designs to government and industry judges.

The MSU EcoCAR team earned nine recognitions, including placing fifth in the overall competition, and Vance Hudson, a Collierville, Tennessee, native who recently graduated with a master's degree in mechanical engineering, was one of only two students in the competition who won the Excellence in Leadership Award.

MSU Bagley College of Engineering Dean Jason Keith praised the team for its performance and said the program fully prepares students to enter the workforce and make an immediate impact in whatever field they choose.

"Across the four years of the EcoCAR Mobility Challenge, I have seen the impact of our students' hard work on their career trajectories," he said. "Team members have obtained internships, full-time jobs and other research positions across Mississippi State University and in industry throughout the nation. Additionally, the leadership experience that EcoCAR students obtain allow them to start their positions with salaries higher than peers."

The complete list of awards earned by the MSU EcoCAR team includes:

—First place, Project Status Presentation
—First place, Overall Project Management
—First place, HMI/UX Evaluation
—First place, MathWorks Model-Based Design Award
—Second place, HMI/UX Presentation
—Second place, Communications Presentation
—Second place, CAV Capability Evaluation
—Third place, PCM Presentation
—Fourth place, Overall Communications
—Fifth place, Overall
—Excellence in Leadership Award, Vance Hudson

"This team has undergone some major challenges over the years, and at the start of this four-year competition, their specific goal was to re-establish a sustainable basis for having a highly competitive team year-in and year-out," said Randy Follett, the team's faculty advisor and an MSU associate professor of electrical and computer engineering.

"As a part of this, their focus was on having a vehicle that could complete every event in the Year 4 final competition. Not only did they accomplish this task, but they were also the first team to complete every dynamic event in the week-long series of competitive events in Yuma, Arizona. In doing this, they have re-established the MSU team as a solid competitor for the foreseeable future, with clear leadership development processes to continue the winning tradition in the EcoCAR EV Challenge, which begins this fall. I'm incredibly proud of the hard work that they have put in over the last four years, and the successes that this work has created for them—both in the competition and personally. It has truly been an honor to be associated with each and every one of them," Follett said.

MEMBERS OF THE MSU ECOCAR TEAM POSE WITH AWARDS THEY RECEIVED DURING THIS MONTH'S ECOCAR MOBILITY CHALLENGE'S YEAR 4 COMPETITION IN ARIZONA.

Pictured are (front row, from left to right) General Motors Mentor Gary Rushton; Oussama Oussi, mechanical engineering graduate student, Starkville; Nathan Reynolds, mechanical engineering junior, Petal; Ashutosh Shah, mechanical engineering senior, Starkville; Vance Hudson, mechanical engineering master's graduate, Collierville, Tennessee; Jonah Gandy, electrical and computer engineering master's graduate, Madison; (second row, from left) Staff Advisor Debi McNabb, project coordinator, MSU's Center for Advanced Vehicular Systems; Debbie Alencar Oliveira, industrial engineering senior, Brazil; Bailey Jose, industrial and systems engineering graduate student, Olive Branch; Rachel Hendricks, Master of Business Administration graduate, Hoover, Alabama; Mary Nielson Clinton, communication/public relations graduate, Germantown, Tennessee; (third row, from left) Jagdeo Singh, mechanical engineering senior, Laurel; Faculty Advisor Randy Follett, associate professor of electrical and computer engineering; Amine Taoudi, electrical and computer engineering graduate student, Morocco; Matthew Sinclair, mechanical engineering senior, Mendenhall; and Staff Advisor Michael Gibson, research engineer III at the Center for Advanced Vehicular Systems.

CAVS EXPANDS STEEL RESEARCH CAPABILITIES

By James Carskadon

A newly renovated facility on the Mississippi State campus is forging new capabilities and partnerships in steel manufacturing and materials research.

The Edwards Building, located at the eastern edge of the parking lot behind the Industrial Education Building, has been optimized to meet the research needs of MSU's Michael W. Hall School of Mechanical Engineering and the Center for Advanced Vehicular Systems. The updated facility is helping MSU researchers improve steel production methods as the industry works toward the next generation of steel alloys.

Originally built in the 1960s as a facility to study nuclear engineering, it later transitioned into a steel research building. The updated space now serves as a place to design and prototype novel steels, bridging the gap between research labs producing a few ounces of steel and industrial steel production facilities.

The Edwards Building operates like a steel mill on a smaller scale, giving researchers the ability to create steel plates up to 50 pounds that can then be analyzed for different quality measures. New equipment was added as part of the renovation, including a metal formability tester, as well as a re-design of the equipment layout to maximize efficiency.

"From melting and casting to rolling and forging downstream processes, these facilities enable MSU researchers to advance steel development in areas relevant to both industrial and government sectors," said CAVS Research Engineer Dawn Van Iderstine. "Precise impurity control through vacuum induction melting provides an ideal environment for alloy design. Subsequent thermomechanical processing can be carried out through controlled hot and cold rolling or by forging schedules, making CAVS research facilities relevant to a variety of industries."

Ross Smith, assistant professor of practice in the School of Mechanical Engineering, said the updated facility and state-of-the-art equipment will serve as a nucleus for interdisciplinary collaboration and empower MSU researchers to push the boundaries of metallurgy and materials engineering.

"This initiative not only enhances MSU's research prowess but also provides students with unparalleled opportunities for hands-on learning and innovation, strengthening the school's academic excellence," Smith said. "Moreover, by fostering collaboration between academia and industry stakeholders, the renovation project serves as a catalyst for regional economic development and industry partnership, positioning MSU as a leader in materials science and engineering."

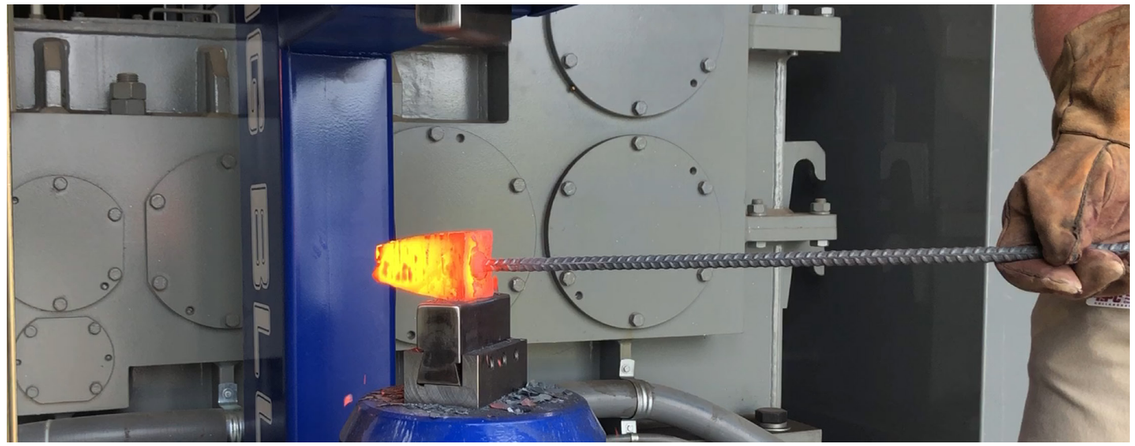
Haitham El Kadiri, School of Mechanical Engineering Director and PACCAR Endowed Chair, said MSU research is helping to bridge the gap between new materials developed in a lab and industrial production.
"Closing the valley of death for materials microstructure development at the production scale through integrated

computational materials engineering (ICME) techniques continues to be daunting challenge in materials science and engineering research," El Kadiri said. "The manufacturing capabilities at the Edwards Building have been designed to generate and study microstructure evolution mechanisms that operate at intermediate size and times scales suitable to create and validate high-fidelity ICME models."

The upgrades come at a time for growth in the regional steel industry. In 2022, Steel Dynamics Inc. announced plans to invest $2.5 billion into an expansion of its facility in nearby Lowndes County, with the company currently building an aluminum mill. With the success of Steel Dynamics' current operation and plans for growth, CAVS Executive Director Clay Walden said the center is making strategic investments to be a resource for the steel manufacturing community, helping to grow regional economic development.

"While we are doing work in next-generation steel alloys, a lot of our more immediate activity has been around ways to better support production and strategies for the alloys that are already in existence," Walden said. "If you look at all of the different elements in quenching, rolling, and heating, it is very expensive to experiment with those different parameters at a mill. These facilities allow us to do smaller-scale experiments here and identify potential production improvements."

MSU RESEARCHERS HEAT TREAT A STEEL INGOT USING THE REHEAT FURNACE IN THE EDWARDS BUILDING, WHICH IS EQUIPPED FOR HOT- AND COLD-WORKING OF METALS THROUGH ROLLING AND FORGING.



A PNEUMATIC POWER HAMMER IS AMONG THE FORGING CAPABILITIES AT THE EDWARDS BUILDING, ALLOWING FOR RESEARCH ON NOVEL WROUGHT ALLOYS.

CFD

FLYING FAST: MODELING HYDROGEN COMBUSTION IN SCRAMJET ENGINES AT HYPERSONIC SPEED

By James Carskadon

COMPUTATIONAL FLUID DYNAMICS

A Mississippi State Center for Advanced Vehicular Systems researcher is helping to push the boundaries of what is possible in flight.

CAVS researchers are using computational fluid dynamics to model hydrogen combustion in scramjet engines at hypersonic speeds. The NASA-funded project, led by CAVS Associate Director Shanti Bhushan, will advance the design of hypersonic jet propulsion systems, boosting capabilities for aircraft such as high-speed interceptors used in defense.

SHANTI BHUSHAN

The computational tool aims to resolve engine restart issues that can occur due to hydrogen combustion taking place in supersonic flow conditions. Because scramjet systems use external air for combustion, they can more efficiently propel aircraft within the atmosphere. Bhushan said that laboratory experiments to test hydrogen combustion in scramjet engines have significant cost and logistical challenges, even when only examining a millisecond of combustion activity.

"We are trying to predict whether the combustion will happen or not," Bhushan said of the simulation that analyzed 20 million grid points. "Once we have confidence in the results, we can extrapolate the trends, which will help designers move in the proper direction."

The simulations utilized chemistry models developed by NASA and applied them in the context of conditions faced in scramjet engines, such as hypersonic speeds and altitudes that extend high into Earth's atmosphere. Most of the applications for the NASA models have been related to exhaust plumes at takeoff, but those are not scramjet environments, Bhushan said.

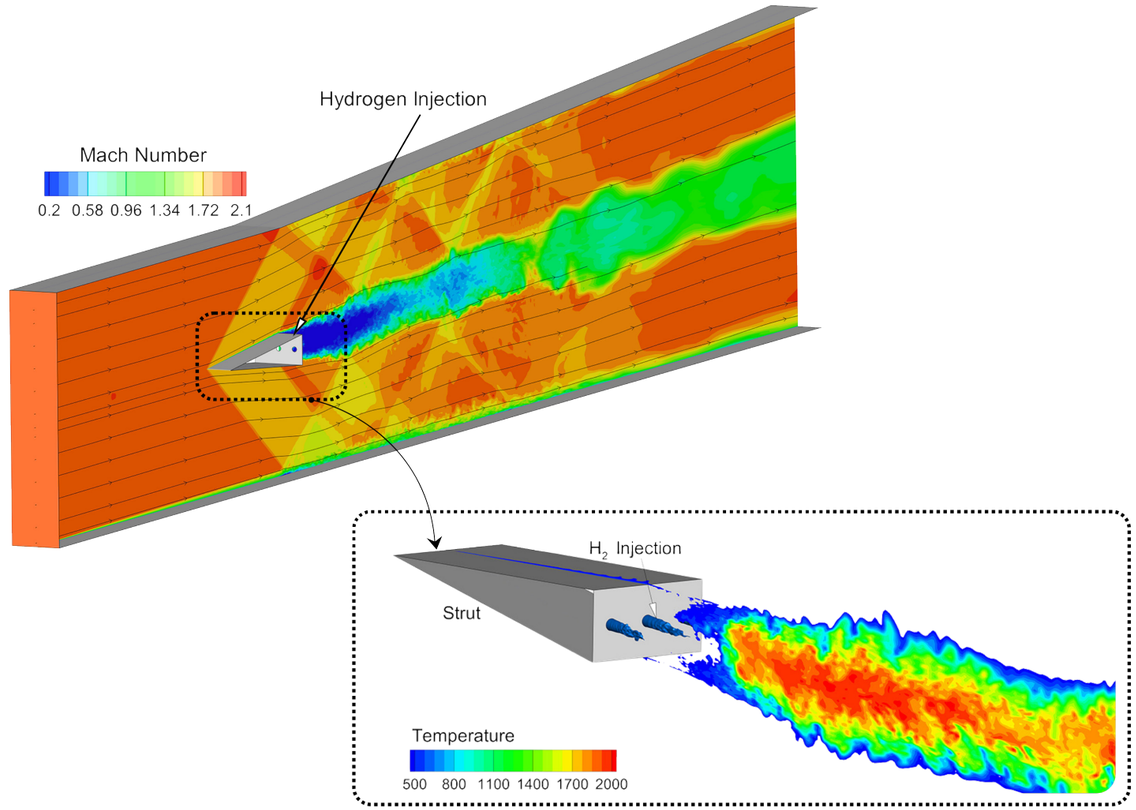
Bhushan modeled the effects of three hydrogen injectors within the scramjet engine with airflow at Mach 2 and hydrogen at Mach 1. The results showed a sharp temperature increase while oblique shock waves reflected from the walls of the engine's combustor section, acting as a flame holder to help maintain regular hydrogen combustion.

The simulation utilized MSU's high performance computing resources, which are among the best of any university in the country and include two supercomputers ranked among the top 500 in the world.

"At MSU, we have been at the forefront of making sure that computational fluid dynamics are well validated, and the physics are as realistic as possible to the actual environment," Bhushan said.

While a jet fighter with a scramjet propulsion engine may not yet be taking off from runways, research taking place at MSU is bringing that day closer to reality by modeling the injection systems needed to make it happen.

SCRAMJET ENGINE FLOW PATHWAY



CFD PREDICTION OF HYDROGEN COMBUSTION IN A SCRAMJET ENGINE. HYDROGEN INJECTED FROM THE STRUT AT SONIC CONDITIONS MIXES WITH SUPERSONIC AIR FLOW IN THE ENGINE PATHWAY RESULTING IN COMBUSTION AND HIGH SPEED EXHAUST. THE OBLIQUES SHOCKS REFLECTED FROM THE TOP AND BOTTOM WALL ACT AS FLAME FOLDER TO KEEP THE COMBUSTION GOING.

HF&AE

HUMAN FACTORS & ATHLETE ENGINEERING

MSU, TOYOTA MISSISSIPPI AND LIQUID WIRE INC. PARTNER ON EFFORT TO IMPROVE INDUSTRIAL SAFETY THROUGH WEARABLE TECHNOLOGY

By James Carskadon

Mississippi State University, Toyota Mississippi and Liquid Wire Inc. are partnering on applied research for the use of smart wearable technology to improve workplace safety and aid in the prevention of injuries.

The collaboration was announced at the MSU Athlete Engineering Summit, a conference focused on improving human performance for sports, industrial, tactical and at-risk athletes. As part of the project, MSU's interdisciplinary Athlete Engineering research group will work directly with the Northeast Mississippi auto-manufacturer to implement and assess Liquid Wire wearable technologies inside its facility, providing new insights into ways Toyota can improve job performance and identify potential injury risks.

Reuben Burch, MSU associate professor of Industrial and Systems Engineering and head of the Athlete Engineering research team, said that while wearable technologies have been widely used in collegiate and professional sports settings, their use in industry has been limited. However, there are several potential benefits for companies and employees on the front lines of manufacturing.

TOYOTA MISSISSIPPI VICE PRESIDENT OF ADMINISTRATION ERIK SKAGGS, LIQUID WIRE INC. CEO MARK RONAY AND MSU ASSOCIATE PROFESSOR OF INDUSTRIAL AND SYSTEMS ENGINEERING REUBEN BURCH CELEBRATE A NEW PARTNERSHIP BETWEEN THE THREE ENTITIES TO USE WEARABLE TECHNOLOGY IN TOYOTA'S BLUE SPRINGS PLANT AS PART OF AN EFFORT TO IMPROVE WORKPLACE SAFETY AND AID IN THE PREVENTION OF INJURIES.

"Wearables and other technologies that monitor human performance have tremendous potential to identify injury risks before they become a larger issue," Burch said. "Industrial athletes have unique, sometimes repetitive movements and this project will help us better understand how the body responds to those tasks. Collaboration is at the core of our Athlete Engineering research, and I am grateful for partners like Toyota and Liquid Wire that are helping us further the societal benefits of these technologies."

Located in Blue Springs, Toyota Mississippi produces the world's best-selling vehicle—the Toyota Corolla. With more than 2,400 employees and over 2 million vehicles produced to date, the journey towards a safer road never ends.

"This collaboration is one of the many ways Toyota works to innovate and advance the culture of safety for the manufacturing process," said Erik Skaggs, Toyota Mississippi vice president of administration. "Leveraging wearable technology to gain data-based insight can help mitigate day-to-day risks while allowing us to predict injury before it occurs. That coupled with Toyota's core value for continuous improvement will provide safer practices for our employees."

MSU has partnered previously with Portland, Oregon-based Liquid Wire Inc. on research that uses the company's wearable soft robotic sensors, which allow for the collection of sophisticated movement data in a more natural or realistic setting than traditional motion capture systems. As part of the project, MSU will conduct validation studies on Liquid Wire's wearable sleeve and generate training materials for proper use of the technology in an advanced manufacturing setting like Toyota Mississippi's plant. Mark Ronay, CEO of Liquid Wire Inc., said that preventative ergonomic monitoring is the next frontier in industrial Personal Protective Equipment (PPE).

"We are excited to partner with Toyota and MSU on applying our wearable musculoskeletal monitoring platform to a manufacturing setting," Ronay said. "Our technology's ability to directly incorporate comfortable and form fitting sensing circuitry into industrial PPE allows seamless real time feedback on ergonomics, efficiency and health of a movement, allowing preventative protection against injury. We look forward to collaborating with MSU and Toyota to characterize application specific motions specific to their manufacturing environment and develop metrics and custom dashboards for preventing repetitive stress injuries at the workplace."

The initial project will last approximately one year. In addition to Burch, MSU principal investigators include Lesley Strawderman, International Paper Chair and professor in the Department of Industrial and Systems Engineering, Harish Chander and Zack Gillen, associate professors in MSU's Department of Kinesiology and David Saucier, research engineer at MSU's Center for Advanced Vehicular Systems.

MSU Athlete Engineering is a multidisciplinary research group that works to improve human performance in military, rehabilitation, industry and sports settings. With a robust student pipeline, the research group is helping to meet the growing demand for individuals that can collect, analyze, and effectively communicate the meaning of data generated by wearable technologies.

For more, see https://www.cavs.msstate.edu/research/athlete_engineering.php.

ATHLETE ENGINEERING EXPANDS CAPABILITIES

Wearables Validation: As part of their most recent efforts under the NSF Partnerships for Innovation grant, the Athlete Engineering research team is looking to validate smart sock and smart insole products in comparison to gold standard force plates during various jumps. The study is being conducted through the efforts of kinesiology and engineering students. This area of AERL is primarily focused on measuring human performance for athletic movements such as jumps, pitches, and swings for a variety of sports. The data collected here informs the team on how they can best make use of the data collected in the field with mutliple MSU athletics teams such as softball, soccer, and volleyball.

Mobile Markerless Development: One of the most recent innovations to spin out of AERL is the mobile markerless motion capture system. This development involves the use of synchronized action cameras mounted to drones to collect video data that can later be processed for biomechanical assessment. Early prototypes and testing have been carried out in collaboration with Raspet Flight Research Labs to evaluate initial feasibility and validity of the proposed concept.

GAIT REALTIME ANALYSIS INTERACTIVE LAB

The Gait Realtime Analysis Interactive Lab (GRAIL) system is a complete solution used for gait analysis and training for a variety of gait patterns in an immersive environment. The research team will be using this system for in-depth validation of wearable systems using the instrumented dual-belt treadmill and optical motion capture system. A variety of built-in applications are used to help with recovery of proper gait patterns and motor skills. The system can be used for a variety of populations including amputees with prosthetics, elderly, and those with increased fall risk. The built-in Body Weight Support (BWS) harness allows for participants to use this system even if they cannot support their own bodyweight during typical walking. The GRAIL also comes with a companion software, called D-Flow, which can be used to develop custom immersive scenes and activities depending on the protocol needed.

MSU CENTER FOR ADVANCED VEHICULAR SYSTEMS RESEARCH ENGINEER DAVID SAUCIER UTILIZES THE NEWEST CLINICAL-GRADE EQUIPMENT IN MSU'S ATHLETE ENGINEERING RESEARCH LAB. THE MOTEK GRAIL SYSTEM PROVIDES THE RESEARCH TEAM WITH AN IMMERSIVE ENVIRONMENT TO CONDUCT WIDE-RANGING GAIT ANALYSIS IN REAL TIME, SUPPORTING EFFORTS TO VALIDATE WEARABLES, IMPROVE PERFORMANCE, AND MINIMIZE INJURIES FOR AT-RISK, MILITARY, SPORTS AND INDUSTRIAL ATHLETES.

CAVS RESEARCHERS STUDY AIMS TO INCREASE UNDERSTANDING OF TRAUMATIC BRAIN INJURIES IN SOCCER

By Camille Carskadon

A research collaboration between Mississippi State University and Cardiff University in the United Kingdom aims to increase understanding of traumatic brain injuries in soccer.

The study, which began in 2020, researched the effects of head impact on aware and unaware soccer players. Raj Prabhu, former Department of Agricultural and Biological Engineering associate professor now deputy project scientist at NASA, and Hamed Bakhtiarydavijani, research engineer for the Center for Advanced Vehicular Systems, conducted the study at Mississippi State, along with Mike Jones from Cardiff University. Youssef Hammi, an associate professor in MSU's Department of Mechanical Engineering also participated in the project. The study found a dramatic difference in the head and brain movement of players who were aware of a head-to-soccer ball collision and those who were unaware.

Bakhtiarydavijani said that the study found that individuals unaware of an incoming impact are at a much higher risk of injury. When an individual is hit unaware by a soccer ball, because their neck muscles are relaxed, they experience significantly larger and faster head movement. These sudden head movements cause the brain tissue to stretch, increasing the risk of brain injury. Aware players, on the other hand, experience smaller head movements and are less likely to be injured. He explained that when someone is in a situation, and something comes towards them, they stiffen their necks in anticipation of that collision. When people are unaware of the collision, they cannot brace their necks.

"When you've got a larger range of motion after a collision, this allows for whiplash and causes the brain to move around and stretch more, causing injury," he said. "This increases the risk of injury in individuals unaware of the incoming ball versus those who are aware of it."

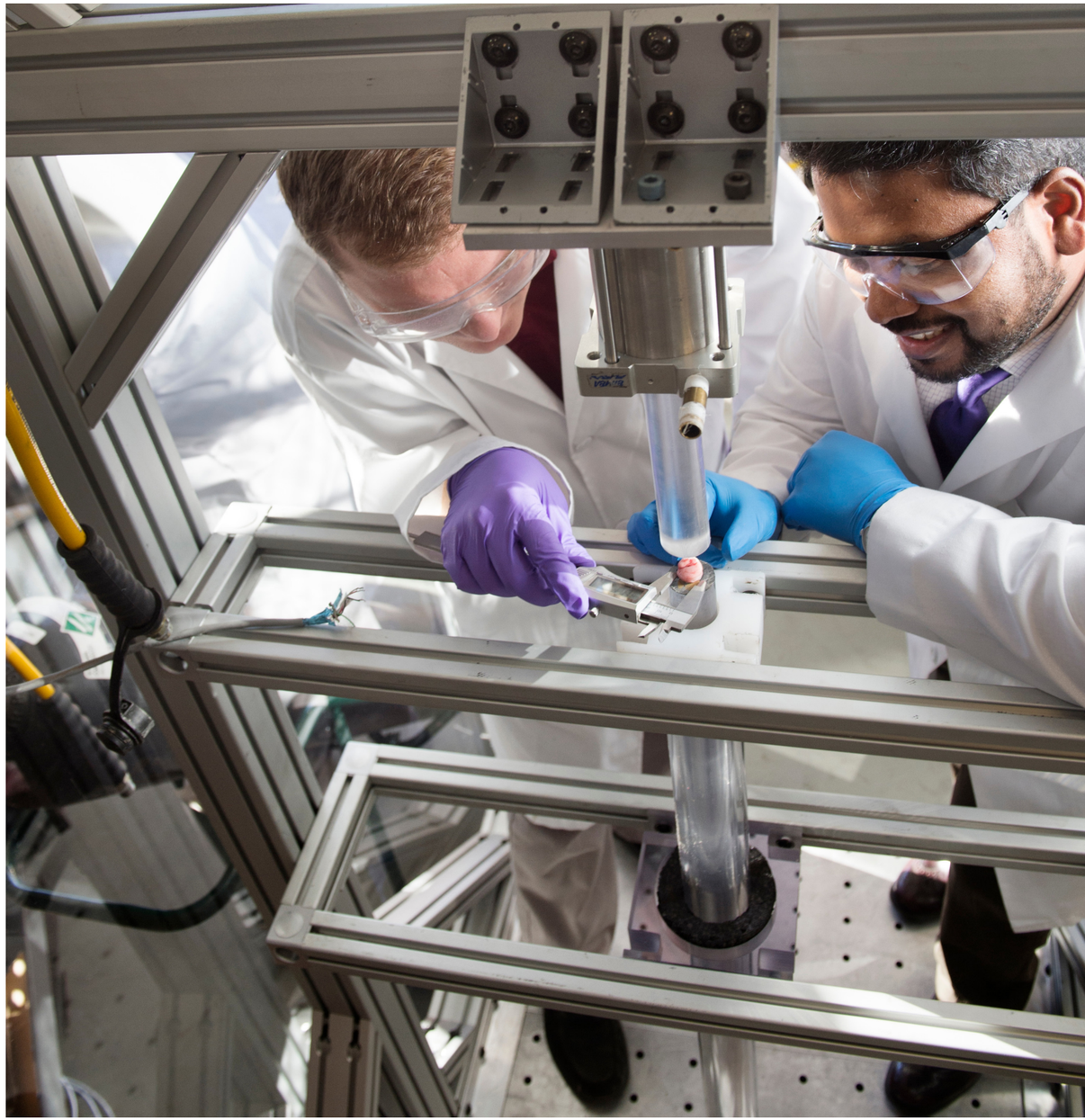
He explained that as soccer gains more and more popularity in the United States, especially in schools, it's always better to know the risks beforehand and that it's best to address issues with head injuries as quickly as possible before the sport's popularity increases.

"If we are able to do this research now and present our findings, it's better to set safety guidelines in the beginning so that further down the line, we don't have to, and it's harder to change people's mindsets. These studies help push that information forward to set guidelines as early as possible and mitigate any damages that might be caused down the line."

Guidelines for heading in soccer have already been set in some countries. Bakhtiarydavijani, who earned his Ph.D. at MSU in 2019, pointed to the fact that there are specific rules for under 12 age groups in Britain. Younger players, for example, are not allowed to do the headings permitted by those participating in professional matches because of the risks of injury.

This research project is the second collaboration between Mississippi State and Cardiff University. A 2017 study was conducted to advance the understanding of infant head trauma, one of the leading causes of death in young children.

Bakhtiarydavijani said he was looking forward to continuing the collaboration between Mississippi State University and Cardiff University with future projects. brain injury and vibration injury mechanisms, hypersonic materials, ballistic impact studies, surrogate modeling, and machine learning and optimization.



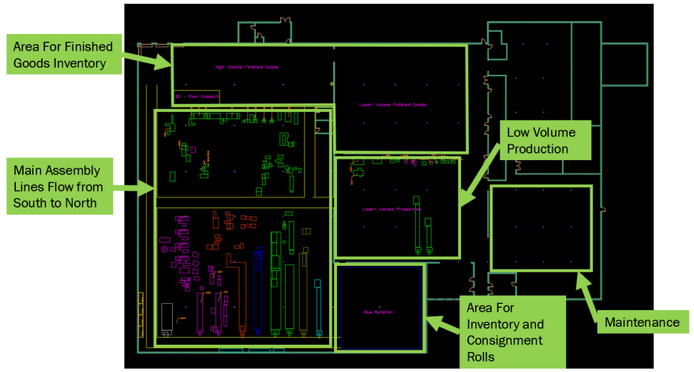
ARCHIVE PHOTO OF A 2017 STUDY TO ADVANCE THE UNDERSTANDING OF INFANT HEAD TRAUMA, ONE OF THE LEADING CAUSES OF DEATH IN YOUNG CHILDREN.

CAVS-E

CENTER FOR ADVANCED VEHICULAR SYSTEMS EXTENSION

TRANSFORMING BSP FILING SOLUTIONS: THE IMPACT OF CAVS-E

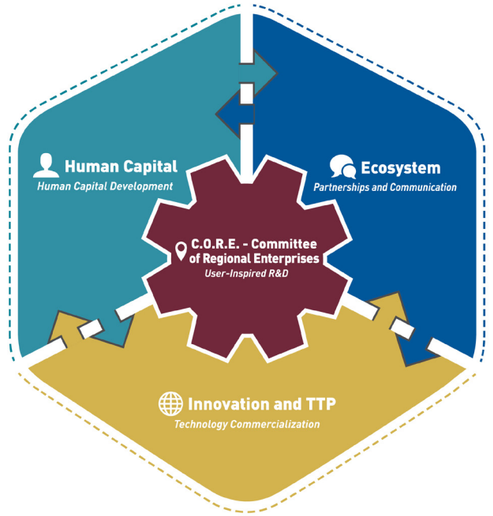
Over the past couple of years BSP Filing Solutions, a prominent manufacturer of filing products, has embarked on a transformative journey to overhaul their operations, aiming to bolster efficiency and drive sustainable growth. At the core of their efforts lies a resolute commitment to cultural change, harnessing the principles of Lean Manufacturing and prioritizing personnel development throughout the entire organization. In close collaboration with MSU-CAVS Extension, BSP initiated the process by conducting a Competitiveness Review (CR) to benchmark their operation against others across the country. At the time, BSP consisted of a 78,000 square-foot production facility and a 77,000 square-foot warehouse, which were separated by a half-mile distance. The frequent truck trips between these locations, compounded by the need for additional resources, resulted in significant operational inefficiencies.



The CR conducted by CAVS-E led to several recommendations that BSP actively pursued. As part of their strategic overhaul, the company adopted a Balanced Scorecard approach, enabling them to align their efforts with their overarching goals. This comprehensive framework encompasses financial, customer, internal process, and learning and growth perspectives, ensuring a holistic focus. Site Master Planning was also meticulously undertaken to evaluate the physical infrastructure requirements for the proposed consolidation. With the support of MSU-CAVSE, BSP created a layout in their warehouse facility capable of accommodating all their operations and, over the subsequent 6 months, they successfully relocated all operations to this consolidated location. This move resulted in streamlined workflow by eliminating the need for travel between separate locations and mitigating communication issues arising from this physical separation. In a relentless pursuit of excellence, BSP implemented a series of Continuous Improvement activities spanning diverse areas. These included enhancing customer-centricity, reducing lead times, implementing a First in, First Out (FIFO) customer order processing system, introducing visual controls for transparency, and streamlining material handling by transitioning Work-in-Progress (WIP) from pallets to rolling carts. Recognizing the invaluable role of a skilled workforce, BSP also made substantial investments in Professional Development classes, affording employees the opportunity to enhance their financial acumen and obtain Lean certificates. Furthermore, the company has shifted its current focus towards Total Productive Maintenance (TPM) and Single-Minute Exchange of Die (SMED) initiatives, with the goal of optimizing equipment reliability and minimizing setup times.

In summary, BSP's collaborative journey with CAVS-E has been characterized by a steadfast commitment to transformation, consolidation, and continuous improvement. Their strategic endeavors, fortified by the adoption of the Balanced Scorecard, promise enhanced efficiency, customer satisfaction, and employee proficiency. Through the ongoing TPM and SMED initiatives, BSP is well positioned for continued growth and sustained competitiveness in the ever-evolving landscape of modern industry.

CAVS-E SUPPORTING MANUFACTURING THROUGH TECHNOLOGY MODERNIZATION EFFORTS WITH SMART TECH MS AND MS SHIPS



SMARTTECH MS

A development grant awarded to MSU's Advanced Research and Development Corporation is propelling the advancement of autonomous technologies in advanced manufacturing throughout Mississippi. Through a strategic focus on research and development, technical innovation, commercialization, and workforce development, SmartTech MS is forging impactful partnerships within the state.

The objective of the Regional Innovation Engines Development Award, funded by the National Science Foundation, is to accelerate the progress of the Mississippi manufacturing sector by developing and integrating smart, autonomous technologies. These innovations are aimed at bolstering U.S. industrial competitiveness and positioning Mississippi for a significant stake in the ongoing technological revolution.

As co-chair of the Committee of Regional Enterprises, Tonya McCall, CAVS-E Director, leads an industry focused committee geared towards understanding and identifying the current gaps in technology that might be addressed by a collaboration of engineers, scientists, and researchers. The SmartTech MS project aims to establish frameworks and processes that foster collaborative solutions through university-industry-community partnerships. It also seeks to stimulate industrial and workforce innovation, particularly benefiting Mississippi's most rural areas, and to cultivate a regional ecosystem that is primed to accommodate Type 2 Engine advancements.

MS-SHIPS

Engineers from both CAVS and CAVS Extension are part of a $5 million dollar state effort to modernize the shipbuilding industry. This project is led by AccelerateMS and funded by the U.S. Department of Defense. This initiative has led to the creation of the Mississippi Shipbuilding Industry Preparedness for National Security (MS-SHIPS) Consortium focused on workforce development initiatives, Industry 4.0 modernization projects, and wearable technology to improve the workforce, increase productivity and reduce injuries at critical companies within the shipbuilding supply chain. CAVS-E's efforts are centered around the development of an Industry 4.0 assessment to evaluate the current state of technology implemented within the shipbuilding supply chain and technology scouting efforts to identify, recommend, and implement advanced manufacturing technology solutions, addressing their current manufacturing challenges, with the goal of boosting their productivity.

Through both of these initiatives, CAVS Extension is taking care of what matters by providing technical assistance to Mississippi manufacturers.

CAVS-E

CAVS EXTENSION

CENTER FOR ADVANCED VEHICULAR SYSTEMS EXTENSION

ECONOMIC IMPACT

The influence of CAVS-E extends across various industries throughout the state by helping to empower companies and give them a competitive edge to meet and surpass the demands of today's economy. Backed by a team of industry experts, CAVS-E effectively addresses workforce challenges and helps companies find innovative solutions to enhance their manufacturing processes and employee skills through engineering outreach, professional development training, and on-site project support. In addition to utilizing cutting-edge technologies, CAVS-E has recently realigned its efforts towards Industry 4.0 (i4.0), which emphasizes interconnectivity, automation, and real-time data analysis in the pursuit of autonomous manufacturing environments. Through the development of its i4.0 programs, CAVS-E intends to prepare workers for high-tech environments that have transitioned, or are currently transitioning, to automated systems.

Here's what some of the CAVS-E clients are saying:

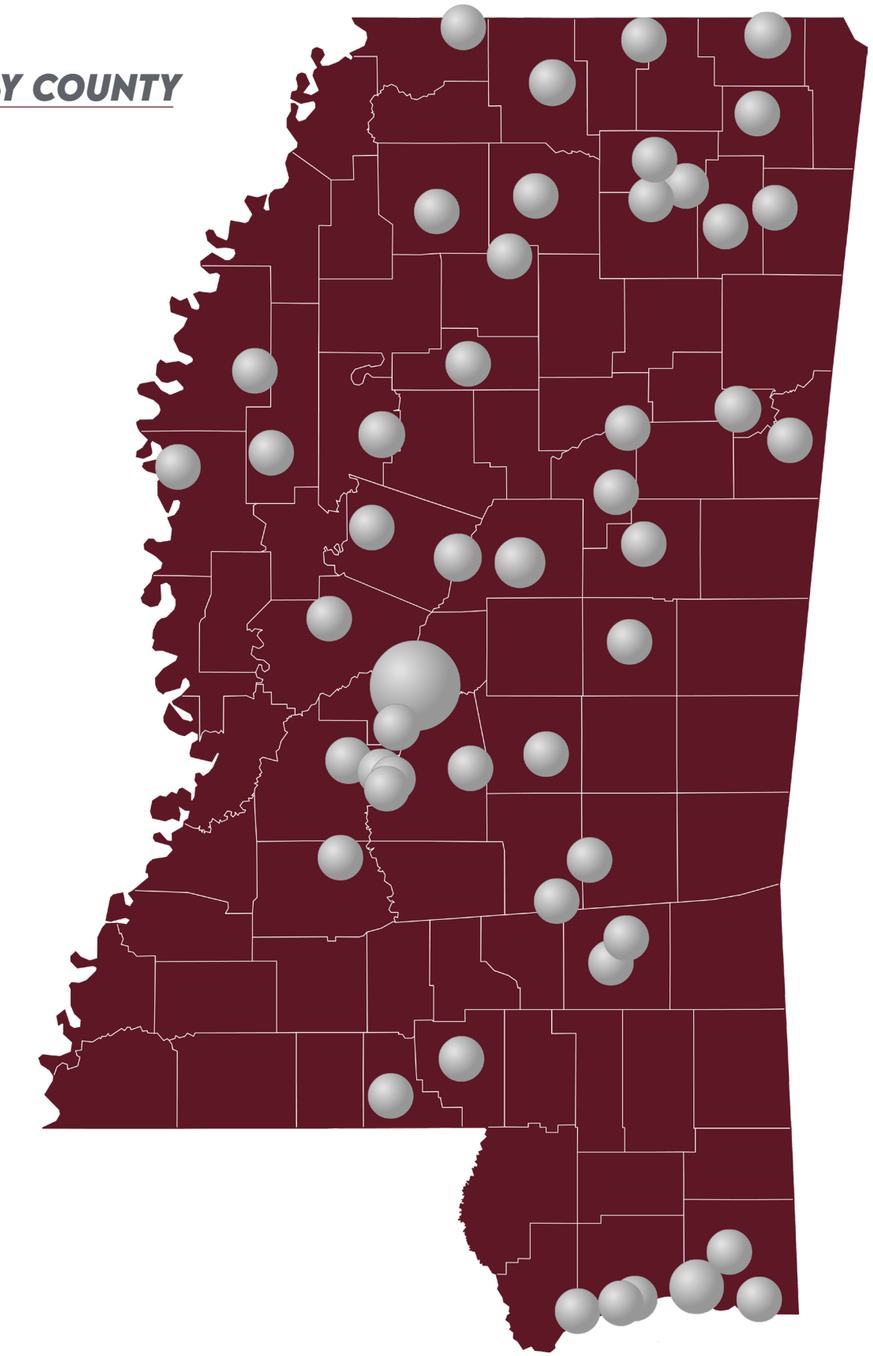
"With the support of MSU CAVS-Extension, our logistics team was able to create data analysis and scheduling software as a tool for planning, tracking, and improving resource utilization...CAVS-E provided our company with the help and support we needed and our team was able to learn a lot of valuable information. The great training and learning environment gave our team a different outlook..."
-Construction equipment manufacturer

"New Way Trucks' inclusion in (CAVS-E services) further legitimized our entrance into a new territory...Thanks to CAVS-E's help, the reputation New Way has been able to develop locally has resulted in a significant bump in sales, not only in Mississippi but throughout the southeastern United States. This support and subsequent growth contributed to us exceeding our initial hiring goals and allowed us to open another manufacturing facility in northeast Mississippi...the impact is felt both directly and indirectly on a daily basis!"
-Refuse truck manufacturer

Since its establishment in 2003, CAVS-E has made a significant economic impact of over $7.2 billion, resulting in cost savings, increased workforce skills, and enhanced sales. This has led to the creation and retention of over 7,300 jobs, demonstrating how CAVS-Extension drives business improvements and fosters future growth in Mississippi. The economic impacts of CAVS-E's services from 2020 to 2023 are visually represented on the accompanying map.

2020 - 2023 ECONOMIC IMPACT	VALUE
Increase/Retained Sales	$509,712,938
Cost Savings/Avoidance	$80,080,605
Total Company Investments	$611,446,857
Total Overall	$1,201,240,130
Jobs Created/Retained	1683

IMPACT BY COUNTY



CAVS-E

CENTER FOR ADVANCED VEHICULAR SYSTEMS EXTENSION

CAVS EXTENSION IMPACTS

237
Projects
Completed

Site Master Planning
Plant Layout and Expansion
Production and Materials Flow
Digital Work Instruction

Number of Companies Served:
160

Employees Trained:
790

C.E.L.L.
CAVS-E Industry 4.0 Experiential Learning Lab

HOW we made a *difference*
2022 - 2023

i4SA
Industry 4.0 Skills Accelerator

Instant Impact Award

JOBS

Jobs Created or Retained

766

Industry 4.0
3D Scanning
3D Design & Printing
Automation

Economic Impact

$905,155,533

FINANCIAL HIGHLIGHTS

CAVS PROPOSALS 2020-2023

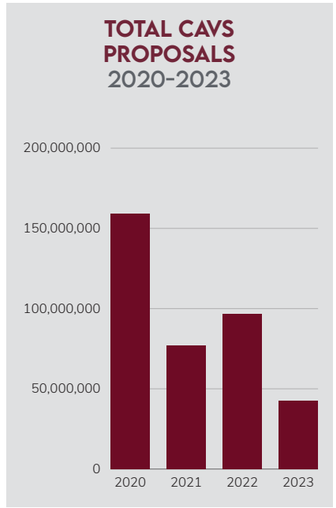
2020	$159,133,105
2021	$76,809,489
2022	$96,697,453
2023	$42,486,943

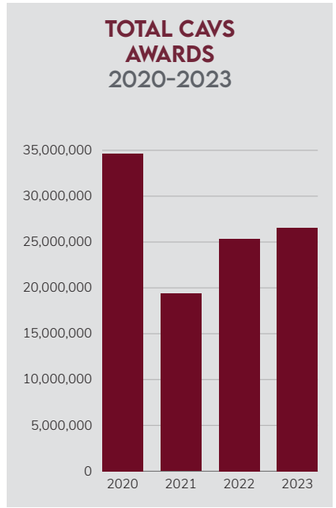
CAVS AWARDS 2020-2023

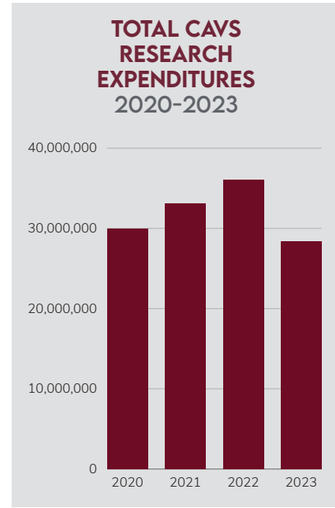
2020	$34,674,692
2021	$19,369,737
2022	$19,369,737
2023	$26,577,465

CAVS RESEARCH EXPENDITURES 2020-2023

2020	$29,976,106
2021	$33,104,019
2022	$36,070,426
2023	$28,349,389







AWARDS & ACCOMPLISHMENTS

DICKEL

Doyl E. Dickel

is receiving the NSF's Faculty Early Career Development (CAREER) award, which will provide a $682,571 grant to support his research. Dickel, assistant professor in the Department of Mechanical Engineering, is developing machine learning models that can incorporate the magnetic properties of iron and cobalt when modeling potential materials for use in items such as electric motors and steel.

Dickel said the resources available at CAVS and MSU's High Performance Computing Collaboratory, which is home to one of the most powerful supercomputers in U.S. academia, have helped advance his materials research.

"The high performance computing facilities are amazing for the work we need to do," Dickel said. "I've also had great support from Clay Walden and Haitham El Kadiri, who has placed a priority on mentoring junior faculty and helping with proposal writing. As we've been working on these topics in recent years, we've had a great infrastructure and support from administration."

Patti Duett

was inducted into the U.S. Army Corps of Engineers Waterways Experiment Station (WES) Gallery of Distinguished Civilian Employees during an induction ceremony Thursday, July 27, at the U.S. Army Engineer and Research Development Center (ERDC) Auditorium in Vicksburg, Mississippi.

Duett, associate director for MSU's Institute for Systems Engineering Research, retired from the ERDC Information Technology Laboratory (ITL) in 2021 after 30 years of service. She dedicated her career to ensuring ITL and ERDC were at the forefront of technical achievements, and her work played a vital role in the laboratory's success and continues to serve as the foundation for its future.

DUETT

Tonia Lane

is now serving as director of Mississippi State University's Institute for Imaging and Analytical Technologies.

LANE

Lane joins I2AT from MSU's Advanced Composite Institute, where she was director of business operations and program manager. At I2AT, she provides leadership for the research institute housing major research instrumentation that is available to MSU faculty, staff, students and external partners. The center is administered by the MSU Office of Research and Economic Development.

"Tonia is an accomplished scientist and project leader, bringing two decades of relevant experience to the position," said MSU Vice President for Research and Economic Development Julie Jordan. "I2AT is an important asset for facilitating a wide range of university research activity that requires advanced imaging instrumentation, boosting our researchers' capabilities and providing a valuable service for government and industry partners."

HILL (MIDDLE)

Travis Hill

was recently presented with the Institute of Industrial and Systems Engineers (IISE) Outstanding Practitioner Award. This award recognized Hill for his excellence in the practice and application of Modeling and Simulation.

As a senior engineering project manager for CAVS-E, Hill has worked with more than 100 companies over the past 20 years, such as Nissan North America, Toyota, FedEx, Viking Range, Northrop Grumman, VT Halter Marine, and Navistar Defense, to help improve their manufacturing and logistics systems through the use of simulation and decision support technologies. Hill has presented at many research and industry conferences and authored a Manufacturing Innovation Blog for NIST entitled "Simulation is a Window into the Future of Your Manufacturing Operation" summarizing the long-term potential that simulation provides in transforming manufacturing operation. He also delivers engineering workshops in topics such as Simulation Modeling and Analysis Using FlexSim and Visual Dashboard Development using Power BI.

AWARDS & ACCOMPLISHMENTS

BURCH

Reuben Burch

is taking on a new role as associate vice president for research. The promotion moves Burch, a distinguished faculty member in the Bagley College of Engineering, into a leadership position within MSU's Office of Research and Economic Development. A two-time MSU alumnus, Burch has been an MSU faculty member since 2016 and led interdisciplinary research teams focused on human performance.

Burch will assist with developing and implementing strategic direction for MSU's research mission, as well as day-to-day oversight of administrative units and research centers reporting to ORED. He will also engage with current and potential university federal, state and local partners, and work to facilitate cross-discipline research teams to compete for funding opportunities.

CAVS-E

MSU's Center for Advanced Vehicular Systems-Extension received the Instant Impact Award from AccelerateMS at the organization's 2023 Mississippi Horizons and Innovation Strategy Symposium this past week. The award was based on CAVS-E's creation of the Industry 4.0 Skills Accelerator Program, which helps train industry personnel for working in high-tech environments and raises the visibility of advanced manufacturing career opportunities in the state.

"It is my hope that the recognition given today in these three awards will inspire others to follow in their lead to make a larger impact in Mississippi communities," said Ryan Miller, AccelerateMS executive director, in announcing the top workforce awards from the conference.

CAVS-E's Industry 4.0 Skills Accelerator Program was established with American Rescue Plan Act funding in response to growing industry needs for workforce training focused on advanced manufacturing environments. With the funding, MSU personnel established the CAVS-E Experiential Learning Lab at the CAVS-E office in Canton. The lab contains a scaled down production line, collaborative robots, sensor equipment, data visualization systems and other technology seen in Industry 4.0 settings. In addition, the project includes virtual reality headsets and other mobile equipment that is being used to provide Industry 4.0 demonstrations to manufacturing companies. The team established a training and coaching program aligned with current industry trends and is conducting K-12 outreach focused on training and exposure for both the student and educator community.

MSU PRESIDENT MARK E. KEENUM CONGRATULATES MSU CAVS-EXTENSION DIRECTOR TONYA MCCALL AFTER CAVS-E RECEIVED THE 2023 INSTANT IMPACT AWARD FROM ACCELERATEMS.

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CAVS