MarTREC

Maritime Transportation Research & Education Center

October 2022-September 2023

martrec.uark.edu

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MarTREC

UNIVERSITY OF ARKANSAS

VANDERBILT

THE UNIVERSITY of NEW ORLEANS

TEXAS A&M UNIVERSITY

JSU

LSU
LOUISIANA STATE UNIVERSITY

MESSAGE FROM THE DIRECTOR

I would like to recognize and thank Kevin Hall. Kevin served as the Executive Director of the Mack-Blackwell Transportation Center at the University of Arkansas since 2006. He is an internationally known researcher in transportation pavements and materials and a devoted professor of civil engineering. Kevin stepped back from his formal leadership role in our center to fully dedicate his time to his new position as associate dean for academics in the College of Engineering. We are grateful for his past leadership and many contributions and wish him well in his new role. We are thrilled to be back in-person and approaching a near-normal presence on our consortium campuses. Our research efforts are back to normal, travel has begun, and we were very excited to welcome our k-12 outreach participants back to campus. I hope you enjoy reading this year's annual report. Heather Nachtmann, MarTREC Director

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ACKNOWLEDGEMENT—This material is based upon work supported by the U.S. Department of Transportation under Grant Award Number 69A3551747130. The work was conducted through the Maritime Transportation Research and Education Center at the University of Arkansas.

MarTREC OVERVIEW

ABOUT

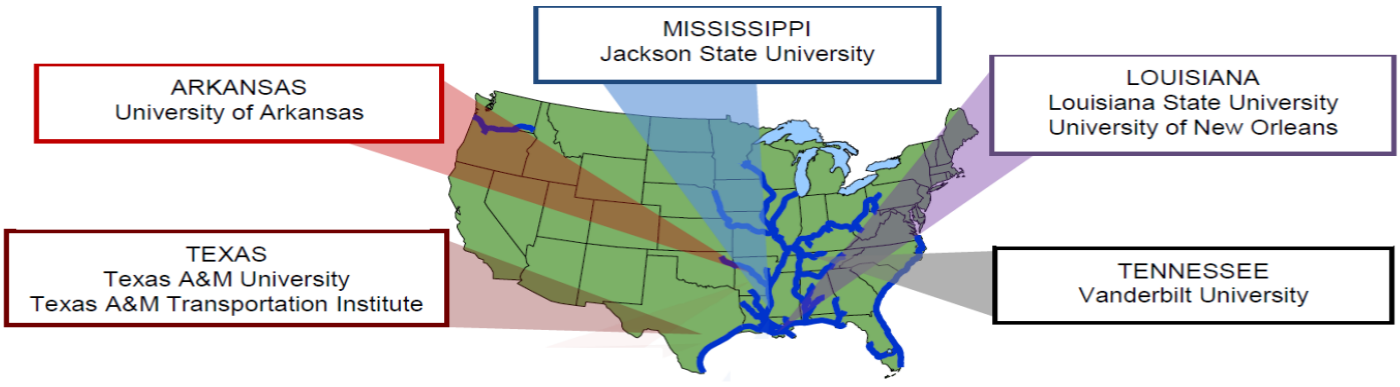
MarTREC is a U.S. Department of Transportation Tier 1 University Transportation Center funded through the Office of the Assistant Secretary for Research and Technology. Under MAP-21, MarTREC contributed to economic competitiveness through efficient, resilient, and sustainable maritime and multimodal transportation systems. MarTREC, through continued funding under the FAST Act, worked to preserve the nation's transportation system through efficient, resilient, and sustainable maritime and multimodal logistics and infrastructure. Now through the Bipartisan Infrastructure Law (BIL) MarTREC will contribute primarily to four United States (U.S.) Department of Transportation (DOT) strategic goals: 1) Economic Strength and Global Competitiveness by addressing resilient supply chains and system reliability and connectivity, 2) Climate and Sustainability by increasing the safety, effectiveness, equity, and sustainability of our nation's transportation infrastructure and the communities it serves, 3) Safety by supporting system response and recovery plans and protocols to minimize the effects of system disruptions and hasten system recovery, and 4) Equity by expanding transportation options in underserved rural and urban communities.

CONSORTIUM

The MarTREC consortium is a diverse team with strong records in conducting transformative research for federal and state agencies and the private sector. Our MarTREC consortium was formed based on nationally renowned expertise, strategic location along a major navigable river or in a coastal area, and dedication to transformative research and inclusive education and workforce development. Our consortium includes the University of Arkansas (UARK), Jackson State University (JSU), Louisiana State University (LSU), Texas A&M University/Texas A&M Transportation Institute (TAMU/TTI), University of New Orleans (UNO), and Vanderbilt University (VU). Each consortium member is strategically located to support MarTREC's theme: UARK, JSU, LSU, and UNO are located along the Mississippi River; VU along the Cumberland River; and JSU, LSU, UNO, and TAMU/TTI along the Gulf Coast. Our vision is to be the nation's premier source for expertise on maritime and related multimodal transportation research and education.

RESEARCH

MarTREC's research activities will be conducted in three research topic areas within the field of maritime and multimodal transportation: 1) Maritime and Multimodal Supply Chain Management: Advance current understanding and facilitate improved operations to improve freight and supply chain reliability, reduce congestion, connect underserved and underinvested communities, and support economic vitality, 2) Maritime Sustainable and Resilient Infrastructure: Support state-of-the-art resilient and sustainable multimodal transportation infrastructure preservation, repair, design, and construction, 3) Disaster Response and Transportation Planning for Coastal and River Valley Communities: Enable the resilience, safety, efficiency, and effectiveness of multimodal transportation systems during disruption response or other major events.



BIPARTISAN INFRASTRUCTURE LAW (BIL)

MarTREC awarded for a third consecutive competition

MESSAGE FROM THE SECRETARY, Pete Buttigieg

We are entering a transformative era in transportation. Driven by American ingenuity, advances in transportation technology from electric and automated vehicles to drones and commercial space travel are creating new possibilities for how people and goods move. With President Biden's landmark Bipartisan Infrastructure Law (BIL), we have an opportunity to make once-in-a-generation investments in modernizing our transportation system, which will make travel safer and more convenient, allow goods to move more effciently, drive economic growth, and help to address the climate crisis. In pursuing this transformation, we have an obligation to ensure that the transportation system works better for all Americans. We must harness investment and ingenuity to create good paying jobs and ensure that innovative technologies are safe and accessible so that no matter who you are or where you live you will see the benefts of these investments in transportation. The BIL creates a number of new programs to drive innovation, create jobs, and support the deployment of transformative technologies.

- It provides $500 million in funding to the Strengthening Mobility and Revolutionizing Transportation (SMART) Program, to kickstart a new generation of smart city innovation.
- It invests in University Transportation Centers that work on climate, equity, and innovation— including at Historically Black Colleges and Universities (HBCUs) and other Minority Serving Institutions.
- It enables an Advanced Research Projects Agency for Infrastructure (ARPA-I) to scale up our R&D efforts to keep pace with innovation and to help to drive it.
- It authorizes $50 million per year in funding to establish a new Open Research Initiative to accelerate the achievement of the Department's priorities and goals by funding unsolicited research proposals that yield disruptive technologies with high-impact potential.

In addition, the BIL includes discretionary grant and formula funding programs that provide billions of dollars across the country targeting challenges such as safety, climate mitigation, equity, eco-nomic strength and global competitiveness through technology deployments, data investments, and new approaches to persistent challenges. These include programs such as Safe Streets and Roads for All, Promoting Resilient Operations for Transformative, Effcient, and Cost-saving Transportation (PROTECT) Program, charging and fueling infrastructure discretionary grants, and the Reconnecting Communities Pilot Program.

BRIEF HISTORY OF UTCS AT THE UNIVERSITY OF ARKANSAS

The University of Arkansas has served the nation and state of Arkansas for over 30 years by providing innovative transportation research and technology transfer and cutting-edge transportation education and workforce development.

In 1987, Congress authorized the U.S. Department of Transportation (USDOT) University Transportation Center (UTC) program. The UTC program was designed to improve transportation research and education in the United States by advancing technology and expertise across multiple modes of transportation and addressing vital workforce needs for the next generation of transportation leaders. The first UTC at the University of Arkansas center was named in the Intermodal Surface Transportation Efficiency Act of 1991 as the National Rural Transportation Study Center. The Mack-Blackwell Rural Transportation Center continued to operate as a UTC through continued funding under SAFETEA-LU and TEA-21.

In 2007, MBTC was designated as one of seven members of the U.S. Department of Homeland Security National Transportation Security Center of Excellence, in accordance with the Implementing Recommendations of the 9/11 Commission Act of 2007. The center fulfilled transportation security research needs for six years under this designation.

In 2013, the University of Arkansas partnered with Jackson State University, Louisiana State University and the University of New Orleans to form the Maritime Transportation Research and Education Center (MarTREC), which was competitively selected as a USDOT Tier 1 UTC under the MAP-21. In 2016 with continued funding through the FAST Act, the MarTREC consortium added Texas A&M University and Vanderbilt University and worked to preserve the nation's transportation system through efficient, resilient, and sustainable maritime and multimodal logistics and infrastructure.

Now in 2023 through the Bipartisan Infrastructure Law (BIL) MarTREC will contribute primarily to four United States (U.S.) Department of Transportation (DOT) strategic goals: 1) Economic Strength and Global Competitiveness by addressing resilient supply chains and system reliability and connectivity, 2) Climate and Sustainability by increasing the safety, effectiveness, equity, and sustainability of our nation's transportation infrastructure and the communities it serves, 3) Safety by supporting system response and recovery plans and protocols to minimize the effects of system disruptions and hasten system recovery, and 4) Equity by expanding transportation options in underserved rural and urban communities.

Photo courtesy of ARDOT

CENTER FOR TRAINING TRANSPORTATION PROFESSIONALS

Front row: Roselie Conley, Lab Certification Manager; Stacy Williams, Director; Mary Fleck, Instruction and Curriculum Manager; Katie Juniel, Administrative Assistant

Back row: Julian Pearson, Support Technician; Talley Faulkner, Online Programs Manager; Austin Williams, Programmer

This year, CTTP has issued more than 1000 CTTP technician certifications with approximately half achieved via online format. CTTP online training modules and videos have been used extensively by course participants and other industry professionals, totaling 10,600 module completions and approximately 250,000 video views. Laboratory renovations have continued to improve the hands-on portions of in-person courses, allowing for more individualized instruction. Certification in inertial profiling has been added to the program and focuses on pavement smoothness testing. This course is held at a test track in Pine Bluff, Arkansas, and includes online training with in-person written and performance exams.

Approximately 100 contractor laboratories maintain participation in the CTTP Laboratory Certification program, with choices in area, reciprocal, and limited certifications. Two new asphalt test methods have been added to the suite of available certifications.

The Arkansas Local Technical Assistance Program (ARLTAP) has logged more than 1000 course completions, with courses offered in both in-person and online formats. Approximately 40 percent of participants have attended ARLTAP webinars and represent local agencies from across the United States. The Arkansas LTAP website has undergone significant renovations, focusing on links to recorded webinars, new safety topics, and improved pavement management resources.

FIFTH ANNUAL GirlTREC CAMP

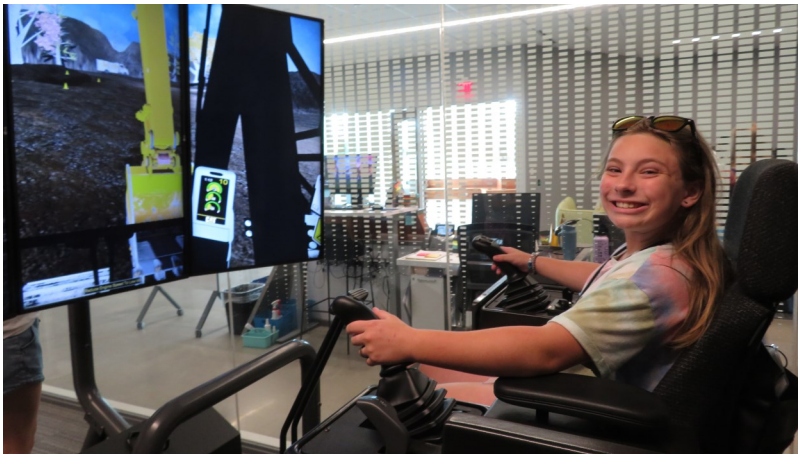
We held our fifth annual Girls Transportation Engineering Camp (GirlTREC) on the University of Arkansas campus in July 2023. The one-week day camp is designed for rising sixth and seventh grade girls to engage with transportation–focused STEM activities and learn about future career opportunities in transportation engineering. The camp provides campers with engaging, hands-on activities related to transportation engineering from roads to railroads to waterways and gives them daily opportunities to engage with female engineers and engineering students. Educational content was developed and taught by several civil and industrial engineering faculty including Drs. Michelle Barry, Richard Cassady, Sandra Eksioglu, Heather Nachtmann, Kim Needy, Gary Prinz, and Shengfan Zhang.

The campers learned about soil strength and its role for holding up bridges, drove driving simulators, learned about supply chain operations and risks, how lock and dam systems work, and interacted with robotic transportation systems. Campers also had the opportunity to hear from Megan Gray, the founder and CEO of moment.ai, whose company develops artificial intelligence technology for vehicles.

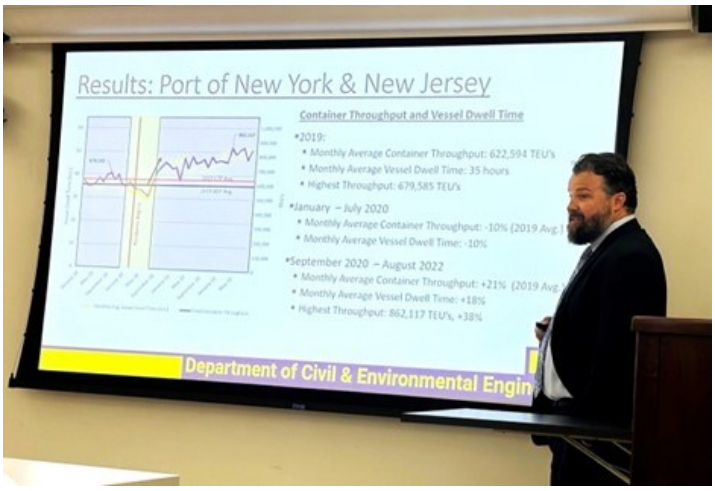
The campers got to take several field trips; ride on the Arkansas & Missouri Railroad from Fayetteville to Winslow and back, watched a drone in practice at Drone Up at Walmart in Bentonville as well as tour of the Louise M. Thaden Fieldhouse also in Bentonville. Special thanks to Caren Kraska, Grant Brewer, and Rachael Holland for making these trips and tours possible.

We'd also like to thank Teresa Simpson, Assistant Director of Recruitment, Outreach, and Summer Programs, and her outstanding student ambassadors Corrin Bowen, Paramita Choudhury, Jemima Pierre. These ambassadors are current engineering students, and it was obvious that the campers really looked at these ladies with admiration and saw that they too can be an engineer some day.

GirlTREC CONTINUED



STUDENTS IN THE NEWS



Corey Mayeux, of the Louisiana Transportation Research Center, defends his Master's Thesis titled "Quantifying the Impact of Covid-19 on Port Congestion." His research, supported by the Maritime Transportation Research and Education Center (MarTREC), sought to investigate the effects of COVID-related governmental policies, economic trends, and health-related relationships on global container port shipping.

Laura Harris, graduate research assistant at University of New Orleans, shown left talking about her poster at The Louisiana Transportation Research conference. The conference is held on a biennial basis to promote technology transfer and interchange of ideas among the transportation community's public and private sectors relative to policy, practice, and problems. The 2023 conference featured more than 70 technical sessions and was attended by over 1,800 transportation professionals from government, industry, and academia.

Texas A&M University Institute of Transportation Engineers (ITE) student chapter won the Best Student Chapter in the Texas Region as well as the Traffic Bowl at the ITE Lubbok, Texas conference in April 2023. The TAMUite Traffic Bowl team will head to the next round, the international competition in Portland, Oregon representing the Texas District. Bruce Wang, is the chapter advisor.

Pictured left to right the team of graduate students in TAMU's transportation engineering program: Anand Kayakkali, Abhishek Kurian, Mohammed Umair Khan , and Ritika Das.

STUDENTS AND PROGRAMS IN THE NEWS

Lizbeth Juarez-Bartolo was awarded MarTREC's Outstanding Student of the Year 2022. Juarez-Bartolo is a graduate research assistant, civil engineering, University of Arkansas. Her projects range from serving as CEO of a startup selling LIDAR technology for a National Science Foundation program to creating and deploying a statewide traffic safety survey. While working on various research projects, she has also been able to participate in the Institute of Transportation Engineers.

Juarez-Bartolo was nominated by her advisor Dr. Sarah Hernandez, Assistant Professor, Civil Engineering at the University of Arkansas and Dr. Heather Nachtmann, Director of the Maritime Transportation Research and Education Center also at the University of Arkansas.

Mississippi Summer Transportation Institute (MSTI)

Twenty high school students visited the Mississippi Department of Transportation's (MDOT) concrete lab to learn how to make a concrete cylinder. MSTI was created 20 years ago and funded by the Civil Rights Division of MDOT.Dr. Kejun Wen, Associate Professor at Jackson State University (JSU) led the MSTI. Dr. Robert Whalin, MarTREC site director at JSU knows the importance of the program and implements funds from MarTREC where it fits into the program.

ONGOING FAST ACT PROJECTS

Changing Trade and Transportation Patterns
Bethany Stich, PhD
University of New Orleans
March 2018-September 2023

This research is working toward determining how changes in NAFTA have affected intermodal freight flows in the Gulf Coast region. The transportation planning process can no longer solely rely on the basics of engineering.

Modeling Dynamic Behavior of Navigable Inland Waterways
Heather Nachtmann, PhD
Justin Chimka, PhD
University of Arkansas
August 2018-December 2023

The inland waterway transportation system of the United States handles 11.7 billion tons of freight annually and connects the heartland of the United States with the rest of the world. The system is challenged with aging infrastructure and limited operations and maintenance budgets which can cause transportation delays and economic losses. We have developed gap research areas and questions to explore related to the McClellan-Kerr Arkansas River Navigation System (MKARNS) and the feasibility of developing container-on-barge transport in the US.

Informing Post-Disaster Restoration through Modeling Interdependent Agriculture and Transportation Networks-Part II
Janey Camp, PhD, PE, GISP, CFM
Vanderbilt University
October 2018-December 2023

Collaborative project with Informing Post-Disaster Restoration through Modeling Interdependent Agriculture and Transportation Networks—Part I

Assessment of Evacuation Network Performance under Different Evacuation Scenarios
Brian Wolshon, PhD, PE, PTOE
Scott Parr, PhD
Louisiana State University
July 2019-September 2023

This study will utilize data from Hurricane Irma (2017) to compare traffic characteristics during the evacuation with those observed during routine non-emergency operations. The research will be conducted in the coastal communities in the Florida Keys.

Planning for Managed Retreat: Decision Making in the Face of Climate Uncertainty
Leah Dundon, JD, PhD
Mark Abkowitz, PhD
Vanderbilt University
December 2019-September 2023

Sea level rise, increased frequency and intensity of flooding, and other extreme weather events have sparked a growing recognition that managed retreat must be among the solutions considered. This project examines the need for managed retreat and the significant challenges to implementing managed retreat.

Bio-Inspired Stabilization of Levee Slope on Expansive Yazoo Clay at the Maritime and Multimodal Transportation Infrastructure in Mississippi
Sadik Kahn, PhD, PE
Jackson State University
April 2020 – September 2023

The existence of Yazoo clay in Mississippi frequently causes distress in levee and highway embankment slopes, which are an integral component of maritime and multimodal transportation infrastructure. This project investigates the effect of vetiver grassroots to stabilize levee slopes for maritime infrastructures.

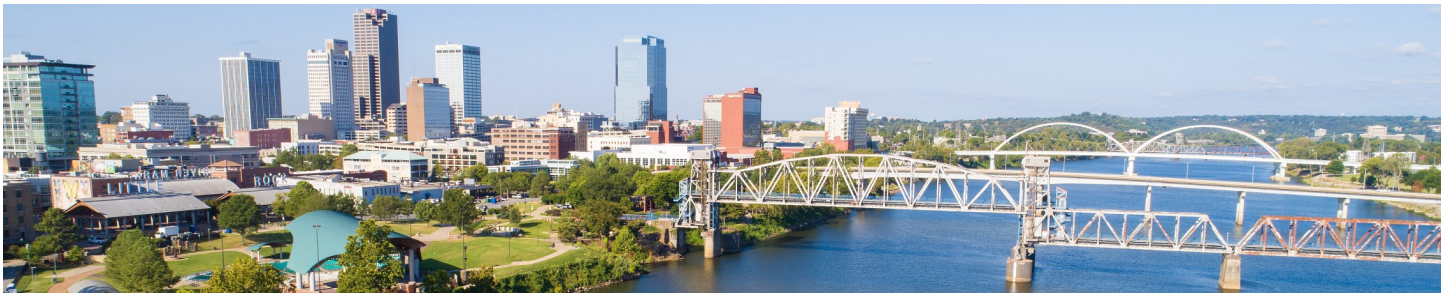


Photo courtesy of ARDOT

Evacuation Behavior and its Mobility Impacts in Coastal Communities from Across the Nation
Brian Wolshon, PhD, PE, PTOE
Scott Parr, PhD
Louisiana State University
July 2020-September 2023

Coastal communities are at risk from a multitude of potentially disruptive events. Severe weather, climate change, and sea-level rise all pose serious and long term societal challenges. This research seeks to develop an understanding of the travel flow principles that govern the evacuation process and its impact on the mobility of a community for different hazards.

Identifying Critical Waterway Infrastructure and Managing Risk Associated with Natural Disasters
Michelle Barry, PhD, PE
Shengfan Zhang, PhD
University of Arkansas
July 2020-September 2023

The transportation system is extremely vulnerable to disruptions and delays from natural disasters. There is a need for an assessment strategy capable of capturing the probability of failure and economic impacts for maritime and inland waterway infrastructure. This research will develop an assessment to aid decision making and mitigation strategies.

Modifying Ramp Management Strategies to Enhance Resiliency of Freeway Facilities
Brian Wolshon, PhD, PE, PTOE
Louisiana State University
July 2020-September 2023

Increased traffic demand of coastal areas during emergency evacuations have been shown to affect transportation systems negatively. Application of the ramp management algorithms becomes increasingly important during these times. This project will study and improve these ramp management strategies.

Rapid Assessment of Internal Erosion Damage and Erodibility in Levees
Michelle Barry, PhD, PE
Clint Wood, PhD, PE
University of Arkansas
July 2020-September 2023

Recent flooding events have tested our nation's levee systems and highlighted the vulnerability of our transportation system. Traditional drilling and sampling techniques only provide discrete data points which can lead to ineffective repairs and wasted funds. The ability of geophysical methods to enable quick measurements of material properties over large areas was demonstrated in previous project. This project seeks to make a correlation between geophysical properties and vital engineering properties.

The Changing Legal Landscape of Intermodalism
Bethany Stich, PhD
University of New Orleans
Janey Camp, PhD, PE, GISP, CFM
Vanderbilt University
July 2021-September 2023

This project investigates the ongoing legal challenges surrounding chassis. In 2020, Intermodal Motor Carriers Conference (IMCC) of American Trucking Associations and the Ocean Carriers Equipment Management Association (OCEMA) were involved in negotiations to resolve what IMCC charged were high-priced and inferior quality chassis at many of the nation's ports. Chassis are considered the linchpin of the intermodal system.

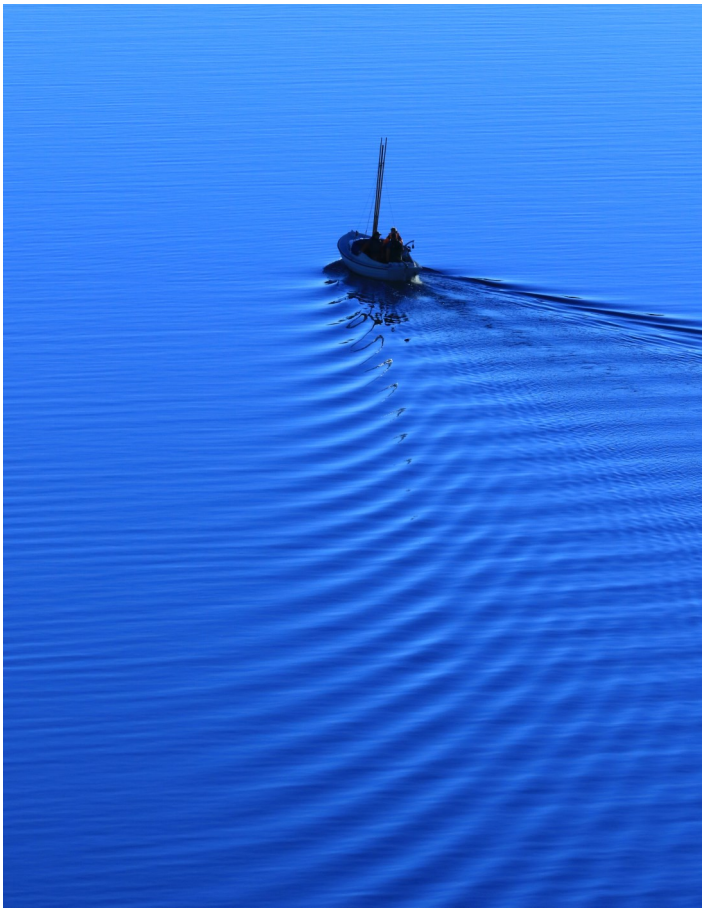


Photo courtesy of Unsplash

Photo courtesy of ARDOT

A Digital Twin for Visualizing, Evaluating and Maintaining Multimodal Transportation
Haitao Liao, PhD
Shengfan Zhang, PhD
Heather Nachtmann, PhD
University of Arkansas
August 2021-September 2023

This research project will develop a digital twin that enables visualizing, evaluating and maintaining multimodal transportation infrastructure. The ultimate goal is to provide an opensource software tool and machine learning-based decision-making approaches that assist the relevant stakeholders in improving their information collection and tracking capabilities, and enhancing the resilience of multimodal transportation infrastructure and beyond.

Continued Study of Rapidly Deployable Soil-Cement Mixtures
Cameron Murray, PhD, PE
Michelle Barry, PhD, PE
University of Arkansas
September 2021-December 2023

The maintenance and repair of maritime infrastructure is critical to maintaining important shipping channels and preventing unnecessary loss of life or economic impact from severe weather events. The objective of this research is to identify the properties and proportioning of Belitic Calcium Sulfoaluminate (BCSA) soil-cement mixtures most effective for use in waterway structures. BCSA cement is a rapid setting, low-shrinkage cement .

K8 MEMES: K-8 Maritime Education Modules to Engage Students
Gary Prinz, PhD, PE
University of Arkansas
September 2021-December 2023

This education project will create entertaining, informative, and STEM promoting curriculum learning modules for K-8 educators, using maritime transportation and infrastructure related topics to teach STEM concepts. Coupling music memory, fun STEM theories, and innovative experiential demonstrations into entertaining video learning modules, the objective of this project is to open the door for student excitement in learning of science topics.

Assessing Maritime Infrastructure along the MS
Berneece S. Herbert, PhD
Jackson State University
November 2021-September 2023

Key outputs of the project will include developing GIS maps of maritime transportation infrastructure along the river delta and database and maps on physical and policy chokepoints.

Big Data and Artificial Intelligence Analytics Methods for Tracking and Monitoring Maritime Traffic
Tor A. Kwembe, PhD
Jackson State University
November 2021-September 2023
This project will utilize Automatic Identification System datasets to design scalable Maritime Traffic Monitoring and Analysis applications and tools.

Mississippi Multimodal Freight Analysis Mode
Tzusheng Pei, PhD
Jackson State University
November 2021-September 2023
The project objective is to develop a multimodal freight transportation analysis model for Mississippi.

Network Science-based Analysis of the US Marine Highway Network
Natarajan Meghanathan, PhD
Jackson State University
November 2021-September 2023
This project will analyze the marine highway network using algorithms to detect where connections could be a bottleneck and capacities need to be enhanced.

Analysis of the Impacts of the COVID-19 Pandemic
Brian Wolshon, PhD, PE, PTOE
Louisiana State University
April 2022-September 2023
This research will investigate shifts in cargo movements by commodity for both import and export operations for several ports across the US.

Documenting the Need for Value-Chain Approaches
Leah Dundon, JD, PhD
Vanderbilt University
April 2022-September 2023
The project is a critical first step in determining what factors may lead to eventual successes and challenges to decarbonization.

Impacts of COVID Restrictions on Freight
Brian Wolshon, PhD, PE, PTOE
Louisiana State University
April 2022-September 2023
The level of impact was influenced not only by the virus itself, but more so by the nature, extent, and duration of governmental restriction on commerce and personal activity to limit its spread.

International Port Dependencies and Resilience
Brian Wolshon, PhD, PE, PTOE
Louisiana State University
April 2022-Septe;mber 2023
The objective is to find applications in resolving supply-chain related issues in the cargo ship network.

Vehicle to Infrastructure (V2I) and Vehicle to Vehicle (V2V) Passenger and Freight Vehicle Applications
Brian Wolshon, PhD, PE, PTOE
Louisiana State University
April 2022-September 2023
The research will address the limitations using driving simulators to assess how drivers interact with V2V and V2I advisories during emergency evacuations.

Photo courtesy of ARDOT

COMPLETED FAST ACT PROJECTS

Economic Impact of the Gulf Intracoastal Waterway on the States It Serves
Jim Kruse, MBA
Brianne Glover, JD
Texas A&M Transportation Institute
September 2017-August 2018

This project examined the total economic impact of the GIWW across all sectors shipping goods along the waterway, in the states that it serves. Using IMPLAN (Economic Impact Analysis for Planning), this report estimated the economic impact of the GIWW to be $61.5 billion annually. Of this, $31.8 billion was generated in Texas, $23.1 billion in Louisiana, $4.5 billion in Mississippi, $1.9 billion in Alabama, and $0.2 billion in Florida. Furthermore, the GIWW supports 143,000 jobs and generates $14.5 billion in labor income annually, with the majority of this occurring in Texas and Louisiana. The GIWW complements the highway system and rail network, requiring less additional investment to add capacity.

A Multimodal Network Approach to the Inland and Coastal Waterway System
Bruce Wang, PhD
Texas A&M University
July 2017-November 2018

Two different maintenance operations are performed annually to rehabilitate the waterway system and keep it functional: dredging and lock and dam repair. The results show that the optimal solution is not dependent on the perceived value of time in vessel delay at locks and dams, nor on the costs of vessels. It shows a clear preference to locks and dams repair over dredging operations in the optimal allocation of the maintenance budget.

Large Scale Evaluation of Erosion Resistance of Biocementation against Bridge Scour and Roadway Shoulder Erosion
Lin Li, PhD, PE
Jackson State University
March 2018-February 2019

This study explored an alternative approach for armoring the riverbed with biocementation through MICP to mitigate soil erosion. Results indicated that the bio-mediated particulate material based on MICP can provide an effective solution for problematic cases of sandy soil in prevention of bridge scour and road shoulder erosion.

Developing and Applying a Methodology to Identify Flow Generation Influences between Vessel and Truck Shipments
Mario Monsreal, PhD
Jim Kruse, MBA
Texas A&M Transportation Institute
December 2017-March 2019

Truck activity is logically connected to, and generated by, vessel activity at a port. In turn, vessel activity is generated by truck shipments. Although one might expect a 1-to-1 relation between the two, that is unlikely the case. This study shed light on the relationship between multimodal flows (trucks and vessels), which will enable agencies and organizations to increase efficiency and thus competitiveness. This analysis provided estimates of specific traffic changes in specific roads, with specific directions of traffic flows and the time when those changes could be expected. These coefficients represent the main contribution of this study. Even though general results are intuitively straightforward, the magnitude of the impact and delays may not be obtained by simple observation.

Photo courtesy of ARDOT

Development and Implementation of Sustainable Transportation Resilience Indicators

Mark Abkowitz, PhD
Vanderbilt University
June 2017-June 2019

Much has been discussed about resilient transportation infrastructure as well as sustainable practices, but only recently have their interdependencies been brought to light in terms of a community's ability to develop sustainable (economic, social and environmental) resource capacity necessary to be resilient in the face of natural hazard events that could lead to catastrophic consequences. This research created a methodology that can be replicated by other regions who wish to evaluate their flood resilience and improve decisions regarding future flood management.

Interdependency of Port Clusters During Regional Disasters

Brian Wolshon, PhD, PE, PTOE
Scott Parr, PhD
Louisiana State University
January 2018-August 2019

Ports play a vital role in our economy of and provide a critical link in the supply chain. Ports form the gateway by which essential goods are received within large geographic regions. Ports are exposed to substantial risk of flooding, storm events, sea-level-rise, and climate change. This research quantified port resiliency applicable at the individual port level and regionally. In general, the results showed that regionally, ports are more resilient to disruptive events than the individual ports that make up the region. This was likely because as one port enters the disrupted state, another may be entering the recovered state.

Exposure to STEM: Diversity in Maritime Transportation

Rick Coffman, PhD, PE
University of Arkansas
August 2018-September 2019

The goal of this project was to develop an educational model to open doors to all students, regardless of socio-economic background, who want to pursue careers in maritime and multimodal transportation. The project proved successful in exposing underrepresented students to STEM related concepts by using examples of maritime and multimodal transport infrastructure. First through fourth grade students were afforded with hands-on experiences with soils that fluoresce and panel dams to help make science fun. Ninth through twelfth grade students were provided an opportunity to tour several lock and dam systems.

Shipping Container Chassis in the US: The Legacy of Ocean Carriers

Bethany Stich, PhD
University of New Orleans
March 2018-November 2019

Containerized shipping, which accounts for approximately 60 percent of all world seaborne trade while generating approximately 12 trillion United States (US) dollars in 2017, links trading partners between the water, rail, and air modes. If motor carriers could choose a lessor from among the chassis pools, based upon cost-competitiveness, rather than being mandated to one with legacy linkages to ocean carriers, the market would generate cost savings. A necessary condition to achieve this is the exit of the ocean carriers from the chassis node of the supply chain. A fuller answer is to encourage the developing practice of trucker ownership of chassis, this is the global model.

Liquefied Natural Gas (LNG) Phase II: The Future of LNG for the US and Gulf Coast Economies

Bethany Stich, PhD
November 2017-December 2019

The continued growth of Liquefied Natural Gas (LNG) production and long-distance trade has traditionally been taken as a given by global energy analysts, who have premised their positive estimates on gas being both relatively scarce and demand for it virtually unquenchable. Current conditions in the global energy market suggest perpetual increase in the volume of traded LNG is in fact a bubble that is in the process of bursting. This project evaluated the feasibility and best practices of equipping the Port of New Orleans for potential storage and shore-side infrastructure for fueling vessels powered by LNG, as well as the feasibility of widespread use of LNG as marine fuel.

Effect of Permeability Variation of Expansive Yazoo Clay at the Maritime and Multimodal Transportation Infrastructure in Mississippi
Sadik Khan, PhD, PE
Jackson State University
September 2018-December 2019

Yazoo clay soil in Mississippi frequently causes pavement distress in multimodal transportation infrastructure. This study investigated the change in unsaturated vertical and horizontal permeability and its effect on the maritime and multimodal infrastructures such as pavement subgrade's moisture variation. The analysis improves the design of the undercut of the pavement, which is critical for deformation and deterioration of pavement of multimodal infrastructure.

Green Technology Approach for Capturing Pollution Washed from Transportation Infrastructures
Danuta Leszczynska, PhD
Jackson State University
March 2018-December 2019

The aim of this research was to produce and investigate a carbon-based substance, namely biochar, as a new material for the in-situ adsorption of pollutants carried by the stormwater runoff from the roads. Biochar, was manufactured from waste biomasses, and investigated in correlation between sources of biomass, firing conditions, presence/absence of oxygen during production, time and temperature of pyrolysis.

Liquefied Natural Gas Phase III: Export Competition in a Well Supplied, Flow-Shifting Global Economy
Bethany Stich, PhD
University of New Orleans
March 2018-December 2019

With trillions of cubic feet of shale reserves, the United States' (US) abundance of natural gas has prompted an increase in production of LNG as an export commodity. UNOTI continues to urge that U.S. natural gas energy policy best practice is not to focus on export and export alone, but rather adopt a diversified and climate responsible energy policy that focuses on the U.S. remaining globally competitive by investing in LNG fueling infrastructure, as well as continued investment in the existing petrochemical sector of Coastal Louisiana and the Gulf Coast.

Trade-Off Analytics for Infrastructure Preservation
Greg Parnell, PhD
Ed Pohl, PhD
University of Arkansas
August 2018-December 2019

This project developed a course that could be taught to civil engineers, industrial engineers, and the maritime and multimodal infrastructure community for trade-off analytics as a tool to assist in their infrastructure preservation efforts. This course was also packaged as a webinar for practicing professionals.

Visualizing Sea Level Rise Impacts in Transportation Planning
Brian Wolshon, PhD, PE, PTOE
John L. Renne, PhD
Louisiana State University
January 2018-December 2019

Transportation planners regularly engage communities through public meetings to seek input and engagement on planning for the future including impacts of sea level rise on streets and neighborhoods.

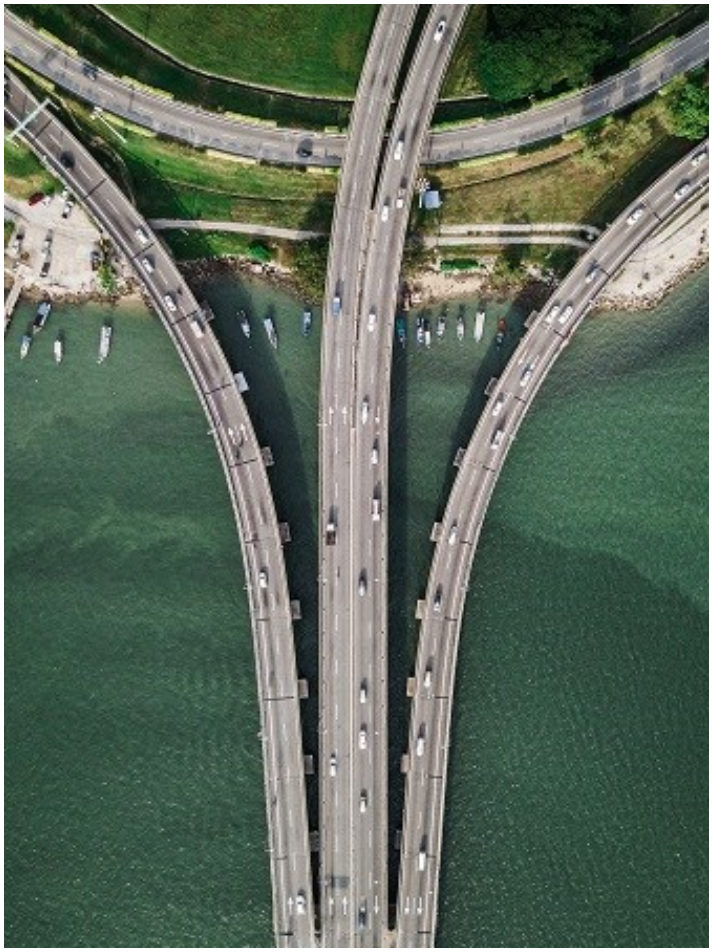


Photo courtesy of Unsplash

New media options allow for three-dimensional (3D) imaging utilizing virtual and augmented reality. It is displayed on glasses that connect to smartphones. This project tested and compared new technologies in South Florida to see if 3D technology helps residents better understand the impacts of sea level rise on transportation infrastructure and communities.

Utilizing Graceful Failure As An Opportunity for Flood Mitigation Downstream to Protect Communities and Infrastructure
Janey Camp, PhD, PE, GISP, CFM
Craig Philip, PhD
Vanderbilt University
May 2018-March 2020

In 2011, prior research observed how "graceful failure" through planned damages to the Birds Point Levee by the U.S. Army Corps of Engineers (USACE) was enacted to alleviate extreme flooding on the Mississippi River. This action reduced flooding and damage to waterway infrastructure and communities downstream. This research identified areas presently protected by levees that could be utilized for floodwater attenuation and storage along inland waterways.

Interdisciplinary Educational Outreach with Traffic Sensor Build Kits
Sarah Hernandez, PhD, PE
University of Arkansas
May 2019-May 2020

The purpose of this project was to develop learning modules that introduce students to new transportation data collection technologies that can be applied to better understand inland waterway port activity. The research developed a low-cost traffic sensor build kit that includes a mini inductive loop detector, detector card, and laptop. To accompany the build kit, we created lesson plans, how loops function, how to build a loop, and two additional lesson plans with targeted activities for middle and high school students. Each lesson plan includes a colorful slide presentation that features a scenarios of port investment prioritization with examples local to Arkansas. Six complete build kits were assembled and in future work, will be shared with summer camps at the UA and with professional transportation groups for outreach events.

Measures of Freight Network Resiliency: An expanded data capture of Truck Drivers and Support Services under Pandemic Distress
Sarah Hernandez, PhD, PE
University of Arkansas
May 2020-September 2020

COVID-19 responses by public agencies and private citizens have affected drivers and driver support systems. The purpose of this research was to collect timely data on the impacts of the Covid-19 pandemic on truck driver and trucking operations with a specific focus on issues that affect driver health and safety. An online opt-in panel survey was developed using the Qualtrics survey platform. The survey questionnaire contained 65 questions with skip logic dependent on responses. A total of 523 responses were collected between May and June. The dates correspond to the period of lifted HOS restrictions.

Analysis of Blockchain's Impacts on and Applicability to Maritime Industry
Jim Kruse, MBA
Texas A&M Transportation Institute
May 2019-October 2020

It is unclear how relevant or critical the use of blockchain is for maritime business. It is clear to maritime shipping industry members that cargo tracking is an important function for customer satisfaction as it ties the physical movement of goods with payments, inventory management, and accountability. Since it is new to an industry that is international, fragmented, and complex, this project explored questions from the application of blockchain to maritime supply chains and logistics, in particular, the possible integration with existing technologies such as automatic identification and data capture technologies.

Combining Truck and Vessel Tracking Data to Estimate Performance and Impacts of Inland Ports
Sarah Hernandez, PhD, PE
Chase Rainwater, PhD
University of Arkansas
January 2019-December 2020

Performance-driven prioritization has shifted public sector focus to freight performance measurement. As a result, quality, multi-modal data is needed to support planning efforts, such as long-range freight travel demand modeling. The purpose of this project is to

develop a method to fuse truck and marine vessel tracking data to better estimate performance of multi-modal supply chains that use inland waterway ports.

Engaging the Business and Tourism Industry in Visualizing Sea Level Rise Impacts to Transportation Infrastructure in Waikiki, Hawaii

Brian Wolshon, PhD, PE, PTOE
John Renne, PhD
Louisiana State University
March 2018-December 2020

This research built upon another related project that focused on visualizing sea level rise impacts to transportation infrastructure in South Florida and extends and focuses on the business and tourism industry of Waikiki HI. Waikiki is facing major impacts from sea level rise. Transportation and community planners engaged with stakeholders to seek input and engagement on planning for the future impacts of sea level rise on streets, buildings and neighborhoods.

Fatigue Crack Control in Waterway Lock Gate Pintle Locations Subjected to Multi-Modal Fracture

Gary Prinz, PhD, PE
University of Arkansas
August 2018-March 2021

Lock gates are an important part of the transportation infrastructure within the United States, having many economic, safety, and environmental benefits over rail and highway transportation systems. Many existing lock gates throughout the U.S. have reached or exceeded their initial design life and require frequent repairs to remain in service. This project sought to improve lock gate reliability by identifying and developing fracture mitigation strategies for multi-mode fatigue issues that arise near key pintle locations.

Towards Integrating Resilience into Everyday Transportation in Coastal Communities

Brian Wolshon PhD, PE, PTOE
Louisiana State University
August 2018-March 2021

Coastal communities have become increasingly vulnerable to sea level rise, hurricanes and other natural disasters. These events force the communities to evacuate in a relatively unpredictable way. This research leveraged technologies such as traffic simulation to help transportation agency entities maximize their resilience practices within their budgets.

Development of AIS Model of Texas Gulf Intracoastal Waterway Travel Times

Jim Kruse, MBA
Texas A&M Transportation Institute
October 2019-April 2021

The focus of this research was to perform analysis on the Texas portion of the Gulf Intracoastal Waterway (GIWW). The Texas GIWW presents a level of complexity significantly greater than rivers mentioned above because of the intersections with ship channels and the fact that some barges go into and exit port areas while others pass through. The project established origins and destinations, segmented the waterway into links, analyzed AIS data to identify vessel

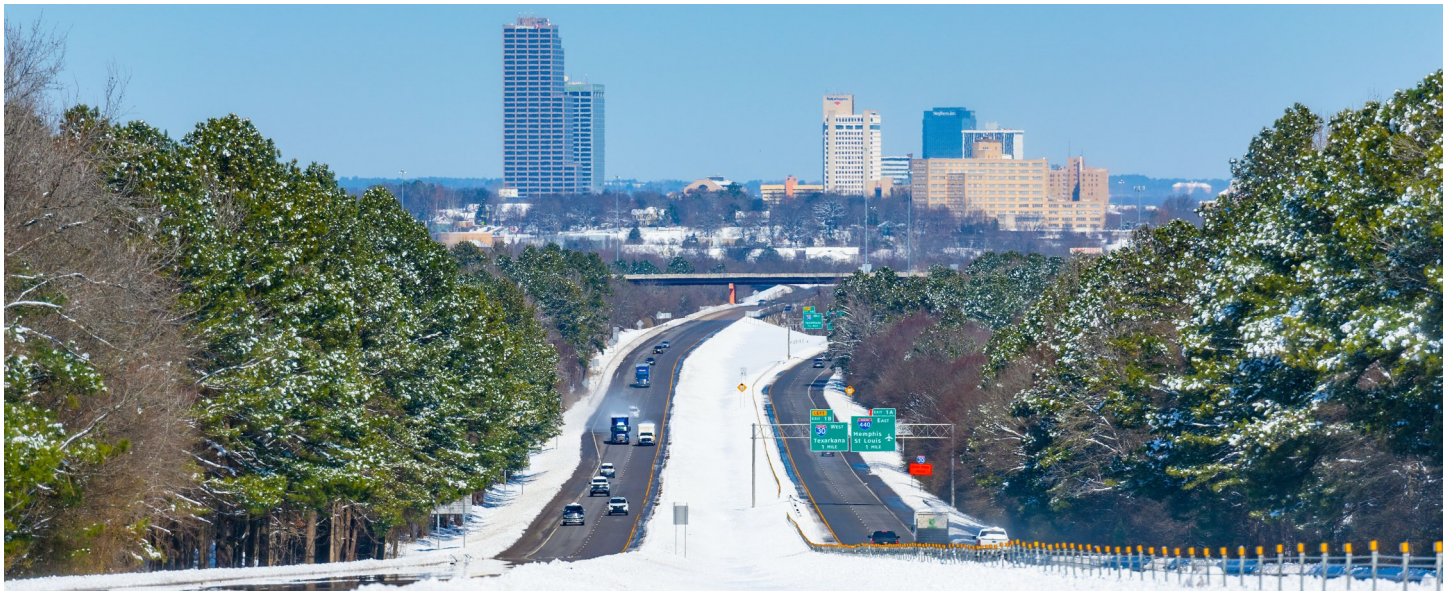


Photo courtesy of ARDOT

transits and associated transit times on the links, and developed a methodology for predicting travel times.

Learning from USACE Open Data for Locks

Justin Chimka, PhD
University of Arkansas
August 2018-May 2021

In August 2017, the USACE began to enable unprecedented data access by publishing its Open Data for Navigation online. This project sought to explore the new USACE Open Data for Locks, describe its relevant datasets, and inventory their contents, identify responses or variables across relevant datasets, and diagnose efficient statistical models of the usable subsets in order to make general statements about USACE lock data and public lock unavailability.

Using CSA Cement for Novel Waterway Repair Materials

Cameron Murray, PhD, PE
Michelle Bernhardt, PhD, PE
University of Arkansas
August 2018-May 2021

Calcium Sulfoaluminate-Belite (CSA) cement is a rapid setting hydraulic cement. Due to its rapid hardening characteristics and lower shrinkage and creep compared to typical portland cement, it is an ideal candidate as a repair material. This research worked on developing new mixtures utilizing CSA cement that can be applied to waterway repairs. A grout mixture capable of setting up rapidly underwater and a soil-cement mixture that can rapidly stabilize slopes and waterway structures will be developed.

Informing Post-Disaster Restoration Through Modeling Interdependent Agriculture and Transportation Networks

Sarah Nurre, PhD
Kelly Sullivan, PhD
Benjamin Runkle, PhD
University of Arkansas
August 2018-November 2021

Agriculture supply chains are of utmost importance for the function of society and are complex due to their interdependency with critical infrastructure systems including energy, water, and maritime and multimodal transportation. This complexity is increased due to the dependence on time-sensitive and capital-intensive operations, uncertain natural events, and volatile commodity markets. This project developed models that determine how to effectively use transportation to make ag supply chains more resilient.

Evaluation of Hydrogel–stabilized Expansive Soils in Mississippi for Sustainable Maritime Infrastructure Design

Yadong Li, PhD, PE
Jackson State University
August 2019-December 2021

Expansive soil causes a variety of maritime transportation infrastructure problem, such as cracks, damage to pipeline, and the differential settlement of foundation. This project sought the feasibility of using innovative hydrogel treatment as alternative expansive soil stabilization.

Dredging Projects Selection when the Random Shoaling Effect is Considered

Bruce Wang, PhD
Texas A&M University
October 2019-December 2021

Dredging is a constant operation necessary to maintain the waterway shipping capacity. This project provided a decision support tool to achieve a maximum network capacity for dredging operations to support the regional and national economies.

Modal Comparison Update: 2001-2019

Jim Kruse, MBA
Texas A&M Transportation Institute
March 2021-December 2021

In December 2007, the Texas A&M Transportation Institute submitted a report to the U.S. Maritime Administration and the National Waterways Foundation titled “A Modal Comparison of Domestic Freight Transportation Effects on the General Public”. Since that time, several updates to the study have been performed, with the last update covering the period 2001 to 2014. This study covered the 2001 to 2019.

Inland Waterway Travel Time Prediction

Jim Kruse, MBA
Texas A&M Transportation Institute
November 2020-April 2022

This project built an inland waterways travel time prediction model that builds on and improves existing

work at the U.S. Army Corps of Engineers. In the first iteration the team forecasted and analyzed travel times in one of the simplest river segments. The resulting forecast model was applied to a more complex river segment involving locks and bridges.

Policy and Infrastructure Evaluation Model of Commodity Flows through Inland Waterway Ports
Sarah Hernandez, PhD, PE
Sandra Eksioglu, PhD
University of Arkansas
August 2020-October 2022

This project was conducted to guide strategic investment into port capacity through the development of a policy and infrastructure evaluation model of inland waterway commodity flows. A multi-stage stochastic optimization model was developed to evaluate tradeoffs in strategic, long-term port infrastructure investment with mid-term capacity expansion decisions and complementary highway infrastructure and shorter-term operational practices.

Development of Freeway Corridor Capacity Measure to Improve Transportation Resilience
Brian Wolshon, PhD, PE, PTOE
Siavash Shojaat, PhD
Louisiana State University
July 2019-October 2022

Although evacuations have a long track record of success, they can be complex, costly, and risky. An approach which considers the whole freeway corridor as a system with bottlenecks and different characteristics is needed to assess traffic carrying ability. This study introduced the concept of corridor capacity to estimate the resilience of freeway operation.

The Unintended Consequences of Flood Mitigation along Inland Waterways – A Look at Resilience and Social Vulnerabilities
Janey Camp, PhD, PE, GISP, CFM
Vanderbilt University
July 2020-March 2023

This project evaluated different flood mitigation efforts in terms of the community costs such as residential buyouts or elevation of structures. This research utilized agent-based models and data from select communities with significant buyouts.

Climate Financing for Marine Transport: Analyzing the Impact of Climate Adaptation Investments in Inland Waterways
Hiba Baroud, PhD
Paul Johnson, PhD
Vanderbilt University
October 2022 – June 2023

We developed a state-of-the-art, data-driven approach to evaluate climate financing strategies for inland waterways based on future costs of inland waterway supply chain disruptions due to climate change. The approach combines recent develop ments in financial analysis, climate modeling, simulation, statistical inference, and economic modeling. With this methodology in place, we can then evaluate cases where investments in resilient, waterborne infrastructure can offer cost-effective means of mitigating projected impacts of climate change. Our project paves the way for researchers being able to quantify the return on investment from climate adaptation strategies based on economic impacts of climate change on inland waterway supply chains and can help policymakers better allocate funding for mitigating future supply chain disruptions.

Driving Simulators as Educational Outreach for Freight Transportation
Sarah Hernandez, PhD, PE
University of Arkansas
August 2021-July 2023

This project was conducted to enhance outreach efforts for middle and high school student groups for freight career awareness by using truck driving simulators. There is a shortage of truck drivers which contributes to inefficiency in the freight system. There are many complex factors leading to the driver shortage, lack of awareness of the trucking profession is one. Through outreach programs, it may be possible to attract a new generation to freight careers.

Port Infrastructure Resilience through Combined Wind-Surge Demand Characterization
Gary Prinz, PhD, PE
University of Arkansas
July 2020-August 2023

This project aimed to understand the interactive effects of severe wind and storm surge demands on port infrastructure and to develop hazard demand

models to aid improvements to infrastructure design. An integrated analytical and experimental research approach combined information from detailed fluid-structure-interaction simulations and scaled wind-wave experiments to support port resilience.

Evaluating the Resilience of Port Operations
Jim Kruse, MBA
Texas A&M Transportation Institute
December 2021-August 2023
This project developed a quantitative model of the local and regional road and rail network that serves a port and the flow of goods to and from the port.

Supply Chain-Oriented Methodology to Analyze Performance of Port-related Multimodal Infrastructure
Mario Monsreal, PhD
Jim Kruse, MBA
Texas A&M Transportation Institute
August 2022-August 2023
This project was built on past studies to develop a supply chain-oriented methodology to analyze performance of the port-related multimodal freight infrastructure. Specifically, the project team identified and matched the key freight corridors with ship activity to analyze what happens on relevant supply chain corridors at times of ship arrivals and departures.

Prediction of Port Recovery Time after a Severe Storm Project
Bruce Wang, PhD
Texas A&M University
October 2022-August 2023
This study introduced a recommendation system designed to predict impacted ports in anticipation of incoming tropical cyclones. Traditional prediction models often fall short of expectations because they typically demand tremendous, detailed data. In contrast, the proposed recommendation algorithm circumvents the issue by focusing on predicting port impact ranking rather than predicting the specific duration of port impacts.

Photo courtesy of Unsplash

FACULTY IN THE NEWS

Engineering Researchers Join Roundtable on Maritime Freight Transportation

Stakeholders from across Arkansas and the United States gathered at the WAIA/MARAD roundtable event in April 2023. Co-organized by the U.S. Department of Transportation Maritime Administration, Western Arkansas Intermodal Authority, Western Arkansas Planning & Development District and Frontier Metropolitan Planning Organization, the roundtable event focused on current challenges facing maritime and multimodal transportation agencies, carriers and shippers.

From left, Western Arkansas Planning & Development District Metropolitan Planning Organization Director Reese Brewer, Sarah Hernandez, Ann Phillips and Heather Nachtmann.

Sarah Hernandez, associate professor of civil engineering presented on "Arkansas Port Sheds: Visualizing Impacts" and shared her concept of "port sheds," which fuse publicly available datasets, including truck and marine vessel tracking data and lock performance data, into freight fluidity measures. Heather Nachtmann, professor of industrial engineering and director of the Maritime Transportation Research and Education Center (MarTREC) shared how maritime transportation stakeholders can engage in research and workforce development opportunities with MarTREC.

Engineering Faculty Awarded $3.5 Million to Advance 3D Concrete Printing

Applied Research Associates, a research and engineering firm headquartered in New Mexico, awarded faculty in the College of Engineering nearly $3.5 million to study the most expedient ways to 3D print horizontal mission structures for the U.S. military. The faculty team will work to identify optimum design patterns and indigenous materials that can be used in horizontal construction projects (such as creating culverts, T-walls and Jersey barriers), as well as develop printing instructions for mobile robots.

Michelle Barry (pictured), associate professor of civil engineering, will serve as the principal investigator. Wenchao Zhou (pictured), associate professor of mechanical engineering, and Cameron Murray, assistant professor of civil engineering, will serve as co-PIs.

FACULTY IN THE NEWS

Sarah Hernandez, associate professor of civil engineering, and **Sandra Eksioglu**, professor of industrial engineering, were awarded $222,039 for their study by the U.S. Army Corp of Engineers Coastal Hydraulics Laboratory at the U.S. Army Engineering Research and Development Center.

The researchers are exploring how the use of real-time data on vessel movements can help government agencies make better-informed decisions about shipping infrastructure to reduce costs and ultimately improve the nation's supply chains.

The agencies historically have relied on manually collected surveys of shippers and carriers to support their decisions about operations maintenance and infrastructure needs for waterways and ports. Detailed information about the movement of goods and vessels is important when scheduling lock and dam repairs, channel dredging and other maintenance, but the way data is processed means it's not available until it's about two years old. Hernandez and Eksioglu will use anonymized vessel data collected by the U.S. Coast Guard to make predictions about waterway and port traffic, giving the agencies more accurate information on waterborne commerce trends.

Heather Nachtmann, director of MarTREC**,** professor of industrial engineering and the Earl J. and Lillian P. Dyess Endowed Chair in Engineering, has been named an Arkansas Research Alliance Fellow. The ARA Fellows program recognizes scientists and engineers already resident at a university or institution in Arkansas for their ongoing, exemplary contributions to the state's core research focus areas with a $75,000 grant paid over three years. The program recognizes research leaders with an established history of impact and includes membership into the ARA Academy of Scholars and Fellows.

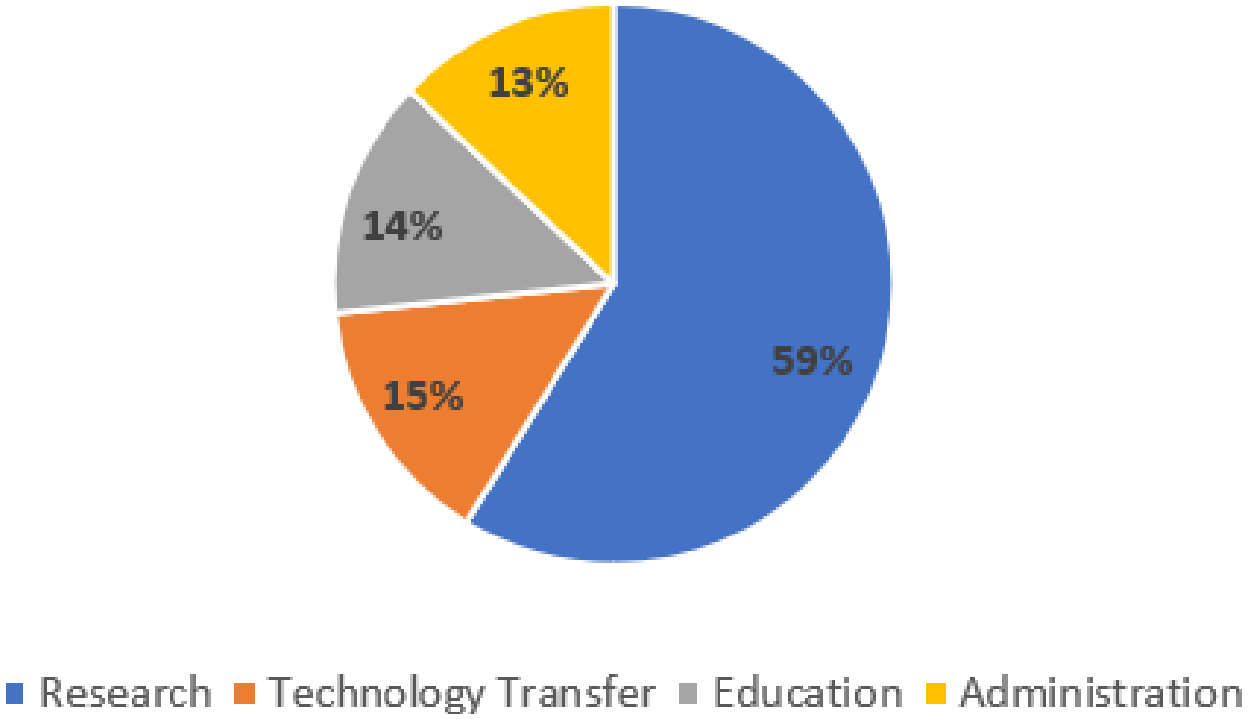
SPOTLIGHT

Kevin Hall has stepped away from his service to Mack-Blackwell and MarTREC, so we wanted to take a moment to thank him and provide some history of Kevin's career at the University of Arkansas. Hall joined the Department of Civil Engineering as an assistant professor in 1993. He was promoted to associate professor in 1997, full professor in 2002 and university professor in 2020. He served as head of the Department of Civil Engineering from 2005-2016. In 2021 Hall was named associate dean for academics for the College of Engineering.

Kim Needy, dean, College of Engineering, among the Top 100 Women of Impact in Arkansas. The Women's Foundation of Arkansas, helped assemble the list. Needy, who is the first female dean of the engineering college. A quote from Kim Needy "I am honored to be recognized alongside these outstanding leaders at the U of A and across the state. I am proud to represent and be part of an institution committed to empowering women in STEM fields. I hope young women and men will look to this group for inspiration to break barriers and never see limits in their potential for excellence."

Shannon Newton, president and CEO of the Arkansas Trucking Association, was elected chair of the Trucking Association's Executive Council. Newton will serve as chair from 2023-24. The council works to promote the trucking industry and comprises executives of state trucking associations and conferences affiliated with American Trucking Associations. Newton was also selected as "Top 100 Women of Impact in Arkansas".

Fiscal Year 2023 Total Expenditures $2,551,251



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