STRIDE | Southeastern Transportation Research, Innovation, Development and Education Center

Technology Transfer Final Report

STRIDE Project ID: **STRIDE G3**

Project Title: **Utilization of Connectivity and Automation in Support of Transportation Agencies' Decision Making**

Project Grant Period: January 1, 2020 – August 31, 2021

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THE STRIDE CENTER

The STRIDE Center is the 2016 USDOT Region 4 (Southeast) University Transportation Center (UTC) housed at the University of Florida Transportation Institute (UFTI). Our mission is to develop novel strategies for Reducing Congestion. The Center has nine partners, representing seven states in the Southeastern U.S. The UFTI and its partners in the STRIDE Center are recognized leaders at state, regional, national, and international levels. The STRIDE Center is focused on assembling and integrating research projects throughout the region in a way that maximizes contributions to solving current and future transportation problems, as well as strengthening expertise and developing new technologies. For more information, see https://stride.ce.ufl.edu/.

DISCLAIMER

ACKNOWLEDGEMENT OF SPONSORSHIP AND STAKEHOLDERS

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1. Project Overview

State, regional, and local agencies have utilized simulation models to support the decisions associated with various business processes. An increase in market penetration is expected for vehicles with advanced technologies, referred to in this document as advanced technology vehicles (ATV) and including connected vehicles (CV), automated vehicles (AV), connected and automated vehicles (CAV), and associated applications. This project identified, developed, and implemented a suite of simulation models and methods to assess the implications of CV, AV, and CAV in the traffic stream and evaluate the impacts of associated applications that use these technologies. The project was built on national and international efforts, including research conducted by the Federal Highway Administration (FHWA). As such, the research started with a comprehensive review and assessment of the literature and existing products on the subject, including examining the products of the FHWA effort. Using the review and assessment as a basis, high-priority CAV applications addressed in this project were identified based on defined criteria, and a framework and guidelines were developed for the use of analysis, simulation, and modeling of CAV. The project then developed procedures for calibrating and validating simulation models to ensure the proper use of these models in replicating emerging vehicle technologies and applications. The research team also identified and developed utilities and extensions of existing models to allow the modeling of selected high-priority modeling applications. The project demonstrated the use of the project development to support agency decisions concerning high-priority CAV applications.

2. Research Goals

- Assessment of the current developments to support CAV modeling in both domestic and international
- Identification of a modeling framework(s) for AV, CV, and CAV for use by traffic engineers and transportation planners
- Development of methods and tools to support the calibration and validation of transportation models based on trajectory-level data combined with other data types (e.g., digitized infrastructure) in support of CAV modeling
- Identification and development of model logic/algorithms and associated tools of specific CV and AV interactions and applications that could be integrated into the more prominent platform in support of CAV modeling
- Demonstration of the application of the developed framework to use cases in the Southeast region
- Development of guidelines for the applications of the identified framework, models, and tools to support CAV-related projects
- Engagement of the research team with public and private agency stakeholders to facilitate the adoption of the methods developed

3. Findings

The review of the literature has revealed different and sometimes contradictory findings on the impact of ATV technologies on transportation system mobility and safety. Those differences can invariably be traced to the use of different assumptions, algorithms, and simulation platforms. This project has identified the needs of public agencies in the southeastern United States in modeling by conducting a virtual focus group meeting with the participation of public agency stakeholders. The participants noted that, currently, state DOTs work with consultants and researchers to select the type(s) of tools for use in the analysis. This project has developed the necessary guidelines and frameworks to provide information that enables the analysis, modeling, and simulation of ATVs based on the information available at the time of the preparation of the document.

4. Performance Metrics

Metric	# Completed
OUTPUTS	
Product(s): Number of new or improved tools, technologies, products, methods, practices, and processes created or improved	1 (CAV Simulation Guidance)
Technical Report: Number of client-based technical reports published	1 (STRIDE Final Report)
OUTCOMES	
Body of Knowledge: Number of training for transportation professionals	1 STRIDE Webinar
Professionals Trained: Number of professionals participating in training	81 (43 webinar attendees, 38 YouTube views)
IMPACTS	
Stakeholders: Number of stakeholders you met with to encourage adoption or implementation of product(s)	8
Adoption/Implementation: Number of incidences outputs of research have been implemented or adopted	0

5. Product(s) – New/improved tool, technology, product, method, practice, or process

Name of the product: CAV Simulation Guidance

Description: The research team provided guidance for use by transportation agencies when using simulation to support the assessment of the impact of connected and automated vehicle technologies.

6. Who benefits/will benefit from your product(s)?

- Traffic Analysts and Traffic Engineers
- Transportation Planners
- Urban Planners
- Government and Private Agencies
- Researchers and Academia
- Traffic Safety Professionals
- Software Developers
- Consulting Firms
- Environmentalists
- Emergency Services
- Community Advocates
- Developers and Businesses
- Transportation Policy Makers
- Students in Transportation Engineering and Planning

7. Body of Knowledge & Professionals Trained

- *Type of activity: Webinar*
- *Title: Utilization of Connectivity and Automation in Support of Transportation Agencies' Decision Making*
- *Date: October 18, 2022*
- *Name(s) and affiliation(s) of the presenter(s): Mohammed Hadi, Ph.D., Florida International University; Michael Hunter, Ph.D., Georgia Tech; Shoaib Samandar, Ph.D., North Carolina State University*
- *Location and organization/event where training took place: Virtually (Zoom)*
- *Total number of professionals trained: 81 (43 webinar attendees, 38 YouTube views)*

8. Journal Publications, Conference Presentations, & Posters

1. Shoaib Samandar, Tanmay Das, Nagui Rouphail, Billy Williams, Eleni Bardaka (2021). CAV Dedicated Lane: Mobility Implications of Access Control in A Mixed Traffic Environment. 100th Annual Meeting of the Transportation Research Board (TRBAM 2021).
2. Mohammed Hadi, Kamar Amine, Thodsapon Hunsanon, Mahmoud Arafat (2021). A Red-Light Violation Warning System in a Connected Vehicle Simulation Environment. 100th Annual Meeting of the Transportation Research Board (TRBAM 2021).
3. Mahmoud Arafat, Mohammed Hadi, Thodsapon Hunsanon, Kamar Amine (2021). Stop Sign Gap Assist Application in a Connected Vehicle Simulation Environment. 100th Annual Meeting of the Transportation Research Board (TRBAM 2021).

4. Mahmoud Arafat, Thodsapon Hunsanon, Kamar Amine (2021). Intersection Safety Applications in a Connected Vehicle Simulation Environment. Invited Presentation at PTV Talk Student Edition.
5. Mohammed Hadi (2021). Florida International University Research and Creative Activities Faculty Award.
6. Mohammed Hadi (2021). Florida International University College of Engineering Mentorship Faculty Award.

9. Stakeholder Engagement

MEETING DETAILS		**NARRATIVE DESCRIPTION** *(What was discussed regarding the direction of the project? Specific benefits of the project that were identified. Barriers/challenges discussed. Plans discussed for adoption/implementation. Opportunities identified for ongoing research or product development)*
STRIDE person at the meeting	*Dr. Mohammed Hadi, FIU*	*The research team conducted a stakeholder-focused workshop with the participation of representatives from several state DOTs and FHWA representatives who have agreed to participate in a videoconference and provide feedback. Valuable information for the research was collected in the workshop.*
Date of Activity	*11/05/2020*	
Type of Activity	*Stakeholder Focus Group*	
Location	*Virtual*	
Stakeholder(s) – Name, title, affiliation	*Frank Corrado, FHWA, Frank.Corrado@dot.gov; Greg Morris, FHWA, greg.morris@fhwa.dot.gov; Phillip Freeze@tn.gov, TNDOT, Phillip.b.freeze@tn.gov; James Sullivan, MDOT, jssullivan@mdot.ms.gov; Raj Ponnaluri, FDOT, Raj.Ponnaluri@dot.state.fl.us; Rob Perry, SCDOT, perryRE@scdot.org; Andrew Heath, GDOT, aheath@dot.ga.gov;*	
STRIDE person at the meeting		

Date of Activity		
Type of Activity	Choose an item.	
Location		
Stakeholder(s) – Name, title, affiliation		
STRIDE person at the meeting		
Date of Activity		
Type of Activity	Choose an item.	
Location		
Stakeholder(s) – Name, title, affiliation		
STRIDE person at the meeting		
Date of Activity		
Type of Activity	Choose an item.	
Location		
Stakeholder(s) – Name, title, affiliation		

10. Adoption/Implementation

Adoption/Implementation:
The CAV Simulation Guidance has been adopted and implemented by state, regional, and local agencies. This product focuses on simulation models and methods to assess the implications of Connected Vehicles (CV), Automated Vehicles (AV), and Connected and Automated Vehicles (CAV) in the traffic stream. It provides a framework and guidelines for the use of analysis, simulation, and modeling to evaluate the impacts of CAV technologies and associated applications.

Users and Usage:
State, regional, and local transportation agencies are the primary adopters/implementers of the CAV Simulation Guidance. The product supports decisions about integrating advanced technology vehicles into the transportation system. Agencies utilize the simulation models to assess the impacts of high-priority CAV applications and make informed decisions regarding their deployment.

Potential Adoption and Stakeholder Benefits:
For agencies that have not yet adopted the CAV Simulation Guidance, implementation would incorporate the provided framework and guidelines into their decision-making processes. Stakeholders, including transportation planners and engineers, would benefit from improved understanding and evaluation of the traffic implications of CAV technologies. The product enables agencies to anticipate and plan for the impacts of emerging vehicle technologies and applications.

Additional Adoption Efforts:
To encourage adoption, efforts may include conducting demonstration/pilot projects showcasing the successful application of the CAV Simulation Guidance. Agencies could also consider adopting guidelines and changes in existing processes to institutionalize the use of simulation models for assessing CAV impacts. Commercialization efforts, such as training programs or workshops, could be initiated to familiarize transportation professionals with the product and its benefits, fostering wider acceptance and use in the industry.

11. Broader Impacts

Positive Impact on Transportation:
The CAV Simulation Guidance significantly enhances the transportation system by improving safety and reliability. Through advanced simulation and mitigation strategies, it addresses potential safety issues related to Connected and Automated Vehicles (CAV), ensuring a safer integration of these technologies. The data-driven decision-making facilitated by the guidance also contributes to increased reliability and durability, minimizing unforeseen issues and optimizing traffic flow.

Short and Long-Term Impact:
Adopting the CAV Simulation Guidance in the short term leads to immediate improvements in traffic flow and safety as agencies implement informed decisions regarding CAV technologies. Over the long term, this guidance establishes a more resilient transportation system. Continuous refinement of approaches based on simulation results ensures adaptability to evolving technologies and contributes to sustained optimization of traffic management.

Impact on Practices, Behaviors, and Commercialization:
Implementing the CAV Simulation Guidance is poised to influence new practices and behaviors in transportation planning and engineering. As agencies adapt to accommodate emerging CAV technologies, the guidance fosters the potential growth of start-ups specializing in simulation services tailored to CAV applications. Furthermore, it facilitates the transfer of standardized practices and results to government and industry, encouraging collaboration and widespread application of simulation insights to advance best practices in the field.