ABSTRACT

Traffic safety and congestion are global concerns. Autonomous vehicles (AVs) are expected to enhance transportation safety and reduce congestion. However, achieving their full potential requires 100% market penetration, a challenging task. This study addresses key issues in mixed traffic environments, where human-driven vehicles (HDVs) and connected autonomous vehicles (CAVs) coexist. A number of critical questions persist: 1) inadequate exploration of human errors (errors originating from non-CAV sources) in mixed traffic; 2): limited focus on information selection and learning efficiency in network-level rerouting, particularly in highly dynamic environments; 3) inadequacy of personalized elements driver-inputs in motion planning frameworks; 4) absence of effective data sharing mechanisms across different locations; 5) lack of consideration of user privacy concerns.

With the goal of advancing the existing knowledge in this field and shedding light on these matters, this dissertation introduces multiple frameworks. These frameworks leverage connectivity and automation to improve safety and mobility in mixed traffic, addressing various research levels, including local-level and network-level safety enhancement, as well as network-level and global-level mobility enhancement. With optimization- and learning-based methods implemented (Model Predictive Control, Deep Neural Network, Deep Reinforcement Learning, Transformer model and Federated Learning), frameworks introduced in this dissertation are expected to help highway agencies and vehicle manufactures to improve the safety and efficiency of traffic flow in the mixed traffic era. Our research findings revealed increased crash avoidance rates in critical situations, enhanced accuracy in predicting lane changes, improved dynamic rerouting within urban areas, and the implementation of effective data sharing mechanisms with a focus on user privacy. This research underscores the potential of connectivity and automation to significantly enhance mixed traffic safety and mobility.

Defense Information:

Two identical sessions

Session1:

Date: November 15th (Wednesday)

Time: 2:00 pm to 4:00 pm (Eastern Time)

Room: Hamp G212

Meeting link:

https://purdue-edu.zoom.us/j/91899448544?pwd=SjVoUWpTbFhQMmo4cmVyUi9qVmNyUT09

Session2:

Date: November 16th (Thursday)

Time: 2:00 pm to 4:00 pm (Eastern Time)

Room: Hamp 4144

Meeting link:

https://purdue-edu.zoom.us/j/98696403689?pwd=ZTNrQVpvY0xjU1o0WTBacjVrb2dpZz09