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2019

Annual Report, 2018-2019

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MarTREC

Maritime Transportation Research & Education Center

October 2018 - September 2019

martrec.uark.edu

MarTREC STAFF

Heather Nachtmann, Ph.D.
University of Arkansas
Director

Kevin D. Hall, Ph.D., P.E.
University of Arkansas
MBTC Executive Director

Amy M. Shell, M.S.
University of Arkansas
Center Coordinator

Bethany Stich, Ph.D.
University of New Orleans
Site Director

Robert Whalin, Ph.D., P.E.
Jackson State University
Site Director

Brian Wolshon, Ph.D., P.E., PTOE
Louisiana State University
Site Director

Craig Philip, Ph.D.
Vanderbilt University
Site Director

Bruce Wang, Ph.D.
Texas A&M University
Site Director

CONTACT INFO

4190 Bell Engineering Center
University of Arkansas
Fayetteville, Arkansas 72701
Phone: 479.575.6021
Email: martrec@uark.edu

MarTREC

UNIVERSITY OF ARKANSAS

THE UNIVERSITY of NEW ORLEANS

JSU

LSU LOUISIANA STATE UNIVERSITY

VANDERBILT

TEXAS A&M UNIVERSITY

Cover photo courtesy of Justin Wilkens on Unsplash

MESSAGE FROM MarTREC DIRECTOR

As you will read in this annual report, MarTREC had a great year. We have research projects actively contributing across the Nation. All of our faculty and student researchers are dedicated to transferring our research into practice. The MarTREC consortium is extensively networked through existing stakeholder partnerships and dedicated to implementable research. Established and new partnerships are essential to effective technology transfer of research outputs, educational resources, and workforce development programs. I hope you enjoy reading this year's report.

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Photo courtesy of ARDOT

MarTREC

Maritime Transportation Research & Education Center

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 built economic competitiveness through efficient, resilient, and sustainable maritime and multimodal transportation systems. MarTREC, through continued funding under the FAST Act, is working to preserve the Nation's transportation system through efficient, resilient, and sustainable maritime and multimodal logistics and infrastructure.

VISION

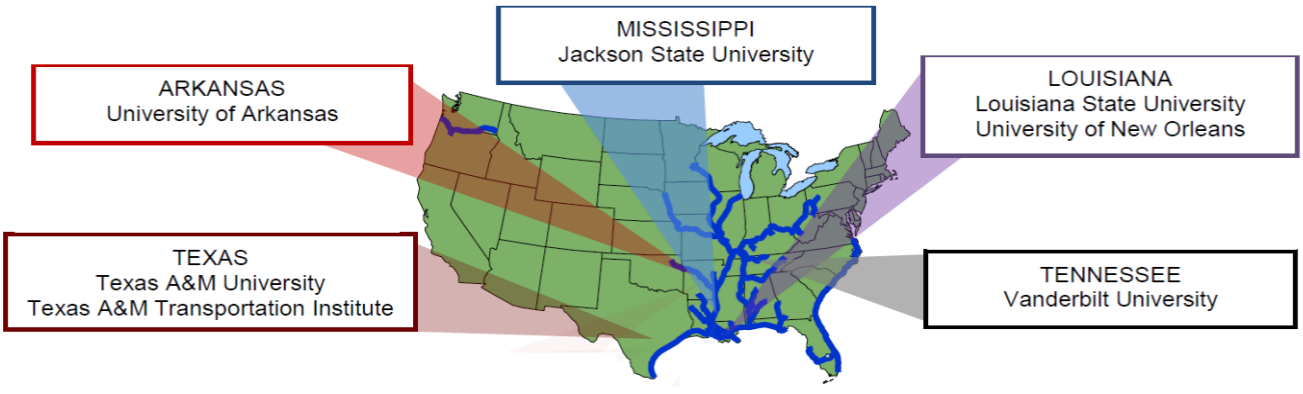
Our vision is to be recognized as the Nation's premier source for expertise on maritime and multimodal transportation research and education. The MarTREC consortium consists of renowned maritime transportation researchers dedicated to transferrable research and inclusive education and workforce development.

CONSORTIUM

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.

RESEARCH

MarTREC conducts research activities in three topic areas: 1) Maritime and Multimodal Logistics Management to expand decision support and facilitate improved operations within the Nation's multimodal supply chain networks; 2) Maritime and Multimodal Infrastructure Preservation to advance state-of-the-art resilient multimodal transportation infrastructure preservation, repair, design, and construction; and 3) Disaster Response and Transportation Planning for Coastal and River Valley Communities to enable the resilience, safety, efficiency, and effectiveness of multimodal transportation systems during disaster response or other major events.



NEW MarTREC FAST Act PROJECTS

Informing Post-Disaster Restoration through Modeling Interdependent Agriculture and Transportation Networks-Phase II VU

Janey Camp, Ph.D, P.E.
Vanderbilt University
October 2018-July 2020

Agriculture is a critical part of the U.S. economy. Agriculture is interdependent on certain sectors, particularly transportation to get seed and fertilizers to fields at appropriate times and in getting products that may spoil to market efficiently. This project will develop models which determine how to effectively use transportation and coordinate restoration efforts to make ag supply chains more resilient through combined mathematical modeling and visualization and simulation using geographic information systems (GIS).

Combining Truck and Vessel Tracking Data to Estimate Performance and Impacts of Inland Ports

Sarah Hernandez, Ph.D, P.E.
Chase Rainwater, Ph.D
University of Arkansas
January 2019-December 2020

This study builds on a growing body of research related to multi-modal freight performance measurement, specifically freight fluidity measures. Freight fluidity measurement attempts to capture freight system performance from a multi-modal supply chain perspective. To date, most freight fluidity measures are not truly multi-modal, and rather capture only one end of the supply chain, i.e. the long haul portion of the trip that uses either truck, rail, or barge. In this study, we will determine how to effectively combine marine Automatic Identification System (AIS) data with truck Global Positioning System (GPS) data.

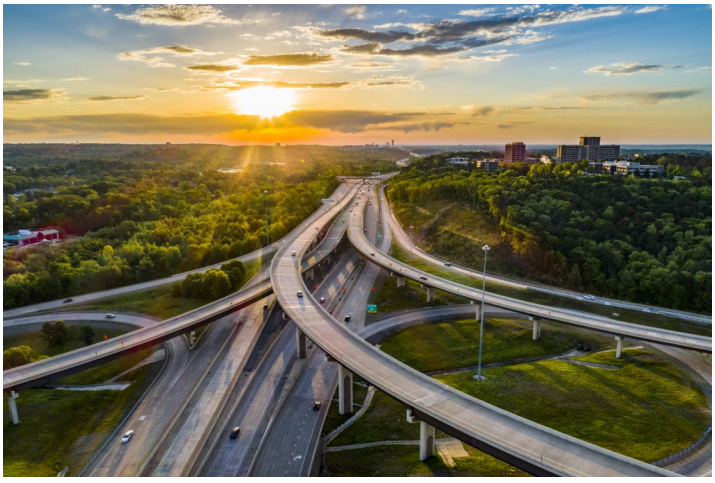


Photo courtesy of ARDOT

Interdisciplinary Educational Outreach with Traffic Sensor Build Kits

Sarah Hernandez, Ph.D, P.E.
University of Arkansas
May 2019-May 2020

This project seeks to design and implement freight oriented educational outreach activities centered on traffic sensing technologies. The project will create sensor "build kits" and associated lesson plans for three grade levels (middle school, high school, and first year university students). The concept borrows from the Boy Scouts' Pinewood Derby car kits in which all necessary materials are provided in a single kit. The build kits will engage students in an interdisciplinary learning activity that introduces tools and skills from civil, computer science, and industrial engineering while building students' knowledge of maritime transportation issues.

Analysis of Blockchain's Impacts on and Applicability to Maritime Industry

Jim Kruse, M.B.A.
Texas A&M Transportation Institute
May 2019-May 2020

It is unclear how relevant or critical the use of blockchain is for maritime business. A recent survey by Deloitte interviewed U.S.-based executives in the shipping sector and found that 39% of them have little or no knowledge about blockchain. 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 in nature, we explore several research questions arising 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 (AIDC) technologies.

Development of Freeway Corridor Capacity Measure to Improve Transportation Resilience

Brian Wolshon, Ph.D., P.E., PTOE
Siavash Shojaat, Ph.D.
Louisiana State University
July 2019-June 2020

Although evacuations have a long track record of success, they can be complex, costly, and risky. Capacity is one of the most important characteristics of a freeway, which quantifies traffic carrying capability, and is a critical component to the resilience of transportation systems and the evacuation process. 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 will introduce the concept of corridor capacity to estimate the resilience of freeway operation.

Assessment of Evacuation Network Performance under Different Evacuation Scenarios

Brian Wolshon, Ph.D., P.E., PTOE
Siavash Shojaat, Ph.D
Scott Parr, Ph.D., E.I.T.
Louisiana State University
July 2019-June 2020

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 2017 evacuation of Hurricane Irma has been referred to as the largest evacuation in the history of the nation with approximately 6.5 million Floridians under mandatory or voluntary evacuation orders. The present research will be focusing on the evacuation process of the coastal communities in the Florida Keys.

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

Yadong Li, Ph.D, P.E.
Jackson State University
August 2019-July 2020

Expansive soil causes a variety of maritime transportation infrastructure problem, such as cracks, damage to pipeline, and the differential settlement of foundation. This project seeks the feasibility of using innovative hydrogel treatment as alternative expansive soil stabilization. Hydrogel is a network of polymer chains that are hydrophilic, which has physical entanglement and chemical bonding to integrate solid and liquid properties. The hydrogel treatment may provide opportunities as cost-effective alternative.

ONGOING MarTREC FAST Act PROJECTS

Changing Trade and Transportation Patterns: NAFTA, Cuba, and the US Gulf Coast

Bethany Stich, Ph.D.
University of New Orleans
March 2018-November 2019

Since the passage of the National Environmental Protection Act in 1969, transportation planning became a complex, interdisciplinary challenge. The need for meeting environmental legislation coupled with public participation demands have revealed innumerous problems associated with the use of outdated techniques. In order to satisfy the current regulations and public policies, the transportation planning process can no longer solely rely on the basics of engineering; it is now forced to find the way in a sea of data, values and actors towards a comprehensive and integrated solution. As a consequence, the variety, quality, and quantity of data to be processed has become one of the big issues for transportation practitioners.

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

Brian Wolshon, Ph.D., P.E., PTOE
John L. Renne, Ph.D., AICP
Louisiana State University
March 2018-November 2019

This research builds upon another related UTC project that focuses on visualizing sea level rise impacts to transportation infrastructure in South Florida and extend this research to Waikiki, located in Honolulu, Hawaii and focus on the business and tourism indus-

try community. Waikiki is facing major impacts from sea level rise, and transportation and community planners will engage with stakeholders through meetings to seek input and engagement on planning for the future including impacts of sea level rise on streets, buildings and neighborhoods.

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

Bethany Stich, Ph.D.
James Amdal,
November 2017-November 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. Unfortunately, current conditions in the global energy market suggest that what many have predicted as a near perpetual increase in the volume of traded LNG is in fact a bubble that is now in the process of bursting. This project seeks to evaluate 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 research into the feasibility of the widespread use of LNG as marine fuel, considering the new United Nation's International Maritime Organization's Annex VI maritime emissions regulations set for 2020.

Liquefied Natural Gas Phase III: Export Competition in a Well Supplied, Flow-Shifting Global Economy

Bethany Stich, Ph.D.
University of New Orleans
March 2018-November 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. Initial research reasoned that policy focused too heavily on LNG as an export is misguided. A more robust energy policy acknowledges the higher value of natural gas to the petrochemical manufacturing industries as well as the development and commercialization of new LNG technologies in the maritime industry, particularly as a marine fuel.

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

Bethany Stich, Ph.D.
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. The international chassis system in the US is unique compared to global chassis utilization where the motor carriers, freight customers, or off-site terminals provide chassis. In the US, the divestment of international chassis by ocean carriers, resulted in three major international chassis leasing companies linked to the foreign carriers being American shippers' only options for international leasing. This research will examine the current state of international chassis utilization in the US.

Utilizing Graceful Failure As An Opportunity for Flood Mitigation Downstream to Protect Communities and Infrastructure

Janey Camp, Ph.D., P.E.
Craig Philip, Ph.D.
Vanderbilt University
May 2018-November 2019

In 2011, we 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 seeks to identify areas presently protected by levees that could be utilized for floodwater attenuation and storage along inland waterways.

Effect of Permeability Variation of Expansive Yazoo Clay at the Maritime and Multimodal Transportation Infrastructure in Mississippi

Sadik Khan, Ph.D., P.E.
Jackson State University
September 2018-December 2019

Yazoo clay soil in Mississippi frequently causes pavement distress in multimodal transportation infrastruc-

Photo courtesy of ARDOT

ture. This study investigates 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 will improve 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, Ph.D.
Jackson State University
March 2018-December 2019

The aim of this research is 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. Thus far a series of lab-scale experiments have been designed to optimize biochar's microscopic structures and to determine its adsorption capacities.

Towards Integrating Resilience into Everyday Transportation Practices of Coastal and River Valley Communities

Brian Wolshon Ph.D., P.E., PTOE
Louisiana State University
August 2018-December 2019

Coastal and river valley communities have become increasingly vulnerable to sea level rise, hurricanes and other natural disasters. In many cases, these events force the communities to evacuate in a relatively unpredictable way. This research will leverage technologies such as traffic simulation to help transportation agency entities maximize their resilience practices within their budget constraints.

Trade-Off Analytics for Infrastructure Preservation

Greg Parnell, Ph.D.
Ed Pohl, Ph.D.
University of Arkansas
August 2018-December 2019

The objective of this project is to develop 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 will also be packaged into a webinar to be delivered on-line for practicing professionals.

Visualizing Sea Level Rise Impacts in Transportation Planning

Brian Wolshon, Ph.D., P.E., PTOE
John L. Renne, Ph.D., AICP
Louisiana State University
January 2018-June 2020

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. New media options allow for three-dimensional (3D) imaging utilizing virtual and augmented reality. Such 3D visualizations are increasingly affordable. It is displayed on glasses that connect to smartphones. This project will test and compare 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.

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

Gary Prinz, Ph.D., P.E.
University of Arkansas
August 2018-August 2020

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 seeks to improve lock gate reliability by identifying and de-

veloping fracture mitigation strategies for multi-mode fatigue issues that arise near key pintle locations.

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

Sarah Nurre, Ph.D.
Kelly Sullivan, Ph.D.
Benjamin Runkle, Ph.D.
University of Arkansas
August 2018-August 2020

Agriculture supply chains are of utmost importance for the function of society and are inherently 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 as well as their position within rural and low socioeconomic communities. This project will develop models that determine how to effectively use transportation to make agriculture supply chains more resilient.

Learning from USACE Open Data for Locks

Justin Chimka, Ph.D.
University of Arkansas
August 2018-August 2020

In August 2017, the USACE began to enable unprecedented data access by publishing its Open Data for Navigation online. This project seeks 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.

Photo courtesy of ARDOT

Modeling Dynamic Behavior of Navigable Inland Waterways

Heather Nachtmann, Ph.D.
Justin Chimka, Ph.D.
University of Arkansas
August 2018-August 2020

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. We presented in May 2019 at the Institute of Industrial and Systems Engineers annual conference. We provided economic impact data to the Arkansas Waterways Commission in support of their response to the MKARNS flooding event that occurred this fall.

Using CSA Cement for Novel Waterway Repair Materials

Cameron Murray, Ph.D.
Michelle Bernhardt, Ph.D., PE
University of Arkansas
August 2018-August 2020

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. The goal of this work is to develop 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. We have found the ideal water/cement ratio for an underwater BCSA cement grout. Soil cement mixtures will be developed in spring and summer 2020, to test the soil cement under moving water and determine its resistance to erosion.

COMPLETED MarTREC FAST Act PROJECTS

Economic Impact of the Gulf Intracoastal Waterway on the States It Serves

Jim Kruse, M.B.A.
Brianne Glover, J.D.
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, Ph.D.
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 which removes sediments in the waterway to restore the lost navigational draft depth, and lock and dam repair due to aging and deterioration. This research solves this special knapsack problem considering the budget constraints, system randomness, and network connectivity to minimize the costs of operations in order to choose the most beneficial projects. By using the data from the Ohio River basin network, the model is solved with Cplex. 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, Ph.D., P.E.
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. Long-term erosion exposed to outdoor environment, rainfall induced erosion, and accelerated erosion were conducted on MICP-treated samples to prove the feasibility of the MICP technique for potential applications in prevention of bridge scour and road shoulder 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, Ph.D.
Jim Kruse, M.B.A.
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 types of shipments, 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 – for industry, while minimizing negative impacts on a region. Specifically, this analysis provides 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.

Development and Implementation of Sustainable Transportation Resilience Indicators

Mark Abkowitz, Ph.D.
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 counties and regions who wish to evaluate their flood resilience and improve decisions regarding future flood management. The transferability and scalability of this approach provides considerable value beyond the locale where the case study was implemented.

Interdependency of Port Clusters During Regional Disasters

Brian Wolshon, Ph.D., P.E., PTOE
Scott Parr, Ph.D.
Louisiana State University
January 2018-August 2019

Ports play a vital role in the economy of nations and provide a critical link in the supply chain. Often times, ports form the gateway by which essential goods are received within large geographic regions. Because of their function, ports are exposed to substantial risk of flooding, storm events, sea-level-rise, and climate change. This research quantified port resiliency that is 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 recovery state or stable recovered state.

Exposure to STEM: Diversity in Maritime Transportation

Rick Coffman, Ph.D., P.E.
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 with an opportunity to tour several Lock and Dams.

Photo courtesy of Rick Coffman

COMPLETED Map 21 MarTREC PROJECTS

Maritime and Multimodal Logistics Management

Dynamic Decision Modeling for Inland Waterway Disruptions
Shengfan Zhang, Ph.D.
Heather Nachtmann, Ph.D.
University of Arkansas
December 2016
https://martrec.uark.edu/research/dynamic_decision_modeling_final_report.pdf

Economic Impacts of Lock Usage and Unavailability
Justin R. Chimka, Ph.D.
University of Arkansas
June 2016
https://martrec.uark.edu/research/chimka-final-report-2016.pdf

Efficient Dredging Strategies for Improving Transportation Infrastructure Resilience
Kelly Sullivan, Ph.D.
University of Arkansas
December 2016
https://martrec.uark.edu/research/efficient_dredging_stratagies_final_report.pdf

Multimodal Transport and TransLoad Facilities in Arkansas
Justin R. Chimka, Ph.D.
University of Arkansas
January 2015
https://martrec.uark.edu/research/multimodal-transport-and-transload-facilities-in-arkansas.pdf

Regional Economic Impact Study of the McClellan-Kerr Arkansas River Navigation System
Heather Nachtmann, Ph.D.
University of Arkansas
August 2015
https://martrec.uark.edu/research/mkarns_final.pdf

Supporting Secure and Resilient Inland Waterways
Heather Nachtmann, Ph.D.
Justin Chimka, Ph.D.
University of Arkansas
June 2018
https://martrec.uark.edu/research/ua_ssriwi_final.pdf

Supporting Secure and Resilient Inland Waterways: Phase Two
Heather Nachtmann, Ph.D.
Justin Chimka, Ph.D.
University of Arkansas
August 2018
https://martrec.uark.edu/research/ua_ssriwii_final.pdf

Maritime and Multimodal Infrastructure Preservation

Climate Impacts on Lock Use and Performance
Justin Chimka, Ph.D.
University of Arkansas
August 2018
https://martrec.uark.edu/research/ua_climate_final.pdf

Corrosion-Tolerant Pre-Stressed CFRP Fatigue Retrofits for Improved Waterway Lock Reliability
Gary Prinz, Ph.D., P.E.
Clint Wood, Ph.D., P.E.
University of Arkansas
September 2018
https://martrec.uark.edu/research/ua_corrision_final_report.pdf

Effect of Swell-Shrink Characteristics on Landslides in Yazoo Clay
Mohammad Sadik Khan, Ph.D., P.E.
Jackson State University
June 2018
https://martrec.uark.edu/research/jsu_final_effect.pdf

Exploration of Novel Multifunctional Open Graded Friction Courses for In-situ Highway Runoff
Yadong Li, Ph.D., P.E.
Lin Li, Ph.D., P.E.
Jackson State University
June 2016
https://martrec.uark.edu/research/yadong-li-final-report-2016.pdf

Evaluating the Performance of Intermodal Connectors
Sarah Hernandez, Ph.D.
University of Arkansas
September 2018
https://martrec.uark.edu/research/ua_evaluating_performance_final_report.pdf

Development of a Design Protocol: Sustainable Stabilization of Slope using Recycled Plastic Pins in MS
Mohammad Sadik Khan, Ph.D., P.E.
Jackson State University
October 2017
https://martrec.uark.edu/research/development_of_a_design_protocol.pdf

Identifying High-Risk Roadways for Infrastructure Investment Using Naturalistic Driving Data
Brian Wolshon, Ph.D., P.E., PTOE
Louisiana State University
June 2015
https://martrec.uark.edu/research/identifying_high_risk_roadways_corrected.pdf

In-Situ Monitoring and Assessment of Post Barge-Bridge Collision Damage for Minimizing Traffic Delay and Detour
Wei Zheng, Ph.D., P.E.
Jackson State University
June 2016
https://martrec.uark.edu/research/wei-zheng-final-report-2016.pdf

Innovative Bio-Mediated Particulate Materials for Sustainable Maritime Transportation Infrastructure
Lin Li, Ph.D., P.E.
Jackson State University
June 2017
https://martrec.uark.edu/research/jsu_innovative_bio-mediated_final.pdf

LNG Bunkering for Marine Vessels at the Port of New Orleans: Siting and Facility Components
Bethany Stich, Ph.D.
James R. Amdal
University of New Orleans
January 2016
https://martrec.uark.edu/research/uno_lng.pdf

Optimal Dredge Fleet Scheduling within Environmental Work Windows
Chase Rainwater, Ph.D.
Heather Nachtmann, Ph.D.
University of Arkansas
August 2016
https://martrec.uark.edu/research/optimal.pdf

Optimal Dredge Fleet Scheduling - Phase 2 Research
Chase Rainwater, Ph.D.
Heather Nachtmann, Ph.D.
University of Arkansas
November 2017
https://martrec.uark.edu/research/ua_optimal_dredge_phase2.pdf

Predicting Soil Type from Non-destructive Geophysical Data using Bayesian Statistical Methods
Michelle Bernhardt, Ph.D, P.E.
University of Arkansas
August 2018
https://martrec.uark.edu/research/ua_predicting_final.pdf

Quantifying Resiliency of Maritime Transportation Systems
Brian Wolshon, Ph.D., P.E., PTOE
Louisiana State University
June 2018
https://martrec.uark.edu/research/lsu_quantifying_final_report.pdf

Rapid and Non-Destructive Assessment of Levees for Strength and Liquefaction Resistance
Clinton Wood, Ph.D., P.E.
Michelle Bernhardt , Ph.D., P.E.
University of Arkansas
July 2017
https://martrec.uark.edu/research/ua_final_levees.pdf

Disaster Response and Transportation Planning for Coastal and River Valley Communities

Development of a Large-Scale Traffic Simulation Model for Hurricane Evacuation of Mississippi Coastal Region
Feng Wang, Ph.D., P.E.
Jackson State University
August 2015
https://martrec.uark.edu/research/martrec_final_report_development.pdf

Evaluating Coastal and River Valley Communities Evacuation Network Performance Using Macroscopic Productivity
Scott Parr, Ph.D., E.I.T.
Louisiana State University
May 2017
https://martrec.uark.edu/research/evaluating_coastal_lsu.pdf

Measurement of Traffic Network Vulnerability for Mississippi Coastal Region
Feng Wang, Ph.D., P.E.
Jackson State University
July 2017
https://martrec.uark.edu/research/jsu_final_measurement_of_traffic.pdf

National Inventory and Analysis of Transit Oriented Development in Proximity to Coasts and Port Facilities
John L. Renne, Ph.D., AICP
University of New Orleans
September 2017
https://martrec.uark.edu/research/uno_tod.pdf

Quantification of Multimodal Transportation Network Vulnerability: A Pilot Study in Mississippi
Himangshu Das, Ph.D., P.E.
Jackson State University
April 2017
https://martrec.uark.edu/research/quantification_multimodal.pdf

Road Sign Recognition during Computer Testing versus Driving Simulator Performance for Stroke and Stroke+Aphasia Groups
Neila J. Donovan, Ph.D.
Louisiana State University
June 2015
https://martrec.uark.edu/research/road-sign-recognition-during-computer-testing.pdf

Statistical Analysis of Vehicle Crashes in Mississippi
Feng Wang, Ph.D., P.E.
Jackson State University
July 2017
https://martrec.uark.edu/research/jsu_final_statistical_analysis.pdf

Vulnerability of Fuel Distribution Systems to Hazards in Coastal Communities
John Pardue, Ph.D., P.E.
Louisiana State University
March 2017
https://martrec.uark.edu/research/vulnerability_fp.pdf

MarTREC STUDENT ACHIEVEMENTS

Dennis Thornton, graduate research assistant with the University of New Orleans Transportation Institute (UNOTI), is MarTREC's 2018 Outstanding Student of the Year. His work consists primarily of freight transportation related research in last mile port congestion and trade-based economic development opportunities for the Gulf Coast Megaregion.

Thornton holds a bachelors degree in Criminal Justice, a master degree in Criminology. In 2012, he began working on his doctorate in Urban Studies at the University of New Orleans. While at UNOTI, Thornton has conducted research under the guidance of Dr. Bethany Stich.

Masoud Nobahar (center in picture), Jackson State University (JSU) civil engineering graduate student, working under the guidance of MarTREC researcher, Dr. Mohammad Sadik Khan. Nobahar won first prize for his project presentation at the JSU Graduate Student Research Symposium.

University of Arkansas Civil Engineering Students, earn multiple honors at Missouri Valley chapter of the Institute of Transportation Engineers (MOVITE). The students conduct research under the direction of Dr. Sarah Hernandez.

In the Student Design Competition, graduate students Sanjeev Bhurtyal, Kayla Diaz-Corro, Mariah Crews (undergraduate) and Sharif Mahmud, (pictured left), earned first place for their project focused on creating a city of 'Complete Streets.'

Doctoral student Magdalena Asborno earned first place in the Student Poster Competition for her work entitled "Estimating Waterborne Port Calls from LPMS and Truck GPS Data: A Multi-commodity Assignment Model." Her new, multimodal fusion model closes a critical gap in the ability to estimate port-level commodity flows, which is essential for estimating the demand for freight transportation facilities and services on inland waterways.

MarTREC OUTREACH

3rd Annual GirlTREC Summer Camp

July 8-12, 2019, MarTREC hosted 24 fifth and sixth grade girls at our GirlTREC summer camp on the University of Arkansas campus. The camp focused on hands-on activities related to transportation engineering from roads to rail to waterways and was designed to build courage and interest towards studying STEM fields and considering a career in the transportation industry. Our interactive programs were taught by faculty at the University of Arkansas' civil and industrial engineering departments and included activities in bridge construction, social media data during disaster response, traffic control systems, and train operations. A special thanks to Caren Kraska (pictured below), Arkansas & Missouri Railroad president and chairman, and crew, for scheduling a train ride and giving us a tour of the depot.

WORKFORCE DEVELOPMENT

Transportation Research Board (TRB) Marine and Freight Committees Conference

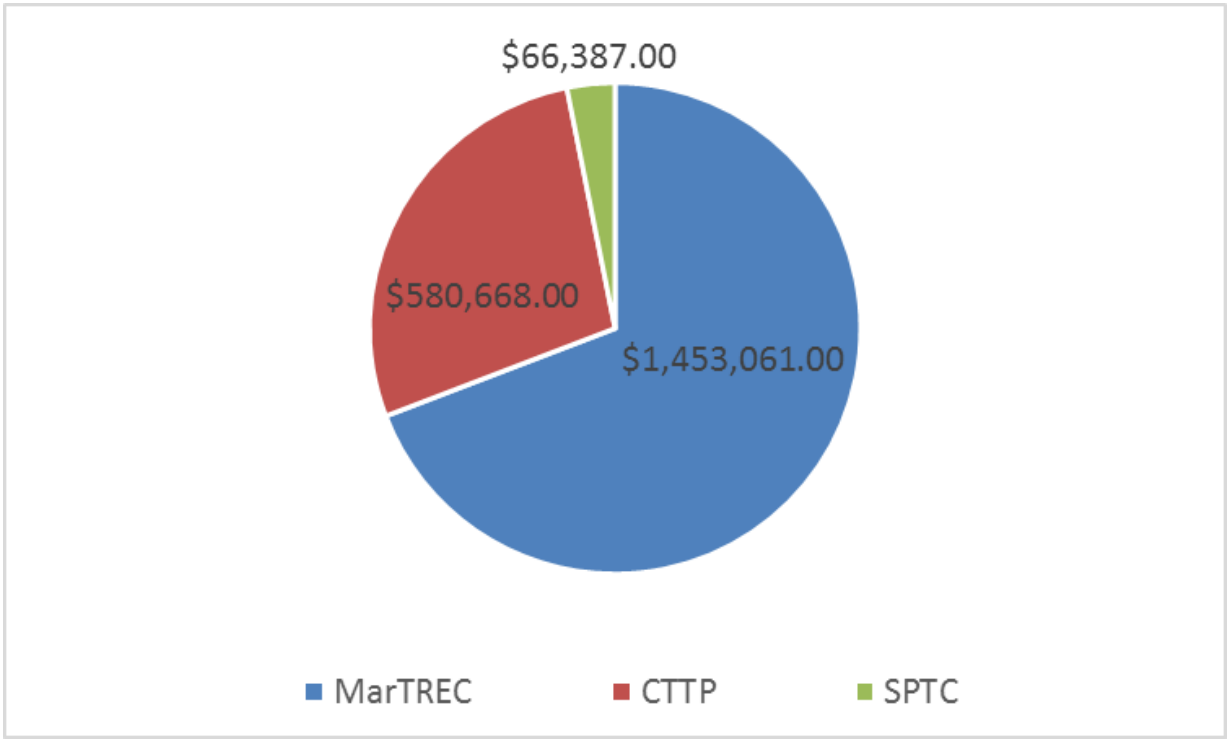
All four Transportation Research Board's Marine Committees and three Freight Committees convened at Texas A&M University at Galveston TX, June 12-14 2019. Jim Kruse and Texas A&M Transportation Institute organized the event in conjunction with A&M-Galveston. The meeting brought together some of the leading researchers in the marine freight arena and allow them to learn more about the latest topics as well as network with each other. The primary objectives of this event were: (1) provide information on marine freight transportation topics that are garnering a lot of attention, (2) allow participants to see actual installations and operations and talk to the people who run them, (3) Allow participants to experience a ship simulator and visit an actual vessel, and (4) provide opportunities for students to participate.

Exposure to STEM—Diversity in Maritime Transportation

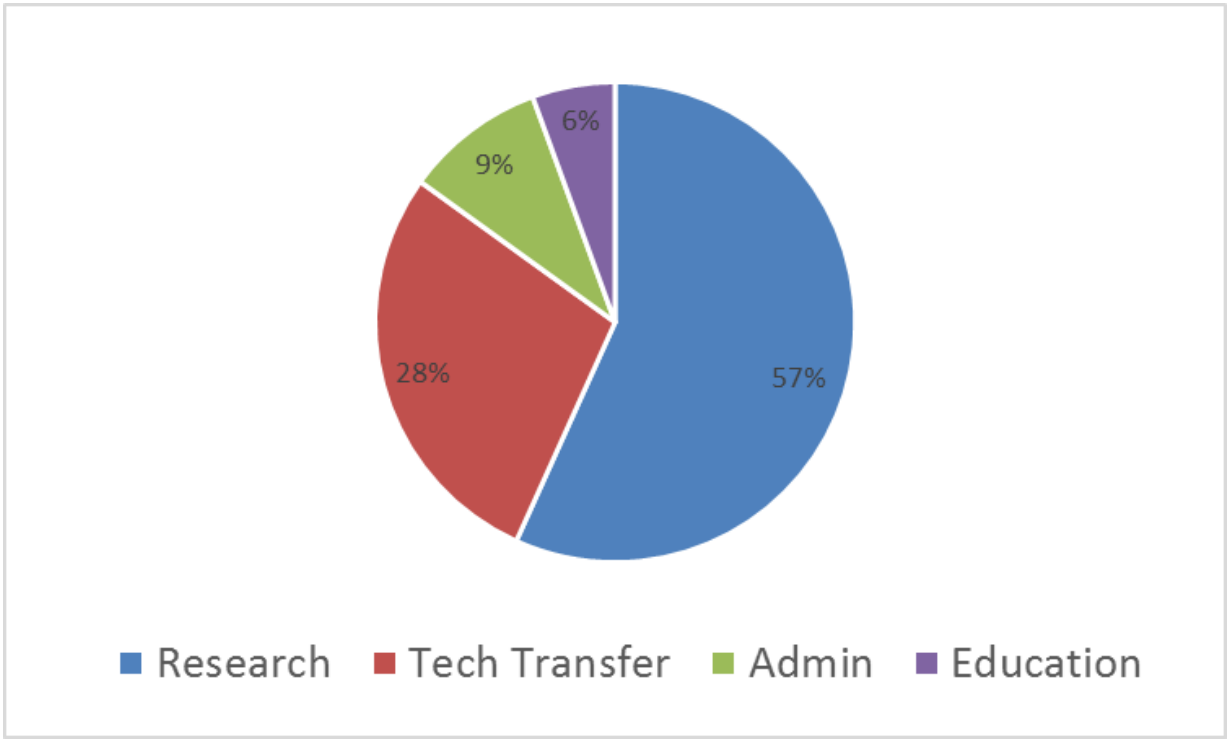
Students from Little Rock Central High School visited Murray Lock and Dam along the McClellan-Kerr Arkansas River Navigation System for a Lock and Dam tour on April 2, 2019. The tour was guided by Eric Gillepsie, the Lock Master for the Murray Lock and Dam. Dr. Rick Coffman, from the University of Arkansas, and graduate student Anh Tran talked about the need for the lock and dam system and encouraged students to pursue careers in the STEM fields.

MBTC FINANCIALS

Center Expenditure Breakdown
FY19 Expenditures = $2,100,116



Expenditure Activity Distribution
FY19 Expenditures = $2,100,116



2018 JACK BUFFINGTON OUTSTANDING STUDENT POSTER

The Jack Buffington Outstanding Student Poster was awarded to Eddie Gallarno and Ashley Johnson for their poster on "Trade-Off Analytics for Infrastructure Preservation". Gallarno and Johnson are Industrial Engineering students under the supervision of Dr. Greg Parnell and Dr. Ed Pohl. Pictured: Eddie Gallarno, Ashley Johnson, and Dr. Kevin Hall.

2019 ARKANSAS GOOD ROADS SCHOLARS

Emily Sherrill , Mariah Crews, Madeline Giebler, Justin Edwards, Brady Patrick, and Jocie Baker (not pictured) were selected as the 2019 Arkansas Good Roads scholarship recipients. The organization grants scholarships to outstanding civil engineering students in their junior or senior year. Recipients of the scholarship commit to work in the transportation field in Arkansas for a minimum of one year after graduation.

CENTER FOR TRAINING TRANSPORTATION PROFESSIONALS

Frances Griffith, **Stacy Williams**, **Roselie Conley**, **Mary Fleck**, **Talley Faulkner**, **Katie Juniel**, **Austin Williams**.

2019 has proven to be another busy year at CTTP, with many new contractors and active highway construction projects in the state of Arkansas. The National Pollutant Discharge Elimination System (NPDES) course continues to see increased enrollment following a 2018 requirement for contractors to be certified in this topic. Materials testing certifications have also been in high demand, resulting in a total of 34 courses held since the beginning of the year. The most popular courses have been Soils Testing and Basic Aggregates, followed by Concrete Field Testing, Hot Mix Asphalt, and Concrete Strength Testing. Laboratory certifications have followed suit, with 6 new laboratory enrollments this year, and 3 re-locations, making a total of 103 laboratories currently participating in the program.

As technology becomes a more natural part of our daily lives, it also becomes a more integral feature of CTTP training courses. CTTP currently maintains 41 online training modules, and has recently launched a series of 40 training videos to assist with technician training. More modules and videos will be added in the coming months. Classroom information has also been added to the website, allowing a technician to more thoroughly prepare before attending a class, or to refresh in specific test methods after attending a class. In some cases, the online training materials may be completed in lieu of attending the full class, allowing technicians to simply attend a 1-day testing session. This reduces travel costs, as well as time away from the job.

The Technology Transfer (T2) program has continued to be a significant part of the CTTP program, with CTTP instructors presenting popular courses such as Unpaved Roads and Erosion Mitigation, Asphalt Pavement Maintenance, Stormwater Management, and Guide for Traffic Signs, Markings, and Signals. Newly developed courses, including Asphalt Paving Basics and Concrete Construction Basics, have also gained considerable attention, and have garnered favorable feedback as practical introductory training for new local agency employees and valuable refresher training for seasoned veterans. Pavement management and pavement preservation have continued to be popular topics of discussion at state and local conferences, and CTTP personnel have worked individually with local agencies to launch pavement management programs, explore alternative paving options, and assist in problem solving sessions. For information about CTTP and Technology Transfer, please visit www.cttp.org and www.cttp.org/ardot/t2.

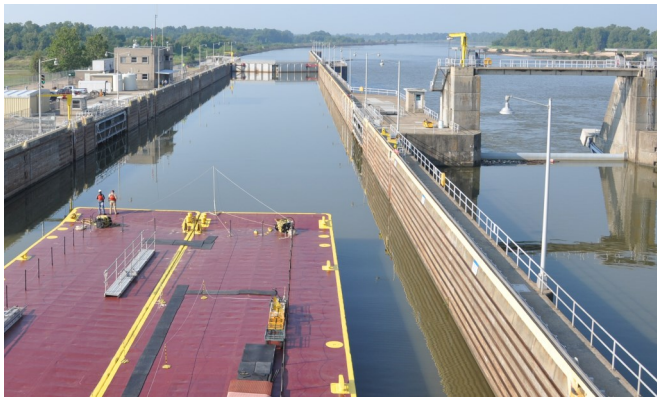
WORKFORCE DEVELOPMENT

Stacy Goad Williams, research associate professor and director of the Center for Training Transportation Professionals, was named Professional of the Year by the Arkansas Chapter of the association.

The focus of the award is to inspire dedication and excellence in public service by recognizing individuals who have demonstrated those qualities in their career service to the public works profession.

Williams was recognized for her role as an expert in the field of public works, and for the guidance she has provided to infrastructure professionals in the public and private sectors. She has contributed to the Arkansas Technology Transfer Program to develop and teach courses that aid local agencies in understanding and implementing new technologies and best practices to improve the work quality throughout Arkansas.

The Arkansas Department of Transportation made a $1 million investment in a Civil Engineering Research and Education Center at the University of Arkansas to support the creation of a facility that will benefit students, researchers and companies across Arkansas. Students will use the center's design and construction process to explore topics in construction techniques and management; computer-aided design and drafting; plan development; construction materials; soil mechanics and foundation design; structural steel design and reinforced concrete design.



MarTREC hosted a Regional Resiliency Assessment Program (RRAP) of the McClellan-Kerr Arkansas River Navigation System. Chad Johnston, Protective Security Advisor, Region VI Cyber Security and Infrastructure Security Agency directed the meeting.

The goal of the RRAP was to generate greater understanding and action among public and private sector partners to improve the resilience of a region's critical infrastructure. *Photo courtesy of USACE*

ers, rather than uniformly sampling across a site. The resulting resistivity plots revealed continuous subsurface soil information and the impact of water level when interpreting the resistivity results.

Evaluation of Surface Treatments to Mitigate Alkali-Silica Reaction

Micah Hale, Ph.D., P.E.
University of Arkansas
October 2013-October 2019

Alkali-silica reaction (ASR) is the most common form of alkali-aggregate reaction and has become a problem in concrete structures throughout the world. This research focused on mitigating ASR once it has occurred. The project examined using silane and other sealers to mitigate ASR in concrete structures. Due to the limited amount of time that this test has been ongoing, the conclusions here for 1 year and 3 months may not be applicable for a longer amount of time. It is recommended that the blocks be measured for at least 7 years to come to an accurate conclusion of how each sealer performs over time. Expansion readings along with recording winter temperatures should continue to determine the freeze-thaw and ASR damage.

Impact of Extreme Summer Temperatures on Bridge Structures

Micah Hale, Ph.D., P.E.
University of Arkansas
Royce W. Floyd, Ph.D., P.E.
University of Oklahoma
October 2013-October 2019

This research investigated temperature gradients in AASHTO I-girders without wide top flanges to determine the environmental conditions that produce these gradients. This research also sought to understand the global response of concrete bridge girders to thermal gradients through three-dimensional finite element modeling. Large daily temperature variation is the most important contributing factor. Low wind speeds and no precipitation also contribute. Proper lateral bracing at all points during construction should negate the effects of transverse thermal gradients enough to keep tensile stresses below the cracking limit. During modeling, measured temperature gradients decreased camber. However, design gradients increased camber. Based on the results of this research, the vertical thermal gradient is recommended for AASHTO Type I, Type II, Type III, and Type IV girders in the pre-deck placement condition.

ONGOING MBTC RESEARCH PROJECTS

Data Simulation to Support Interdependence Modeling in Emergency Response and Multimodal Transportation Networks

Haitao Liao, Ph.D.
Heather Nachtmann, Ph.D.
University of Arkansas
September 2017-August 2020

Access to data on the design and operation of interdependent critical infrastructures (ICIs) is now recognized as essential for developing new data analytics, design and decision-support tools. This project will create and make available synthetic and simulated data on ICIs by developing new data creation techniques and model-based approaches to simulating data on ICIs and human cognition and/or behavior with ICIs. It will provide research communities a free tool for modeling and collecting data on complex ICIs involving human activities and decisions. The research investigates a methodology for developing hybrid data-driven statistical models and simulation tools that help decision-makers, researchers and other stakeholders have a good understanding of multimodal freight movement processes based on different data sources. So far, a spatiotemporal statistical model has been developed to capture extreme natural events causing disruptions in inland waterways and to predict such events in the future to facilitate commodity flow planning. Moreover, a simulation tool has been built to capture the effect of inland waterways disruptions on the commodity flow through other ICIs. A case study based on the Mississippi River and the McClellan–Kerr Arkansas River Navigation System (MKARNS) has been used to validate the hybrid model.

COMPLETED MBTC RESEARCH PROJECTS

Development of the MASW Method for Pavement Evaluation

Clinton Wood, Ph.D., P.E.
University of Arkansas
October 2013-July 2016

Infrastructure deterioration is a major issue for transportation infrastructure. This project explored the use of the Multi-Channel Analysis of Surface Waves (MASW) as a NDT method for characterization of pavements. Tests were conducted on concrete samples and full size pavement sections affected by alkali-silica reaction (ASR) to determine the relationship between shear wave velocity developed using the MASW method and strain increases due to ASR expansion of the concrete. Results indicate that the MASW method is capable of detecting the damage due to ASR for low to moderate damage levels.

Evaluation and Repair of Existing Bridges in Extreme Environments

Royce Floyd, Ph.D., P.E.
University of Oklahoma
Gary Prinz, Ph.D., P.E.
University of Arkansas
October 2013-July 2016

The goal of this project was to increase the longevity of existing structures through development of comprehensive strategies for evaluation and resilient repair of pre-stressed concrete and steel bridge girders subjected to extreme environments. Detailed finite element simulations indicate that the partial-depth cross-frame-to-girder attachments within these multi-girder systems are the most fatigue critical regions. Laboratory tests equipped with the prototype retrofits were successful in shifting the mean stress in an instrumented steel beam. The result is a cost-effective and corrosion resistant "bridge band-aid" that can be applied to mitigate fatigue cracks.

Final project reports available @ www.sptc.org/projects/

Dependence of Infrastructure Restoration on Transportation Networks

Sarah Nurre, Ph.D.
University of Arkansas
May 2016-October 2017

The restoration of critical infrastructure systems after extreme events is vital. We developed an optimization model which decides on the restoration of tasks in interdependent infrastructure networks, such as power, based on the availability and restoration of transportation over time. We found favorable configurations of work crew skills and preplacement within an impacted area.

Effects of Weather Events on Truck Traffic Using Fixed and Mobile Traffic Sensors

Sarah Hernandez, Ph.D.
University of Arkansas
March 2016-January 2018

Severe weather conditions can effect traffic volumes. Unlike passenger vehicles, which may choose not to travel, freight trucks adhere to delivery schedules requiring them to alter their route. This study applied spatial panel regression techniques to develop a predictive model that relates variations in truck traffic patterns to weather conditions. The model developed can assist state and regional transportation agencies in developing freight-oriented programs for road and winter maintenance, structural and geometric pavement design, highway life cycle analysis, and long range transportation planning.

Rapid and Continuous Assessment of Soil Conditions along Highway Alignments

Clint Wood, Ph.D., P.E.
University of Arkansas
April 2016-July 2018

The purpose of this research was to explore the applicability of Capacitively-Coupled Resistivity (CCR) as an improvement on traditional drilling and sampling methods for subsurface soil investigations. The CCR method could be used to identify critical locations for drilling and sampling such as expansive clay lay-

DAN FLOWERS DISTINGUISHED LECTURE SERIES

November 15, 2018

Dr. Tianjia Tang
Chief of Travel Monitoring and Surveys Division, Federal Highway Administration
U.S. Department of Transportation

U of A Ph.D., Agronomy '92

Lecture: Challenges & Opportunities in Surface Transportation

April 15, 2019

Eric C. Shen
Director of the Mid-Pacific Gateway Office in the Maritime Administration of the U.S. Department of Transportation

Lecture: Marine Transport and Goods Movement: Why Should You Know and Why Should you Care

Mr. Eric Shen and Dr. Sarah Hernandez

HISTORY OF MACK-BLACKWELL

The Mack-Blackwell Transportation Center (MBTC) has served the state of Arkansas and the nation for over 25 years by providing state-of-the-art research, high quality transportation education, and technology transfer.

In 1987, Congress authorized the U.S. Department of Transportation (USDOT) University Transportation Center (UTC) program, which led to the establishment of ten regional UTCs, one in each of the ten federal regions. 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 center was named in the Intermodal Surface Transportation Efficiency Act of 1991, which was signed into law by President George H. W. Bush. Dr. Bob Elliott coined the center name cited in the bill – the National Rural Transportation Study Center.

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 HR1, implementing the recommendations of the 9/11 Commission Act of 2007. The center fulfilled transportation security research needs for six years under this designation.

In 2013, MBTC 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 University Transportation Center under the MAP-21 transportation bill. With continued funding in 2016, the MarTREC consortium added Texas A&M University and Vanderbilit University and, through the FAST Act, and is working to preserve the Nation's transportation system through efficient, resilient, and sustainable maritime and multimodal logistics and infrastructure.

Mack-Blackwell has been fortunate to be led by four outstanding directors over the past twenty seven years.

- Dr. Walt LeFevre, Civil Engineering, 1992-1996
- Rear Admiral Jack Buffington, Civil Engineering, 1996-1999
- Dr. Melissa, Tooley, Civil Engineering, 1999-2006
- Dr. Heather Nachtmann, Industrial Engineering, 2007-present

Spotlight on Jack E. Buffington

Admiral Jack E. Buffington served thirty-four years in the Navy Civil Engineer Corps, wherein he rose to the position of Chief of Engineers and Commander of the Naval Facilities Engineering Command in charge of navy contracting and public works worldwide. He was in charge of an annual workload of $7 billion dollars with over 22,000 employees. In addition, he represented the 24,000 active and reserve Seabees and Civil Engineer Corps officers throughout in the Navy.

For thirteen years Buffington managed the University of Arkansas, Mack-Blackwell Transportation Center (MBTC), either as Director or Associate Director. The Mack-Blackwell Transportation Center is dedicated to improving the quality of life in America through our transportation research, education, and workforce development programs.

An expert in public works and transportation engineering, Admiral Buffington is a member of several professional societies including the National Society of Professional Engineers, the Arkansas Academy of Civil Engineers, which he helped to found, and the Society of American Military Engineers.

MESSAGE FROM MBTC EXECUTIVE DIRECTOR

As we get closer to 2020, there has been significant discussion concerning "the future". What does the 21st century's next 20 years hold? What transportation challenges will we face? What opportunities do we have? How do we educate and train our workforce for these challenges and opportunities? As various groups have grappled with these questions, it seems that a number of common themes continue to surface: *innovation*; *critical thinking*; *systems thinking*; *people/professional skills*; *diversity, inclusion, and equity*; and many others. It is clear that technology continues to evolve more rapidly than we can prepare, educate, and train people to fully harness it – and importantly, to fully understand its impact from social and cultural perspectives. The faculty, staff, and partners of the Mack-Blackwell Transportation Center are committed to proactively explore not only boundary-redefining innovative technologies, but also innovations in how we think, how we prepare engineers and others working in the transportation community, and how we can implement innovative technology in a socially, economically, and environmentally responsible manner. It is truly a joy and a privilege to work alongside the many dedicated folks associated with MBTC. We certainly look forward to the 'next' 20 years of the 21st century.

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Photo courtesy of ARDOT

MBTC STAFF

Heather Nachtmann, Ph.D.
Director

Kevin D. Hall, Ph.D., P.E.
Executive Director

Amy M. Shell, M.S.
Center Coordinator

Stacy G. Williams, Ph.D., P.E.
CTTP Director

Frances Griffith, M.S.
CTTP Associate Director

Roselie Conley
CTTP Research Technologist

Mary Fleck
CTTP Instructor

Austin Williams
CTTP Programmer

Talley Faulkner
CTTP Program Specialist

Katie Juniel
CTTP Administrative Specialist

CONTACT INFO

4190 Bell Engineering Center
University of Arkansas
Fayetteville, Arkansas 72701
Phone: 479.575.6021
Email: mbtc@uark.edu

UNIVERSITY OF ARKANSAS

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Director of External Initiatives, Texas A&M Transportation Institute

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Mack-Blackwell Transportation Center

October 2018 - September 2019

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