Abstract

Recent improvements in autonomous driving have the potential to revolutionise transportation systems by improving traffic safety and efficiency and reducing traffic congestion. However, even with the current advancements, the seamless integration of Connected Autonomous Vehicles (CAVs) into complex mixed traffic scenarios like highway on-ramp merging still remains a substantial challenge.

Existing approaches to highway on-ramp merging are predominantly focused on single-lane highway on-ramp merging scenarios and often overlook the scenarios where multi-lane on-ramps exist, leaving the behaviour of the CAVs highly unknown in such scenarios. So, to address this crucial gap, this dissertation explores the scalability of existing Multi-Agent Reinforcement Learning (MARL) frameworks to a multi-lane highway on-ramp merging scenario of CAVs in mixed traffic. This dissertation extends the “highway-env” merge simulation environment to include an additional lane on the on-ramp and tests the scalability of the MAPPO, MADQN, and MAACKTR algorithms.

The results show that the MAPPO algorithm is highly efficient and scalable to the modified (multi-lane on-ramp) environment. In contrast, MAACKTR and MADQN algorithms show inconsistent performance and are not scalable to the multi-lane on-ramp environment.