Request for Research Funding for FY 2022-2023			
SPR Subpart B Project: FTE-23-01			
Requesting Office	Turnpike Enterprise	**Priority**	1 of 1 (for FTE SunTrax program)
Proposed Title	Test Use Case Design for Cooperative Driving Automation at SunTrax		
Justification	Cooperative Driving Automation (CDA) technology holds the promise of improving traffic safety and mobility. At present, 7.2% of vehicles maufactured worldwide are featured with CDA functions (e.g., adaptive cruise control) and the CDA market penetration grows at an annual rate of around 20%. It is expected that CDA technologies can largely improve safety (e.g., reducing 80% of non-impaired collisions) and mobility (e.g., doubling capacity with platooning). To achieve these goals, numerous federal (e.g., the CARMA program) and state-level project efforts (e.g., I-4 Frame, Tampa CV pilot) have been initiated. With such booming developments, CDA technologies are relatively new, and their benefits, costs, and impacts are yet to be tested and evaluated before being widely deployed. Florida's SunTrax test facility, operated by Florida's Turnpike Enterprse, provides unique platforms for testing new CDA technologies before introducing them to the market. On top of the cutting-edge hardware facilities, it is an ideal time to formulate the design of test use cases for conducting these relevant CDA tests prior to active projects being undertaken by FDOT as an agency and further private sector collaboration. Designing a use case may include configuration, infrastructure maps, test routes, data needs, vehicle controls, roadside units, other accessories (e.g., sensors signs), test protocols, and associated performance measures on safety, mobility, etc. Since SunTrax includes the hardware facilities (ranging from the high-speed oval track through signalized urban streets), it is valuable for the Department to design associated use case scenarios to advise potential users on how to configure their tests, and use SunTrax as the platform to develop these test use cases. With such options of pre-specified use case scenarios, the future users of the SunTrax facility may not need to devise them from the scratch, which means tremendous cost and time savings for all involved. This would also assist in attracting major users to Florida and to SunTrax (e.g., from governments, automakers, OEMs, transportation stakeholders) to utilize this facility. Further, the standard use case design would enable the Department and SunTrax program managers to collect associate performance measures. These measures will be critical to evaluate and articulate the potential benefits and impacts of ongoing and future CDA infrastructure investments across various application scenarios. Also, use case scenario design is benefiting to on-going collaboration between Florida universities and FDOT on CDA technology developments and evaluations. The research fundings of Florida universities on CDA from federal and state sources are in an increasing trend these years. These test scenarios will be able to channel university resources (e.g., the L3 CARMA CAVs housed at USF and the one-tenth CARMA vehicles and associate simulation tools at FIU) to support the relevant test needs from the Department via demonstrations and pilot tests. Note that integrating these resources would largely expand the scope of use cases that SunTrax can support. For example, the USF CAVs may be integrated with roadside units and other facilities to test components and software of potential users (in fact, the USDOT CARMA team has been collaborating with USF on associated SunTrax tests). FIU simulation tools may be used to explore vehicle-in-the-loop tests or system-level tests to scale up the tests of individual facilities to a whole transportation system. To capture these opportunities, the objective of this project is to design a set of CDA use case scenarios. At initiation of the project, communication will start with the SunTrax management team and FDOT stakeholders about the potential use cases of most interest to develop. Afterwards, these scenarios will be detailed and documented, with options for users to customize each. Finally, one or two use cases will be selected for demonstratation with our lab vehicles in conjunction with simulation tools (e.g., for hardware in the loop testing use cases). *The proposers include the director and faculty members of the National University Center housed at the University of South Florida, National Institute for Congestion Reduction (NICR). There is an expectation to have projects from NICR on connected-automated vehicles, multimodal transportation, planning & policies to match this proposed research.*		
Impact	This project will provide guidance for proper CDA field experiments to implement CDA operational strategies and to collect CDA data. New and enhanced CDA operational strategies will be developed to improve the safety, mobility, and energy efficiency of traffic systems.		

	If not investigated, existing and future CDA systems may have safety, mobility, and energy efficiency challenges in implementing operational strategies without proper CDA data support.		
Affected Offices	Florida's Turnpike Enterprise, Transportation Development and Transportation Operations; Traffic Engineering & Operations Office; Roadway Design Office		
Existing Work	Mahmassani HS, Elfar A, Shladover SE, Huang Z (2018) Development of an Analysis/Modeling/Simulation (AMS) Framework for V2I and Connected/Automated Vehicle Environment. United States. Department of Transportation. Intelligent Transportation Shi, X., & Li, X. (2021). Empirical study on car-following characteristics of commercial automated vehicles with different headway settings. Transportation Research Part C: Emerging Technologies, 128, 103134. Shi, X. & Li, X. (2021). Constructing fundamental diagram for traffic flow with automated vehicles: methodology and demonstration. Transportation Research Part B, 150, 219-292. Wang, Z., Zhao, X., Xu, Z., Li, X., Qu, X. (2021). Modeling and field experiments on lane changing of an autonomous vehicle in mixed traffic. Computer-Aided Civil and Infrastructure Engineering, 36(7), 877-889. Yao, H., Li, Q., Li., X. (2020). A study of relationships in traffic oscillation features based on field experiments. Transportation Research Part A, 141, 339-355.		
Keywords Used In Existing Work Search **(Cannot leave blank)**	Cooperative Driving Automation; Field Tests; Operational Strategies.		
Related Contracts (Give contract numbers)	N/A		
Funding Request	Estimated cost: $200,000	**Anticipated Duration**	18 months
Project Manager	John Easterling, P.E., PTOE	**Contracting Method**	RFP to universities only or RFP to all registered vendors
Equipment	Estimated equipment cost (or N/A) N/A	Comments* (understanding leases are preferred, include the proposed use of the equipment, whether lease options are feasible, whether work to be done with equipment could instead be procured through service expenditure, etc.)	
Urgency	Score 1-5 1= highest, most immediate need	Florida Department of Transportation is in need to develop the ideal test use scenarios in order to have framework for evaluation parameters for other CDA projects throughout the state. This research project work will enhance the likelihood as a prime facility for the private sector of SunTrax for this type of OEM or agency research moving forward.	
Implementability	Score 1-5 1=greatest likelihood of and proximity to implementing results	SunTrax will serve as an excellent location to further this research associated with CDA technologies and those research projects can potentially then lead to real highway environments located on managed freeway facilities within the Central Florida region nearby.	

Project Benefits (Succinct, complete explanation)

- Produce new CDA data for both freeway and urban arterial scenarios.
- Improve safety, mobility, and energy efficiency with enhanced CDA operational strategies.
- Establish the Florida's leadership in CDA technologies

Project Benefits **(Select all that apply and explain)**	**Quantifiable Benefits (units, dollars, etc…if applicable)**	**Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits**
o Materials Enhancement	N/A	
o Materials Savings	N/A	
o Time Savings	Reduce congestion due to better control of CDA vehicles (e.g., reduced headway).	Data: Vehicle and Roadside Unit (RSU) sensing data Method: Test CDA vehicles in real-world roadway environment
o Lives Saved/Injuries Prevented	Reduction of safety risks of CDA driving	Data: Vehicle and RSU sensing data Method: Test CDA vehicles in real-world roadway environment
o Other (Explain)	Improve Florida's preparedness for and leadership in emerging CAVs and smart cities infrastructure	Data: Infrastructure design guidelines Method: Evaluation by stakeholders and experts