CENTER FOR CONNECTED AND AUTOMATED TRANSPORTATION

UTC Project Information	
Project Title	**Development of dynamic network traffic simulator for mixed traffic flowunder 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)	Phase 1: $76,735 (USDOT) and $76,735 (Purdue – Cost Share) Phase 2: $43,859 (Purdue) and $65,215 (CCAT)
Total Project Cost	$262,544
Agency ID or Contract Number	69A3551747105
Start and End Dates	8/1/2017-4/14/2021
Brief Abstract of Research Project	**Phase 1:** The advent of connected and autonomous vehicles (CAVs) will generate changes that have the potential to enhance network capacity, reduce congestion, and increase safety. While several studies have examined the potential impact of CAVs on the driving environment, there is the key need for modeling approaches that can characterize network level evolution of traffic flow dynamics and the impacts on stability under mixed traffic streams of human-driven vehicles and CAVs. There is the need for a comprehensive traffic flow modeling framework that incorporates different levels of connectivity and automation as well as different market penetration rates. This study will develop a unified car-following modeling framework that models mixed traffic streams under different market penetration rates of CAVs. It will also perform stability analyses to explore implications for safety and mobility. **Phase 2:** Connected and autonomous vehicles (CAVs) will generate a revolution in the transportation system, with great potential to improve traffic safety, efficiency, and environmental sustainability. However, the transition to CAVs will occur over time and, during it, CAVs will coexist with human-driven vehicles (HDVs), connected vehicles (CVs) and autonomous vehicles (AVs) in the traffic flow. While several studies have examined the potential impact of AVs, CVs and CAVs on the driving environment, there is a key need for modeling approaches that can characterize network level evolution of traffic flow dynamics and their impacts on stability under mixed traffic streams. There is the need for a comprehensive traffic flow modeling framework that incorporates different levels of connectivity and automation as well as different market penetration rates. This study will develop a unified traffic flow modeling framework that models mixed traffic streams under different market penetration rates of AVs, CVs and

	CAVs. It will also perform stability analyses to explore implications for safety and mobility.
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)	There is a key need for modeling approaches that can characterize the network-level evolution of information flow propagation and traffic flow dynamics and their impacts on stability under mixed traffic streams. To fill this gap, this project: • Developed a queuing strategy for equipped vehicles to propagate the received information packets, enabling control for multiclass information propagation. • Proposed a variational inequality-based multiclass traffic assignment model in which CAV users choose routes based on the UE principle and HDV users based on the cross nested-logit (CNL) model, to replicate realistic mixed-traffic networks.
Impacts/Benefits of Implementation (actual, not anticipated)	• Findings of the multiclass information propagation model provide valuable insights for controlling the propagation of multiclass information to practically achieve desired operational performance in a V2V-based traffic system. That is, they provide useful tools to a traffic control center to target different information-based solutions for different traffic-related problems that regularly arise in urban areas. • The dedicated multiclass traffic assignment model contributes to more realistically characterize mixed traffic flows of CAVs and HDVs, and therefore supports effective transportation planning in the emerging future.
Web Links • Reports • Project website	ccat.umtri.umich.edu