CENTER FOR CONNECTED AND AUTOMATED TRANSPORTATION

UTC Project Information	
Project Title	**Cooperative control mechanism for platoon formation of connected and autonomous vehicles Phase 1 + 2**
University	Purdue University
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Funding Source(s) and Amounts Provided (by each agency or organization)	$75,805 (USDOT) and $80,000 (Chongqing University of Posts andTelecommunications, China – Cost Share) - Phase 1 $60,000 (Chongqing University Posts and Telecommunications, China)and $61,156 (CCAT) - Phase 2
Total Project Cost	$276,961
Agency ID or Contract Number	69A3551747105
Start and End Dates	8/1/2017-4/14/2021
Brief Abstract of Research Project	Connected and autonomous vehicles (CAVs) have the potential to significantly improve traffic safety and mobility through platoon formation whereby vehicles follow one another closely. Such platoons can also reduce energy consumption of individual CAVs by reducing air drag. While control mechanisms have been previously proposed to control vehicles in a platoon, for example, through adaptive cruise control, they mainly focus on seeking a better situation for an individual vehicle by controlling its driving behavior. This study focuses on CAV-based control mechanisms to holistically determine the acceleration/deceleration rate of each CAV in a platoon to maximize platoon performance. It designs a cooperative control mechanism for a CAV platoon under realistic vehicle-to-vehicle (V2V) communication environments. Thereby, CAVs can leverage information from other CAVs through V2V communication to collaborate under a joint objective such as systematically optimizing platoon performance while incorporating consensus (for example, to maintain certain inter-vehicle time headway). The impact of information delay and topology of information that is exchanged among vehicles on platoon dynamics will be analyzed. The optimal time headway and platoon size to maximize fuel efficiency of the CAVs in the platoon will be determined.
Most Relevant CCAT Research Thrusts	____ Enabling Technology ____ Planning and Policy ____ Human Factors _____ Infrastructure Design and Management __x___ Control and Operations _____ Models and Implementation

Describe Implementation of Research Outcomes (or why not implemented)	This project investigated the cooperative control mechanism for CAV platoon factoring communication and computational issues, from the following aspects: • Developed a novel CACC strategy, which explicitly factors IFT dynamics and leverages it to enhance the platoon performance in an unreliable V2V communication context for a pure CAV platoon. • Introduced the CACC-SOIFT framework for CAV platoons in the dynamic IFT environment, which arises from V2V communication failures. • Proposed two deployable strategies, i.e., the DMPC approach and the DMPC-FOA approach, to address the control delay issue of the idealized MPC strategy for CAV platooning.
Impacts/Benefits of Implementation (actual, not anticipated)	To the best of our knowledge, the CACC control strategies factoring IFT dynamics are the first attempt in the domain. Further, it is the first study to perform rigorous mathematical modeling of the problem to theoretically illustrate properties. This project demonstrates how to leverage IFT dynamics to proactively reduce V2V communication failures while ensuring realism in terms of factoring the ambient traffic conditions. Insights from this project bring significant impacts in transferring theoretical CACC control strategies into practices.
Web Links • Reports • Project website	ccat.umtri.umich.edu