Center for Advanced Multimodal Mobility Solutions and Education

UTC Project Information – CAMMSE @ UNC Charlotte	
Project Title	Machine Learning-based Trajectory Optimization of Connected and Autonomous Vehicles (CAVs)
University	The University of North Carolina at Charlotte
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Funding Sources and Amount Provided (by each agency or organization)	U.S. Department of Transportation: $60,000 The University of North Carolina at Charlotte: $30,007
Total Project Cost	$90,007
Agency ID or Contract Number	
Start and End Dates	10/01/2019 – 09/30/2021
Brief Description of Research Project	Connected and autonomous vehicle (CAV) technologies provide solutions to the existing problems of the transportation systems. As widely known, CAVs can communicate with each other so that they can have coordinated accelerating or decelerating movements. In this manner, CAVs only need a smaller headway which will lead to a higher roadway capacity. For signalized intersections, CAVs can communicate with the signal lights to adjust their speeds when approaching the intersection, so that they can arrive at the intersection during green time periods. CAVs bring with them many benefits including improving safety, reducing emissions and increasing mobility of the transportation system.

	In past decades, numerous research efforts have been made to focus on modeling longitudinal driver behaviors of traditional vehicles. Most microscopic models assume that human drivers react to the stimuli from leading vehicles to keep a safe headway with a desired velocity. In recent years, with the emerging of CAVs, new car following models have been introduced to accommodate the longitudinal driving behavior of CAVs. Efforts are needed to calibrate these car following models, and the results are highly related to the data availability, calibration method, and model structure. Despite different mechanisms and software interfaces, when multiple simulation software applications are compared, it seems that errors cannot be eliminated no matter how many parameters are introduced. On the other hand, machine learning has achieved much success in recent years. It allows the agent to keep learning from observations, actions conducted, and rewards received. When presented with a sequence of states and corresponding actions, extracted from the trajectory data, the algorithm can learn how the vehicles act when being faced with varying traffic conditions. The algorithm learns by associating any state observation, such as reaction time, speed, headway, and acceleration rate. The degree by which the agent action matches the vehicle's action constitutes a reward in the learning sequence. In order to be better predict the upcoming states of CAVs under varying traffic conditions, there is a critical need to model the car

	following trajectory data using machine learning approach. This research will develop guidelines and recommendations for calibrating CAV car following model using trajectory data, and therefore will leading to a better understanding of how CAVs operate in the freeway system.
Describe Implementation of Research Outcomes (or why not implemented) *Place Any Photos Here*	
Impacts/Benefits of Implementation (actual, not anticipated)	
Web Links • *Reports* • *Project website*	https://cammse.uncc.edu/sites/cammse.uncc.edu/files/media/CAMMSE-UNCC-2020-UTC-Project-Information-04-Fan.pdf https://cammse.uncc.edu/sites/cammse.uncc.edu/files/media/CAMMSE-UNCC-2020-UTC-Project-Report-04-Fan-Final.pdf