UTC Project Information – **Center for Transportation, Environment, and Community Health**	
Project Title	Vehicle-based Sensing for Energy and Emission Reduction
University	University of South Florida
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Funding Sources and Amount Provided (by each agency or organization)	USDOT: $100,000 USF: $50,000
Total Project Cost	$150,000
Agency ID or Contract Number	Sponsor Source: Federal Government CFDA #: 20.701 Agreement ID: 69A3551747119
Start and End Dates	04/01/2020 – 09/30/2021
Brief Description of Research Project	Vehicle technologies have undergone drastic improvements in recent years, in particular sensing technologies that report a variety of vehicle and environmental conditions and control technologies that automate vehicle driving. For example, many existing production vehicles are furnished with sensors that can record vehicles' operational states, including speed, fuel consumption, steering angle, and each individual tire speed. Further, recently emerging automated vehicles (AV) may be able to provide advanced information about the surrounding information with video cameras, radar sensors, lidar sensors, etc. On the other hand, connected vehicle (CV) technology that enables communications between vehicles and road side infrastructure provides the communication platform to integrate sensor information from multiple vehicles or even a traffic stream. Such information will enable estimating and predicting transportation system states on mobility, energy, and emissions. Further, it will help better control AVs to smooth traffic and reduce system energy consumption and emissions, thereby improving environment and community health. This project set up a framework for utilizing vehicle-based sensing information to assist AV driving and traffic control, aiming to bring in mobility and environmental benefits. The following tasks were performed to complete this objective. Task 1: Literature review. Reviewed relevant literature on types of vehicle-based sensors in traffic control. This task focused the research with real-world data collection and experiments, rather than simulation-based studies. The goal was to report the available sensor types and relevant traffic control

	applications. Task 2: Vehicle sensor data collection proof-of-concept test. This task used the AV and CV facilities at USF to test the feasibility of extracting and sharing sensor data relevant to mobility, environment, and safety with the lab vehicles. Summaries of the data types and relevant characteristics (e.g., accuracy, update frequency, and range) of both diagnosis sensors for the target vehicle information, but also AV sensors for surrounding environment information were completed. Plans for how to utilize such information on AV control and traffic control were investigated. Task 3: Case study. Based on the information and findings from the previous tasks, a case study was performed to illustrate the utilization of the vehicle-based sensing data in vehicle and traffic control for improved benefit in environment and/or safety. The case study focused on the traffic flow on a multi-lane highway segment and investigated how it might be controlled (e.g., in terms of speed and platoon) with consideration of the relationship among vehicle operating features and pavement condition (e.g., smoothness and friction), fuel consumption, emission, and safety.
Describe Implementation of Research Outcomes (or why not implemented) *Place Any Photos Here*	In this study, a physical informed neural network was developed to perform an accurate tire-road friction estimation by utilizing those advanced vehicle sensors. A runway friction tester was employed as the ground truth. More than 15,000 GPS data points and other vehicle dynamic data points were collected during the field experiment, as a result, short convergence time and desired prediction accuracy were achieved by introducing the magic tire model and the slip-slop factor into the loss function.
Impacts/Benefits of Implementation (actual, not anticipated)	The performance of the active/passive vehicle stability control system was significantly improved. The operation of the vehicles is more robust.
Web Links • *Reports* • *Project website*	http://ctech.cee.cornell.edu/final-project-reports