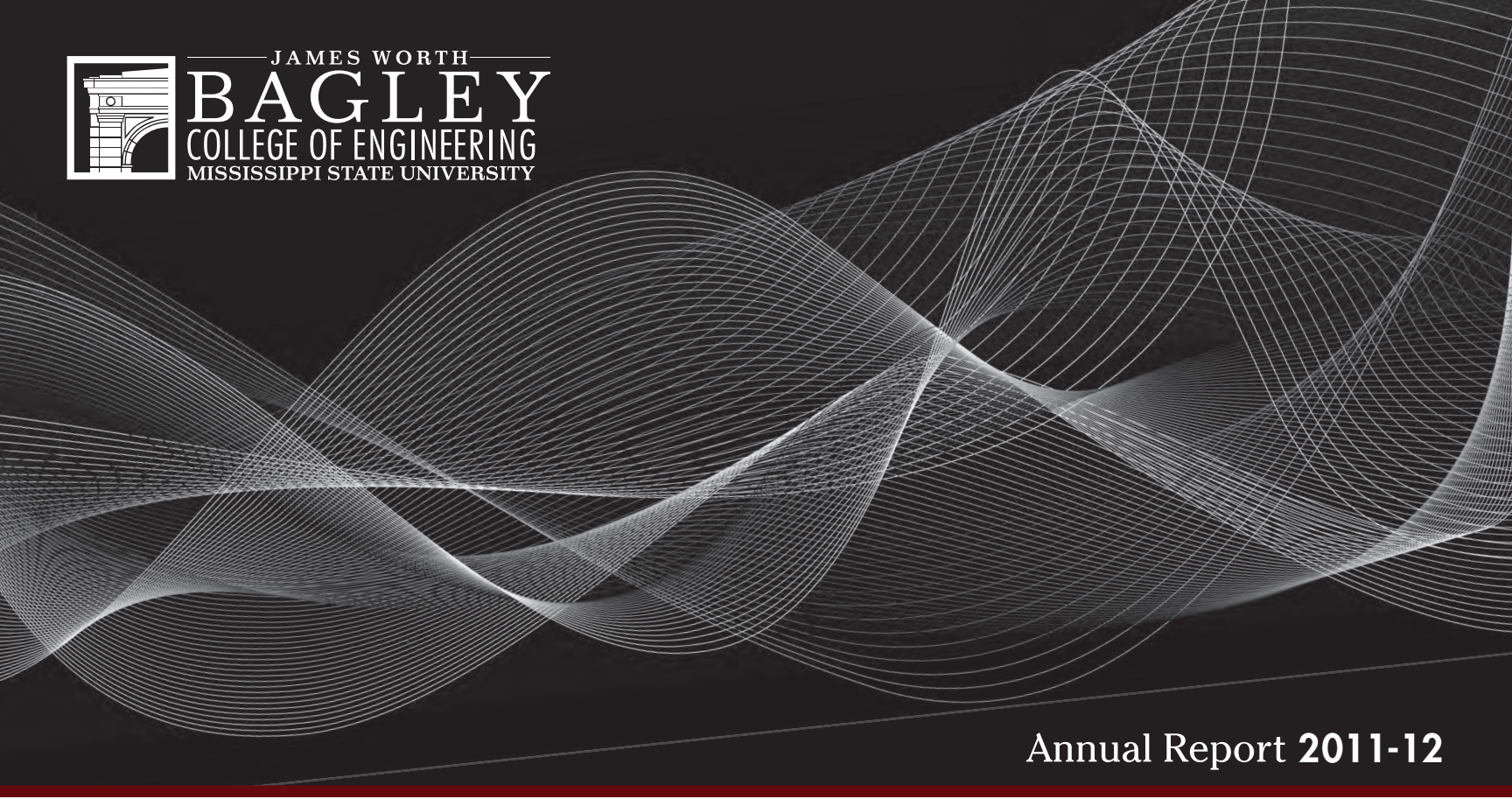

CAVS CENTER FOR ADVANCED VEHICULAR SYSTEMS

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Photographer: Megan Bean and Beth Newman

DR. ROGER KING

WORLD-RENOWN RESEARCH, TECHNOLOGY & EDUCATION FOR ENGINEERING SOLUTIONS

The Center for Advanced Vehicular Systems (CAVS) in the Bagley College of Engineering at Mississippi State University is a nexus for world-class technology, research and education commissioned to address the engineering challenges facing US mobility industries. Our facility is equipped with high performance computational equipment and state-of-the-art analytical tools for modeling, simulation, and experimentation. Our goal is to be the primary Southeastern academic resource for solutions and innovations in complex interdisciplinary fields, such as those characteristic to the automotive, aerospace, and transportation industries.

CUTTING-EDGE, REAL-WORLD EXPERIENCE FOR A UNIQUE EDUCATIONAL ENVIRONMENT

The award-winning faculty, staff, and students at CAVS harness these resources to provide a distinctive, interdisciplinary environment wherein next-generation engineers and scientists train and research alongside field experts to investigate, expand and enhance the design, technology, production, and infrastructure necessary for sustainable human and vehicle mobility. The first place standings in 3 of the last 5 years in the DOE/GM ChallengeX and EcoCar competitions is just one example of the caliber of faculty and students who participate in CAVS projects in conjunction with the MSU engineering programs.

ECONOMIC DEVELOPMENT IN MISSISSIPPI AND THE SOUTHEAST—POSITIONED FOR GLOBAL COMPETITION

CAVS also represents a commitment by the State of Mississippi to assist and support Mississippi industry through project-based activities. The management at CAVS, and the research team in general, recognize the need to generate economic development via technological and scientific discovery. Thus, CAVS serves as a knowledge bank for existing and future Mississippi industries.

Leveraging our broad-impact research, along with our state, national, and international industrial alliances, CAVS contributes substantially to the economic development of the State of Mississippi. In fact, the recruitments of PACCAR and Toyota to this state were facilitated by the core competencies in research, extension, and automotive-related academic prowess at CAVS. As the US economy is turning around, these two organizations are moving toward full production levels and will continue to be supported by CAVS.

CAVS offers an additional means of direct interface to a variety of manufacturers and industries throughout the state and region via the CAVS Extension (CAVS-E) located in Canton, Mississippi. CAVS-E provides a wide range of services to industrial clients, including discrete event simulation, Six Sigma, lean manufacturing, and metrology. According to surveys conducted by the Manufacturing Extension Partnership of Mississippi for the years 2006-2011, CAVS-E generated a more than $5.5 billion economic impact on the state and was responsible for over 2,600 jobs either created or retained.

As further indication of our commitment to the state, CAVS now serves as an active member of the Mississippi Automotive Manufacturers Association (MAMA) and was the recipient of the 2010 MAMA Award of Excellence for promoting the growth, development and improvement of the automotive industry. Hol-Mac Corporation and CAVS-E were also recognized with the 2011 Southern Growth Policies Board Innovator Award for the State of Mississippi.

Without question, the Center for Advanced Vehicular Systems is well situated to continue its support of the short- and long-term research needs of industry and government in Mississippi and the Southeast.

BLAST RESEARCH PROMISES TO POSITIVELY IMPACT WARFIGHTER SURVIVABILITY

Simulations being developed at the Center for Advanced Vehicular Systems promise to help pave the way for improved warfighter survivability in certain blast situations.

By creating digital models of how the human body responds to blasts from improvised explosive devices (IEDs), Lakiesha Williams and a team of researchers in the interdisciplinary human body simulation research group hope to provide the data necessary to better protect men and women in uniform.

The research is funded through the Simulation Based Reliability and Safety Program, a five-year, $75 million partnership between CAVS and the U.S. Army Tank Automotive Research, Development and Engineering Center.

"Our primary focus is on the lower extremity and how bone, muscle and skin deform under very high blast pressure, such as what happens with an under-vehicle blast," said Williams, an assistant professor of biological engineering. "These underbelly IED-blasts are one of the biggest in-theater threats to soldiers."

The group's detailed computational models show approximations of what happens to a human body, specifically the leg, when it is in a vehicle that has been attacked by an IED. Currently, the simulations focus on blasts that occur directly under foot and to the right and left of the leg at specified distances and pressures. Williams, who presented this research at a recent NATO conference, said this work is unique because other simulations have not focused as specifically on IED explosions or produced the level of anatomical and mathematical detail in their models.

"These simulations take an amazing amount of computational power and can take several days to run, but the amount of detail they provide is incredibly refined," Williams said. "We can specifically see how a blast causes the skin to tear, bones to break, and muscles to tear. Ultimately we will couple this data with research in developing enhanced safety countermeasures for soldiers with the goal of increasing soldier survivability."

Williams explained that by first looking at how a human is injured, researchers can then better optimize vehicle design and improve safety equipment. More advanced equipment could lead to a decrease in the number of warfighters wounded or killed in action. The group's simulations are being validated by cadaver studies being conducted by a subcontractor.

"Once we validate that our leg simulations accurately depict what happens during explosions, we can branch out into simulating how different materials or product designs surrounding the limb can impact the results," Williams said.

For more information about this research, contact Dr. Williams at lwilliams@abe.msstate.edu.

HONGJOO RHEE
Assistant Research Professor
& CAVS Associate Director

CAVS NURTURES INTERNATIONAL PARTNERSHIP TO STIMULATE MANUFACTURING GROWTH IN MISSISSIPPI

A new Center for Advanced Vehicular Systems partnership will help Mississippi support Asian-based companies and the jobs they bring.

CAVS and the Korea Institute of Industrial Technology (KITECH) have joined forces to support South Korean manufacturers' efforts to develop products and train employees for their facilities in the southeastern United States.

"The mindset in Asian countries, and in Asian companies, is very different from that of America, but through this collaboration, CAVS will help bridge that gap by serving as regional hub of support for KITECH's interests," explained Hongjoo Rhee, a CAVS associate director and partnership leader.

The South Korea native added, "The missions of CAVS and KITECH are very well aligned, so this was a logical collaboration to help foster manufacturing growth in Mississippi."

KITECH was established in 1989 as a research, development and support center for small and medium sized enterprises. Rhee compared its function to the National Institute of Standards and Technology-sponsored Manufacturing Extension Partnership, a network of centers, like CAVS, that support American industry.

The alliance with KITECH focuses on automotive part manufacturers that are moving to the Southeast in order to support carmakers like Hyundai and Kia that have opened production facilities in the region. In addition to work-force training and efficiency improvements, CAVS will provide research and development capabilities to help the parts suppliers address quality control issues and further cultivate new products and business partnerships.

"These small companies don't have their own research facilities for product development and improvement," Rhee explained. "KITECH helps provide these services for the companies' Korean facilities, and this partnership will allow CAVS to fill that role for the plants in the southeastern United States."

He added, "KITECH's researchers will provide the database and CAVS will provide experimentation, modeling and simulation that will help them finalize products. Experimentation, modeling, simulation, and validation are the steps required for developing a product or process."

Currently, the international partnership is funding two collaborative projects at CAVS. One will develop a model to predict the thermo-mechanical behavior of advanced high strength steels during hot press forming, an advanced technique to achieve high strength and good formability. The second project focuses on resistance spot welding of a magnesium alloy and how to improve its mechanical properties. Both projects have applications in the development and production of automotive components for vehicle weight reduction and passenger safety.

"The automotive industry in the Southeast has really taken off, and now that these companies are moving here, we want to be sure that they continue to be successful and provide growth for our region," Rhee said.

For more information about the partnership, contact Dr. Rhee at hrhee@cavs.msstate.edu.

CAVS-EXTENSION HELPS SAVE STATE INDUSTRY MILLIONS OF DOLLARS

A coalition, led by the Center for Advanced Vehicular Systems-Extension, generated a $2 million-per-year economic impact for the Magnolia State through a new professional development program.

The Enhancing On-the-Job Problem Solving program has provided critical skills training to more than 400 employees from Nissan's Canton, Miss. facility and its in-state suppliers.

"This training picks up on the team concepts that are introduced in undergraduate classes but takes them to a deeper level," said Clay Walden, director of CAVS-E. "It is driven by the automotive industry's need to rapidly solve problems using a team approach."

The program was initiated in 2009 with a $660,000 grant from the Mississippi Department of Employment Security through the American Reinvestment and Recovery Act. Thus far, it has provided an 8-to-1 return on the initial investment. With their project partners Holmes Community College and Nissan, CAVS-E has been honored with several recognitions for this program, including the 2012 Southern Growth Policies Board Innovator Award for the State of Mississippi, the 2011 Community Economic Development Award from the Mississippi Economic Development Council, and finalist for the 2011 University Economic Development Association Summit Award of Excellence in Talent Development.

"This project was the best use of stimulus funds of any of the projects that I am aware of across the country," said Les Range, executive director of the Mississippi Department of Employment Security.

Bob Mullins, Nissan's senior manager of training, added, "This initiative was well received by Nissan and our suppliers. It has improved problem-solving skills throughout the automotive industry."

Prior to the start of the program, analysis showed that only 5.8 percent of workers in Mississippi's automotive sector possessed higher ordered skills, such as team-based critical thinking and problem solving, which trails the 10.5 percent national average. In order to overcome this gap, the coalition taught workers using a three-pronged curriculum: instrumentation and diagnostics, problem-solving methodologies, and teaming topics.

Personnel from the MSU Bagley College of Engineering trained students on the use of specialized equipment and software. CAVS-E provided instruction in applying problem-solving methods to real, on-the-job problems and projects. Instructors from Holmes then worked to enhance the communication, leadership and collaboration skills of the students.

"Many of the workshops had projects associated with them where we could coach the participants in the use of these new techniques on real-life projects from their companies," Walden explained.

More than 60 percent of the students who participated in the program have earned a wage increase since receiving training. Since the start of the program, 59 projects have been completed, resulting in $2,019,000 in savings per year through resolution of chronic problems at the trainees' companies.

The 27 courses developed or enhanced through this program are now available for additional training opportunities. Because a substantial portion of the start-up funding was used to purchase equipment and software, the training can be continued in a cost-efficient manner.

For more information about this project, contact Clay Walden at walden@cavse.msstate.edu. Information about the CAVS-Extension can be found at www.cavse.msstate.edu.

DAVID THOMPSON
Associate Professor
Aerospace Engineering

SIMULATIONS PUT AIRCRAFT SAFETY CONCERNS ON ICE

Things can get chilly at 30,000 feet in the air. While the cozy airplane cabin protects passengers from the below-zero temperatures, the plunging mercury can have a negative effect on a plane's exterior.

With air temperatures that can hover around negative 30 degrees, supercooled liquid water droplets can freeze and accumulate on the aircraft. EADS Innovation Works is developing more efficient solutions to the problem of reducing ice buildup on aircraft—with a helping hand from David Thompson and the Center for Advanced Vehicular Systems.

"EADS-IW scientists are working to develop coatings that will help prevent ice from building up on surfaces," explained Thompson, CAVS associate director. "We are performing simulations that will help estimate the effectiveness of their compounds."

Working with a three-year, $300,000 contract, Thompson and a team of graduate students are assisting EADS-IW by helping them design a wind tunnel used for physical testing and creating simulations to show how water droplets behave under certain conditions.

"The wind tunnel CAVS optimized and the droplet simulations they are developing will help us save time and money, by reducing the need for physical tests and providing us with a reliable, less expensive way to conduct tests when needed," explained Dominik Raps, project leader for Munich-based EADS-IW.

Thompson explained that in the first year of the contract, his team focused on designing a droplet delivery device for a small-scale, refrigerated wind tunnel capable of simulating the interaction of water and an aircraft's surfaces under freezing conditions. The tunnel system needed to be capable of introducing supercooled water droplets into the air-stream and having them accurately deposit on a test specimen.

"In most icing tunnels, water droplets are introduced into the flow via spray bars and are chilled as they go down stream, but that takes a lot of space," Thompson explained. "EADS-IW asked us to find a way to introduce already chilled water into the system, without it freezing in the delivery tube, in order to build a smaller wind tunnel."

Thompson's group is now using computational fluid dynamics to simulate how water droplets behave when they hit different surfaces.

"We can simulate how water will interact with a surface when given its physical properties," Thompson said. "This allows EADS-IW to evaluate the impact their surface coatings will have on ice accumulation and reduce the number of physical tests that must be performed."

Thompson, who has been honored by NASA for his aircraft-icing research, expects to finish this latest project in 2013. He said the next step will be to focus on the droplet solidification process and how it is affected by the surface coatings developed by EADS-IW.

For more information about this aviation safety project, contact Dr. Thompson at dst@cavs.msstate.edu.

TRANSPORT PHENOMENA RESEARCH HAS THE RIGHT MOVES

Sergio Felicelli has got the right moves, for manufacturers at least.

His broad base of research provides insight into how thermal energy is transferred and components move within a heterogeneous mixture.

"Most of my research falls under the framework of transport phenomenon. It involves heat and mass transfer, fluid mechanics, phase change, and material response," explained Felicelli, an associate director at CAVS and the Coleman and Whiteside professor of mechanical engineering. "One major line of work is to study the transport mechanisms of heat, mass and liquid within alloys."

Transport is simply the movement of something from one place to another. In everyday conversation, it typically refers to moving people or products from place to place, but in a research sense, it refers to things on a smaller scale, such as how molecules flow and disperse within a fluid substance and how heat transfer is achieved. Felicelli's research creates computational models of these behaviors and properties to understand what happens during product fabrication.

"We track concentrations of materials. We track velocity. We track temperatures. We try to understand the evolution of why things happen," Felicelli said. "By understanding these things we can better predict what happens at the moment of solidification."

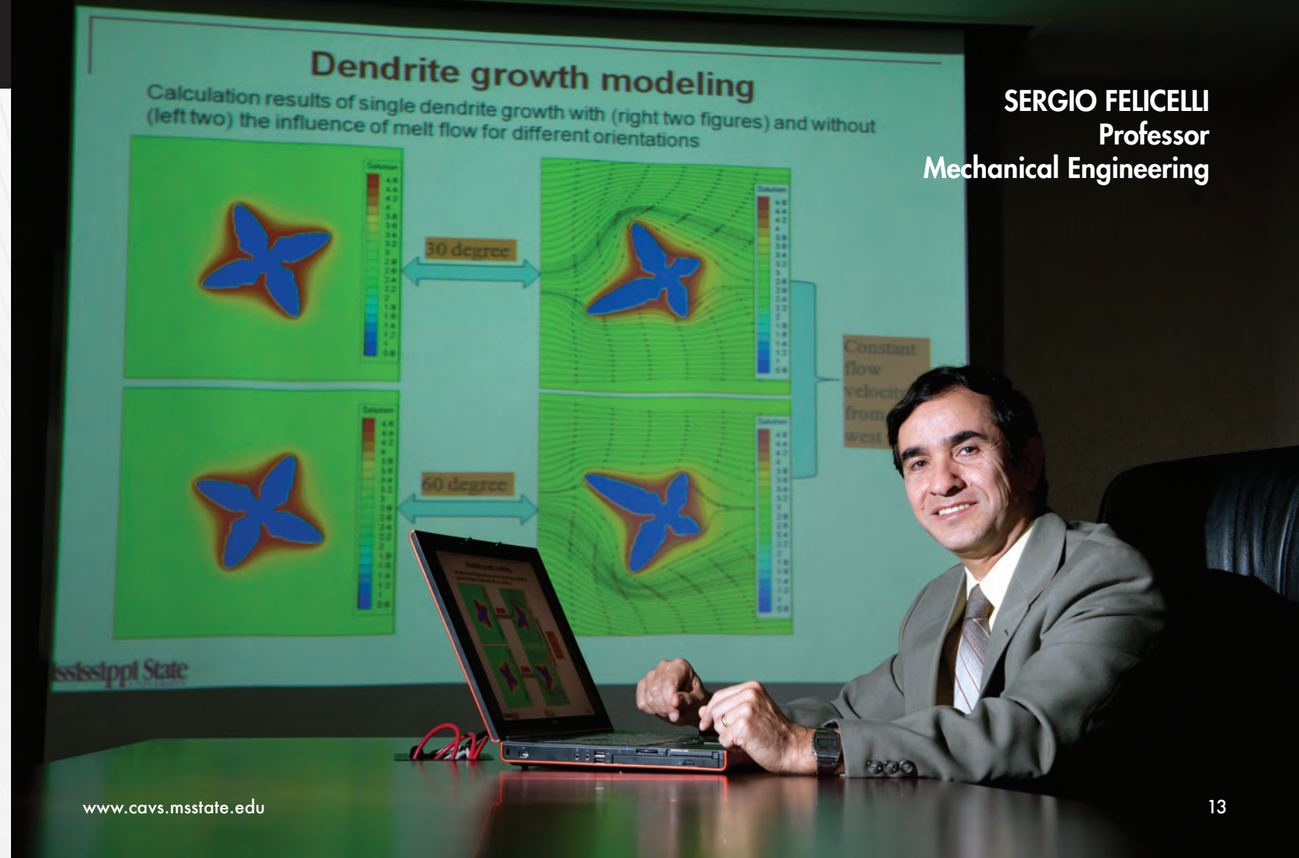
He added, "With this information, we can advise companies about what processes they should use or what issues they can look out for in order to produce stronger products and avoid defects."

This research has applications in a variety of manufacturing situations, including the production of automotive parts or other composite material-based products. Most of Felicelli's research has been funded by organizations such as NASA, the Department of Energy, the Department of Defense, and the National Science Foundation. He explained that this support helps keep his transport phenomena research open for publication.

"Much of my research is on the fundamental side," Felicelli said. "This allows me to publish it where people can use it. However, we can create models for the specific geometries of a company's product if the manufacturer needs to correct a production issue or protect against defects or structural weaknesses."

Felicelli is also studying the microstructure of materials produced using the freeform fabrication method, layer-additive metal deposition. This technology allows for components with complex shapes to be created, layer-by-layer, directly from CAD models. His research directly compares and contrasts two different layer-additive systems to evaluate the effectiveness of the new technology.

For more information, contact Dr. Felicelli at felicelli@me.msstate.edu. Summaries of his various research projects can be found at www.me.msstate.edu/faculty/felicelli/felicelli_research.



SERGIO FELICELLI
Professor
Mechanical Engineering

RECOGNITIONS FOR CAVS AND CAVS-ASSOCIATED FACULTY, STAFF AND STUDENTS

Fazle Ahad
2011 American Society of Mechanical Engineers (ASME) Joint Rail Conference Student Scholarship

2011 Bagley College of Engineering Graduate Fellowship

Mohsen Asle Zaeem, Hebi Yin, Sergio Felicelli
2011 COMSOL Conference Best Poster Award

Jean-Luc Bouvard
2011 StatePride Faculty Award

Matthew Doude
2011 Bagley College of Engineering Research Award—Research Support Staff

Sergio Felicelli
2011 Bagley College of Engineering Hearin Faculty Excellence Award

Youssef Hammi
2011 StatePride Faculty Award

Mark Horstemeyer
William L. Giles Distinguished Professor

2011 International Journal of Plasticity Young Research Award

2010 Honorary Professor at Xihua University, Sichuan Province, Chengdu, China

Sundar Krishnan, Kalyan Srinivasan
2010 SAGE Best Paper Award, Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering

Roger King
Named Co-chair, Design and Protection Technologies for Land and Amphibious NATO Vehicles, North Atlantic Treaty Organization

Thomas Lacy
Fellow, American Society of Mechanical Engineers (ASME)

Recording Secretary, American Society for Composites

David Lavallee
2011 Bagley College of Engineering Research Award—Undergraduate Student

William Lawrimore II
2011 Bagley College of Engineering Graduate Fellowship

NaYeon Lee
2011 Korean Honor Scholarship, Korean Embassy

Dana Lewis
2011 Bagley College of Engineering Professional Staff Award

Pedro Mago
Tennessee Valley Authority (TVA) Professorship in Energy Systems and the Environment, Department of Mechanical Engineering, Bagley College of Engineering

2011 Bagley College of Engineering Hearin Faculty Excellence Award

2011 StatePride Faculty Award

David Marcum
Invited Professor, INRIA, Paris-Rocquencourt, France

Honorary Professor, University of Wales, Swansea, UK, 2007-present (awarded 2nd 5-year term 2012-2017)

Marshall Molen
2011 National Science Foundation (NSF) Outstanding Veteran Faculty Advisor Award

Kendra Posovich
2011 Bagley College of Engineering Professional Staff Award

Rajkumar Prabhu
2011 Bagley College of Engineering Research Award—Graduate Student

Masoud Rais-Rohani
2011 Konrad Dannenberg Educator Award, American Institute of Aeronautics and Astronautics, Greater Huntsville Section

2011 StatePride Faculty Award

Hongjoo Rhee
2011 StatePride Faculty Award

Kiran Solanki, Amitava Moitra, & Mehul Bhatia
2011 Minerals, Metals & Materials Society (TMS) Light Metals Magnesium Best Paper Award

Rani Sullivan
2011 Bagley College of Engineering Academy of Distinguished Teachers

Mark Tschopp
2011 StatePride Faculty Award

Keith Walters
2011 Bagley College of Engineering Research Award—Faculty

Chris Walton
2011 GEM Fellowship, National Consortium for Graduate Degrees for Minorities in Engineering & Science, Inc. and Corning, Inc.

2011 Bagley College of Engineering Graduate Fellowship

National Science Foundation (NSF) Graduate Research Fellowship Honorable Mention

Phi Kappa Phi Honor Society

Liang Wang
2011 StatePride Faculty Award

Liang Wang, Ratessiea Lett, Sergio Felicelli, John Berry
2011 Metalcasting Congress Best Presentation Award (one of five presentations honored)

CAVS Extension
2011 Mississippi Economic Development Council Community Economic Development Award

Finalist, 2011 University Economic Development Association Summit Award of Excellence in Talent Development

2012 Southern Growth Policies Board Innovator Award for Mississippi

MSU EcoCAR

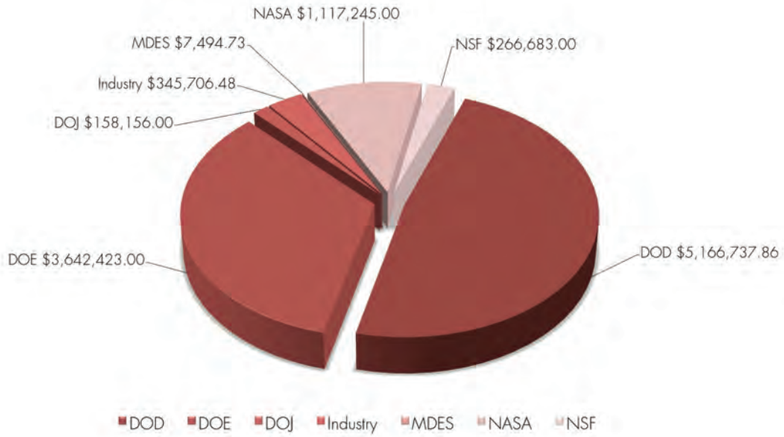
2011 EcoCAR (3rd year)

6th place overall
3rd place Outreach Program
Best Influencer Campaign
Best Creative Promotion of EcoCAR
Best Technical Presentation
Best Static Consumer Acceptability
Best Towing Passby
Best Acceleration
Best Autocross
Best Sportsmanship Award

2012 EcoCAR 2 (1st year)

1st place overall
Best Media Relations Program
Best Overall Public Outreach Program
Best Final Technical Report
Best Facility Inspection (CAVS)
Best Trade Show Evaluation
Best Project Initiation Approval Presentation
Best Controls Presentation
2nd place Business Program
2nd place Electrical Presentation
2nd place Final HIL Evaluation
2nd place dSPACE Award
2nd place A123 Design Report
3rd place Design Report
Women in Engineering Award

CAVS 2011 RESEARCH AWARDS: $10,704,446.07



*Subcontracts awarded through the SimBRS Contract vehicle are not included in the total awards figure.

Interested in how your business, company or organization can partner with CAVS - contact Dr. Roger King at rking@cavs.msstate.edu or visit www.cavs.msstate.edu.

CAVS is also now home to one of three free EV charging stations Entergy donated to universities to jump-start plug-in electric vehicle infrastructure development in the state.

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