

# Abstract

Connected autonomous driving has piqued the curiosity of the research community over recent years due to its potential to provide driving assistance and reduce traffic congestion, among other benefits. Despite promising advancements, safe lane-changing remains a significant challenge for connected autonomous vehicles (CAVs), particularly in mixed and dynamic traffic conditions. Investigation of the state-of-the-art papers on motion planning for CAVs suggests a gap in research for safety supervisor techniques for lane changing algorithms in CAVs.

This paper uses multi-agent reinforcement learning (MARL) to model lane-changing in connected autonomous vehicles in mixed traffic scenarios, i.e., with human-driven vehicles (HDVs) on the road. Parameter sharing and replay buffer are employed to motivate cooperative behaviour and collaboration among CAVs. An OpenAI gym-like environment highway-env is developed and modified to simulate the lane changing in CAVs. In addition, various state-of-the-art safety supervisor techniques for reinforcement learning (RL) approaches are analysed, and their applicability to designing safer MARL for lane changing of connected autonomous vehicles (MARL-CAV) is examined. Comprehensive analysis and experimental results show that integrating some promising safety supervisors to MARL for lane changing in CAVs is challenging, and none of the existing safety supervisor techniques can be directly applied to MARL-CAV as these safety techniques require prior knowledge of unsafe states and recovery policies.