UPCOMING EVENTS

Co-op Presentations
March 23-25

National Highway Institute (NHI) Course No. 133121V -
Traffic Signal Design and Operation *(Virtual Delivery)*
April 5-8

*To view more events, please visit
http://www.ltrc.lsu.edu.*

RESEARCH

Louisiana Acquires Probe Data to Shed Light on Congestion and Road System Performance

Real-time data alerts drivers of travel times and assists DOTD in planning and research

Louisiana drivers may have noticed new travel prediction time messages appearing on signs along interstates, especially at upcoming exits. These predicted travel times are connected to an intricate data-streaming network of real-time positioning and speeds of commercial vehicles, passenger vehicles, and mobile devices—also known as probe data. Through a newly acquired contract with the University of Maryland, DOTD and LTRC now have access to local transportation data updated every minute daily for 72,300 road segments in the state that gives accurate snapshots into congestion, road performance, and travel patterns.

The data is collected using connected vehicles data streaming technologies and other mobile device positioning (location intelligence) technologies, data fusion, and artificial intelligence. All data streams are completely anonymized because the platform does not receive or handle data that are personally identifiable.

Special Studies Research Administrator and data facilitator Julius Codjoe, Ph.D., P.E., explained, "By archiving those data streams as they come in, and then fusing them with other agency data sets like the location of crashes, weather data, signal systems locations, etc., users of the RITIS platform can view or produce compelling visualizations about the performance of Louisiana's roadways and answer many tough questions. This data provides
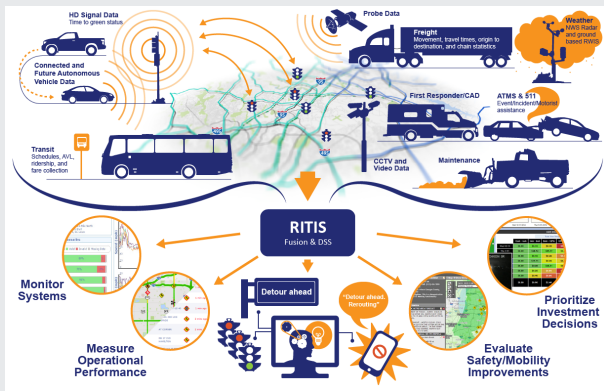
RITIS integrates any existing data from transportation and public safety systems, the private sector, and military. The data is fused in a private, secure cloud, and then disseminated to credentialed users through interactive websites, applications, data feeds, and APIs. (Source: https://ritis.org/intro)

deep insights into congestion and systems performance on Louisiana roadways, and is particularly innovative in that nearly all roads are covered 24/7/365."

The probe data is collected by a company called INRIX. Then, a platform called RITIS or Regional Integrated Transportation Information System archives the data and makes it available through a series of web-based visualization and analytics tools to any DOT, MPO, or consultant working on behalf of these agencies for use in planning, operations, and research activities. The RITIS platform is managed by the University of Maryland's CATT Lab (Center for Advanced Transportation Technology Laboratory). Through this partnership, DOTD is able to not only install accurate travel prediction signs across the state but give decision-makers clarity into deeper transportation issues and expand Louisiana's planning and research efforts for years to come.

For example, access to RITIS data and data tools will help DOTD staff accurately report to media or elected officials about roadway incidents and subsequent impacts, plan for future events by analyzing past events in detail, and make the case for funding future projects or which projects should be prioritized over others. Similarly, planners and researchers can use these data tools to document the movement patterns of people and goods and monitor where mobility or safety is improving or degrading. And agency executives and senior managers, who need to communicate visions about where their agencies are headed, can use the RITIS data and tools to help them understand the present and recent past, choose and articulate realistic goals and objectives, select performance metrics and targets, and then monitor reports on progress.

This technology also comes with a lower cost than other alternatives (such as installing costly sensors) because of its infrastructure-free operation, saving taxpayers a considerable amount of money. "This [RITIS data tools] makes the decision-making process more transparent and defensible, and can help to reduce wasteful spending," Dr. Codjoe added. "The use of these modern sources of information and technologies ultimately solve congestion issues that enable the public to move around—themselves or shipments—much more freely and efficiently than otherwise possible at cost levels that provide an enormous coverage extent everywhere that people or goods can travel."

Any DOTD personnel with an la.gov email address can automatically get access to the RITIS platform by requesting an account at https://www.ritis.org/register/. Metropolitan planning organizations (or MPOs) from Louisiana and consultants can also request an account by following a few additional steps. If you have questions about this technology, RITIS account access, or training options, please contact Dr. Codjoe at Julius.Codjoe@la.gov.

LTRC would like to thank and recognize the late Kirk Zeringue, who first began exploring probe data opportunities for Louisiana almost 5 years ago in response to local drivers' ongoing questions and concerns involving congestion, performance, investment strategies, and even safety. He spent many hours researching and lobbying data options to the Department for all Louisiana citizens to benefit.

DOTD Expands Testing Opportunities for Employees

Within the structured training programs, employees are required to be proficient in courses for their specific role and career progression group. These courses require employees to engage in self-regulated learning with manuals, workbooks, or videos. To become proficient and receive credit in these courses, employees need to schedule an exam with their training coordinator. Considering that the content is work-related, employees would take the tests during the work day. However, the opportunities were limited to once a month, which did not accommodate all levels of employees and their various work schedules. This low frequency of testing opportunities had an effect on training compliance.

Beginning in August 2020, trainers began offering testing at DOTD headquarters and TTEC. On the first and third Mondays of every month, testing is offered at headquarters. On the second Mondays of every month, testing is offered

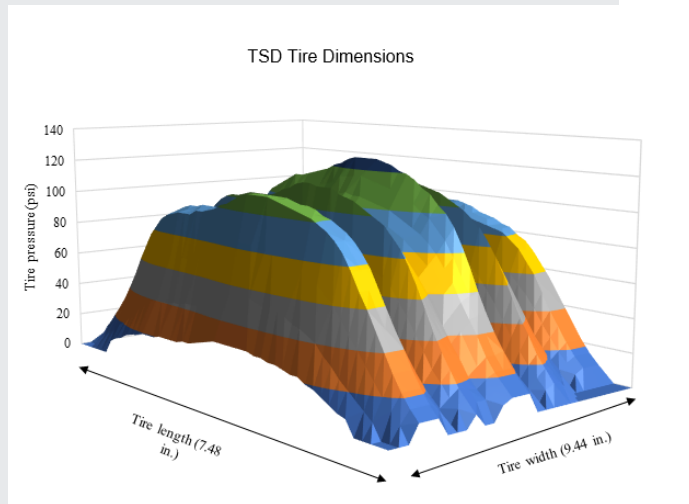# Researchers Create Conversion Application to Use Traffic Speed Deflectometer Measurements for Backcalculation

Non-uniform tire pressure distribution in the 3D-Move model

In their project "A Mechanistic Approach to Utilize Traffic Speed Deflectometer (TSD) Measurements into Backcalculation Analysis," researchers Mostafa Elseifi, Ph.D., P.E. (VA), Zia U.A. Zihan, and Patrick Icenogle created and sought to validate a theoretical model using 3D-Move software in order to utilize traffic speed deflectometer (TSD) measurements in backcalculation analysis.

Backcalculation takes a measured surface deflection (a real-life test) and attempts to match it (within some tolerable error) with a calculated surface deflection (the desired result) generated from an identical pavement structure. Usually, backcalculation analysis is used based on falling weight deflectometer (FWD) measurements, which need lane closures and traffic control to be accurate. However, in recent years a number of continuous deflection devices have been introduced, including the traffic speed deflectometer (TSD), which involves a special vehicle that actively scans the road while driving.

"Recent studies conducted in Louisiana and elsewhere suggest that the TSD is a promising device for pavement evaluation at the network level because it can measure deflection at traffic speeds, which enable large spatial coverage and can provide continuous deflection profile rather than measuring pavement deflection at discrete points, which is the case with FWD," Dr. Elseifi explained. "However, in spite of the encouraging advantages of TSD, currently available tools to backcalculate layer moduli use FWD deflection measurements as the main input and cannot be directly used with TSD deflection measurements."

As a result, researchers created an application to convert TSD deflections into FWD deflections. Dr. Elseifi and his team utilized 3D-Move software to calculate the theoretical deflection bowls corresponding to FWD and TSD load-

> **"The results of this research were successfully presented at the TRB annual meeting in 2020 with several agencies expressing interest in evaluating the developed Windows applications."**

ing configurations. Dr. Elseifi explained, "Since 3D-Move requires the definition of the constitutive behavior of the pavement layers, cores were extracted from 13 sections in Louisiana and were tested in the laboratory to estimate the dynamic complex modulus of asphalt concrete."

Researchers then generated deflection bowls in 3D-Move; these bowls proved to be acceptably accurate, so the researchers moved forward with their parametric study, wherein all model loading configurations created in 3D-Move were field-tested for validation.

"The results obtained from the parametric study were utilized to develop a Windows-based application, which uses artificial neural network as the regression algorithm to convert TSD deflections to the corresponding FWD deflections," said Dr. Elseifi. "The converted deflections may then be used in regular backcalculation analysis software to backcalculate the pavement layer moduli."

According to researchers, this application can greatly reduce computational efforts in backcalculating from TSD measurements and is ready for implementation in TSD deflection research. In addition, the results of this research were successfully presented at the TRB annual meeting in 2020 with several agencies expressing interest in evaluating the developed Windows applications.

For more information
Please visit https://www.ltrc.lsu.edu/pubs_final_reports.html and select Final Report 612 or contact Dr. Mostafa Elseifi at elseifi@lsu.edu.

LTRC Participates Virtually in TRB's 100th Annual Meeting

In light of precautions associated with COVID-19, this year's TRB annual meeting shifted online as policy makers, administrators, practitioners, researchers, and representatives of government, industry, and academic institutions met to virtually attend sessions and workshops. Almost 100 researchers representing DOTD, LTRC, and local university partners were selected to present on a variety of topics as shown below. The spotlight theme for the 2021 meeting was "Launching a New Century of Mobility and Quality of Life." This year's meeting also featured a number of sessions highlighting how COVID-19 has impacted transportation and how transportation professionals and researchers are responding.

Modulus Behavior of Geogrid-Reinforced Clay
Qiming Chen

Thermal Camera Sensing for Soil Embankment Monitoring: Soil Moisture Content Detection
Zhongjie Zhang, Qiming Chen, Benjamin Key, Terrell Gorham, and Biyuan Zheng

Geotechnical Asset Management for Louisiana
Gavin Gautreau and Adele Lee

Optimization of Overweight Truck Impact on Roadway Network with Minimum Cost Method: A Case Study in Louisiana
Yilong Liu, Md G. Sobhani, and Zhong Wu

Evaluation of Site Variability and Its Implementation into LRFD Design of Pile Foundations
Murad Abu Farsakh, Md Habibur Rahman, Ismaail IB Ghaaowd, and Navid Jafari

Evaluating the Effect of Site Variability on the Bearing Capacity Resistance Factor of Foundations and the Slope Stability Analysis
Ismaail Ghaaowd, Murad Abu Farsakh, and Md Habibur Rahman

Evaluation of the Pile Set-Up Parameter, 'A', using Artificial Neural Network (ANN)
Md Ariful, Hassan Mojumder, and Murad Abu Farsakh

Evaluation of Interface Behavior of Clay due to Heating-Cooling Cycle
Abedalqader Idries, Murad Abu Farsakh, and Shengli Chen

Non-Destructive Detection of Asphalt Concrete Stripping Damage Using Ground Penetrating Radar
Ye Ma, Mostafa Elseifi, Nirmal Dhakal, Mohammad Bashar, and Zhongjie Zhang

Effects of Asphalt Concrete Stripping on the Performance and Cost-Effectiveness of Chip Seal and Asphalt Concrete Overlay in Hot and Humid Climates
Hossam Abohamer, Mostafa Elseifi, Nirmal Dhakal, Zhongjie Zhang, and Christophe Fillastre

Effectiveness of Loaded Wheel Tracking Test to Ascertain Moisture Susceptibility of Asphalt Mixtures
Moses Akentuna, Louay Mohammad, Sanchit Sachdeva, Samuel Cooper, III, and Samuel Cooper, Jr.

Short-term Field Performance and Cost-effectiveness of Crumb-Rubber Modified Asphalt Emulsion in Chip Seal Applications
Md Nafiur Rahman, Md Tanvir Ahmed Sarkar, Mostafa Elseifi, Corey Mayeux, Samuel Cooper, and Ken Free
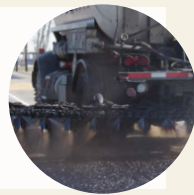
Development of an Artificial Neural Network (ANN)-Based Procedure for the Verification of Traffic Speed Deflectometer Measurements
Hossam Abohamer, Mostafa Elseifi, Zia Zihan, Zhong Wu, Nathan Kebede, and Zhongjie Zhang

Fatigue and Reflective Cracking Mechanisms: Modeling and Accelerated Pavement Testing Validation
Nirmal Dhakal, Mostafa Elseifi, Imad Al-Qadi, and Tyson Rupnow

Evaluating the Performance of Crumb Rubber and High Float Polymer Modified Asphalt Emulsions in Chip Seal Applications
Md Tanvir Ahmed Sarkar, Md Nafiur Rahman, Mostafa Elseifi, Samuel Cooper, III, and Samuel Cooper

Development of Artificial Neural Network (ANN) and Convolutional Neural Network (CNN) Applications to Classify Pavement Cracks as Top-down, Bottom-up, and Cement-Treated Reflective Cracking
Nirmal Dhakal, Mostafa Elseifi, Zia Zihan, Zhongjie Zhang, Christophe Fillastre, and Jagannath Upadhyay

Laboratory Testing and Modeling Continuous Stringer Floor Systems
Jay Puckett, Daniel Linzell, Emmanuel Akintunde, C. Shawn Sun, Dinesha Kuruppuarachchi, and Oluwatobi Babarinde

Quantifying Statistical Uncertainties for Temperature Gradient Analysis of Bridges
Ahmed Elshoura and Ayman Okeil

Investigating Factors Affecting Pedestrian Crash Severity at High Speed Urban Arterial Roadways: A Case Study of Louisiana
Raju Thapa, Julius Codjoe, and Paul Eyram Kornyoh

Safety Effectiveness of Protected Only over Permitted/Protected Left Turn Phasing in Louisiana
Md Asaduzzaman, Raju Thapa, and Julius Codjoe

Queue Analysis at Work Zones: An Analysis from Field Collected Data
Julius Codjoe, Raju Thapa, and Elisabeta Mitran

A Survey of Work Zone Practices and Validation of HCM Work Zone Capacity Model
Raju Thapa, Julius Codjoe, and Amanua Osafo

Estimation of ADT for Low Volume Roadways in Rural Areas of Louisiana
Afia Serwaa Yeboah, Julius Codjoe, and Raju Thapa

Investigating Underage Alcohol Intoxicated Driver Crash Patterns
Md Mahmud Hossain; M. Ashifur Rahman, Xiaoduan Sun, and Elisabeta Mitran

Freeway Incident Diversion Behavior as a Measure of Transportation Network Resiliency
Ravindra Gudishala, Saurabha Bawankule, Chester Wilmot, and Brian Wolshon

Analyzing and Modeling Grocery Store Visits during the Early Outbreak of COVID-19
Ruijie Bian, Pamela Murray-Tuite, and Brian Wolshon

Commuting Behavior Changes in the Post COVID-19 Period: A Case Study of Shanghai
Xinyuan Wang, Jian Li, Ruijie Bian, and Yuyang Zhou

Suitability of Fusing Vehicle Probe Data and Vessel Data to Contextualize the Multimodal Interaction Impacts on Corridor Mobility – a New Orleans Case Study
Bethany Stich, Kirk Zeringue, and Guang Tian

Calibration and Development of Safety Performance Functions for Two-Way Stop-Control Intersections on Rural Two-Lane Highways in Louisiana
Ming Sun, Xiaoduan Sun, M. Rahman, and Subasish Das

Interface Bond Strength of Engineering Cementitious Composites (ECC) in Pavement Applications
Ricardo Hungria, Gabriel Arce, Marwa Hassan, Louay Mohammad, Tyson Rupnow, and Moinul Mahdi

Properties of Engineered Cementitious Composites with Post-Processed Sugarcane Bagasse Ash as Sand Replacement
Hassan Noorvand, Gabriel Arce, Marwa Hassan, Sujata Subedi, Michele Barbato, Tyson Rupnow, and Yasser Bigdeli

Feasibility of Engineered Cementitious Composites with High Volumes of Post-Processed Bagasse Ash as Partial Cement Replacement
Sujata Subedi, Gabriel Arce, Marwa Hassan, Louay Mohammad, Tyson Rupnow, and Michele Barbato

Effect of Raw Sugarcane Bagasse Ash as Sand Replacement on the Fiber-Bridging Properties of Engineered Cementitious Composites
Sujata Subedi, Gabriel Arce, Marwa Hassan, Michele Barbato, and Louay Mohammad

Evaluation of HeadLight: An E-Construction Inspection Technology
Tyson Rupnow, Mary Leah Coco, George White, and Julian Yamaura

Novel Metakaolin Based Engineered Geopolymer Composites
Ruwa AbuFarsakh, Gabriel Arce, Marwa Hassan, Oscar Huang, Miladin Radovic, Tyson Rupnow, Louay Mohammad, and Svetlana Sukhishvili

Lafayette Consolidated Government: Transitioning Internal Curing from the Laboratory to the Field
Tyson Rupnow, Jose Milla, and William Saunders

Development of a 4.75 mm NMAS Mixture for Implementation in LADOTD Specifications: A Life-Cycle Cost Analysis of the Designed Pavement using AASHTOWare Pavement ME
Saman Salari, Samuel Cooper, Peyman Barghabany, and Corey Mayeux

A Novel Aging Model to Predict Fracture Parameter SCB J_c for Asphalt Mixtures Using an Artificial Neural Network Approach
Peyman Barghabany, Jun Zhang, Louay Mohammad, Sam Cooper, III, and Sam Cooper, Jr.

Effect of Laboratory Aging Levels on Asphalt Binder Chemical/Rheological Properties and Fracture Resistance of Asphalt Mixtures
Peyman Barghabany, Jun Zhang, Louay Mohammad, Sam Cooper, III, and Sam Cooper, Jr.

Developing a Competency Model for Highway Safety Engineers: A Delphi Method
Garrett Wheat

DOTD testing | *continued*

at TTEC. With the new testing schedule, there has been an increase of employees scheduling their tests and being up to date with their training requirements. Additionally, headquarters employees no longer have to travel to take their exams. Research shows that adult learners must be engaged with effective learning that exhibit characteristics of "autonomy, goal-oriented, practical, purposeful, competence and mastery, and reduction in limitations" (https://elearningindustry.com/8-important-characteristics-of-adult-learners).

Due to the updated schedule and locations, testing has become more convenient and our employees possess the ability to tailor the training experience for their individual needs. LTRC is committed to implementing strategies that will drive effective performance and development.

For more information about testing opportunities, you may contact Annisia Osborne at annisia.osborne@la.gov. She serves as the Engineering Technician Training Program Manager and HQ Training Liaison.

Louisiana Students Awarded Scholarships

The Louisiana Department of Transportation and Development and the Louisiana Transportation Research Center, in association with the Southeastern Association of State Highway Transportation Officials (SASHTO), have awarded scholarships to 10 students from five Louisiana universities. The $1,000 scholarships are given to civil engineering juniors and seniors with a professed interest in the transportation field, and students must apply each year to be considered. SASHTO provides the funding for the scholarships.

"We are pleased to award these scholarships to these deserving students across our universities," said DOTD Secretary Shawn D. Wilson, Ph.D. "I look forward to the talent and dedication they will bring to each school's civil engineering programs and hope that one day they will bring their knowledge to Louisiana's transportation and engineering industries."

Congratulations to the followings students who received scholarships:
- **Louisiana Tech University**—Sydney Bratton, Jacob Hampton, and Zach Hill
- **Louisiana State University**—Hiruni Fernando and Olivia Kilpatrick
- **University of Louisiana at Lafayette**—Bailey Bergeron, Matthew Tassin, and Aaron Enlund
- **McNeese State University**—Breanna Cross
- **Southern University**—Rossano Bailey

Staff Updates and Accomplishments

LTAP Program Manager **Chris Melson** was elected as a member of the TRB Committee on Traffic Simulation (ACP80) and co-chair of the associated Joint Simulation Subcommittee (ACP80(1)). He also serves as the vice chair of ITE's Simulation and Capacity Analysis (SimCap) Committee. In addition, Melson recently passed the PE exam.

LTRC would like to welcome **Coty Hardy** who is the new Engineering Tech DCL over PCC and Structural Training as well as one of the District Training Liaisons.

Statewide Strategic Program Manager **Garrett Wheat** has earned his Ph.D. in Agriculture and Extension Education and Evaluation from the College of Agriculture at LSU. Through LTRC, he developed a competency model for the Highway Safety section of DOTD. Using this model as a framework, a Delphi Method was used to expand this model for highway safety engineers across the country. Highway safety experts from 13 states identified and rated competencies important for the years 2020 and 2030 over three rounds.

Senior Geotechnical Research Engineer **Gavin Gautreau**, P.E., and Computer Manager **Adele Lee** submitted a paper to TRB on Geotechnical Asset Management for Louisiana (18-4GT), which was accepted for both publication and presentation.

Vijaya (VJ) Gopu, Ph.D., P.E., Associate Director–External Programs, is serving as a member of the Transportation Committee assisting Louisiana Governor's Climate Initiatives Task Force. Dr. Gopu also served on a NSF site visit panel to evaluate a NHERI Experimental Facility.

EMCRF Manager and Professor **Louay Mohammad**, Ph.D., P.E. (WY), was recently appointed president of LSU Phi Kappa Phi, the Honor Society of Phi Kappa Phi and the nation's oldest and most selective all-discipline honor society.

Recently Published

Final Report and Technical Summary 605 (16-5SS)
Diverted Traffic Measurement
Ravindra Gudishala, Ph.D.; Chester Wilmot, Ph.D., P.E.; Venkata Vamsikrishna Peddisetty; and Matthew Roberts

Final Report and Technical Summary 622 (14-4C)
Evaluation of Bonded Concrete Overlays over Asphalt under Accelerated Loading
Moinul I. Mahdi, Ph.D.; Zhong Wu, Ph.D., P.E.; and Tyson Rupnow, Ph.D., P.E.

Final Report and Technical Summary 625 (19-1PF)
Synthesis on Documentation and Tracking Research Implementation
Husam Sadek, Ph.D.; Marwa Hassan, Ph.D.; Farah Zaremotekhases; and Momen R. Mousa, Ph.D.

Final Report and Technical Summary 626 (14-1ST)
Evaluating Louisiana New Continuity Detail for Girder Bridges
Ayman M. Okeil, Ph.D., P.E. (FL), and Marco Canales, Ph.D.

Final Report and Technical Summary 627 (11-1GT)
In-Situ Evaluation of Design Parameters and Procedures for Cementitiously Treated Weak Subgrades using Cyclic Plate Load Tests
Murad Abu-Farsakh, Ph.D., P.E.; Allam Ardah; Allam Ardah, Ph.D.; and Qiming Chen, Ph.D., P.E.

Final Report and Technical Summary 628 (18-4B)
Demonstration Project for Enhanced Durability of Asphalt Pavements through Increased In-Place Pavement Density
Louay N. Mohammad, Ph.D., P.E. (WY), and Moses Akentuna, Ph.D., P.E. (TX)

Final Report and Technical Summary 629 (18-6SS)
Assessment of Consultant Plan Development and Performance Rating Processes
Ron Hamilton, P.E., Caroline Leary, and Bill Dye

Final Report and Technical Summary 630 (18-4SA)
Intersection on Horizontal Curves: Problems and Potential Solutions
Xiaoduan Sun, Ph.D., P.E., and Ming Sun

Final Report and Technical Summary 633 (19-3PF)
Synthesis on the Best Practices for State DOTs to Determine Project Delivery Time, Project Management, and Ratio of Consultant to In-House Design
Amirhosein Jafari, Ph.D.; Sharareh Kermanshachi, Ph.D.; Elnaz Safapour; and Arash Taghinezhad, Ph.D.

Final Report and Technical Summary 635 (19-3SS)
Exploring Non-Traditional Methods of Obtaining Vehicle Volumes
Julius Codjoe, Ph.D., P.E.; Raju Thapa, Ph.D., and Afia Serwaa Yeboah

Final Report and Technical Summary 637 (19-4SS)
The Impact of the Louisiana Rail Infrastructure: A System Analysis and Plan
Bethany Stich, Ph.D., and Guang Tian, Ph.D.

Final Report and Technical Summary 638 (20-1GT)
Literature Search on Use of Flexible Pipes in Highway Engineering for DOTD's Needs
Navid H. Jafari, Ph.D., and H. Omar Ulloa

Final Report and Technical Summary 640 (19-2SS)
Determining Louisiana's Roundabout Capacity
Julius Codjoe, Ph.D., P.E.; Raju Thapa, Ph.D.; Sam-Mark Ansah Ayernor; and Matthew Loker

Final Report and Technical Summary 642 (18-3SS)
Evaluation of DOTD's Existing Queue Estimation Procedures
Julius Codjoe, Ph.D., P.E.; Raju Thapa, Ph.D.; and Yaa Amanua Osafo

Technical Assistance Report 19-02TA-SA
Golf Carts on Public Roads–Literature Review of Legislation and State of the Practice in the United States
Elisabeta Mitran, Ph.D.; Julius Codjoe, Ph.D., P.E.; and Hilda Ofori-Addo

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