Keystone Abstracts
Tyrone Hou

Non-technical Abstract

The incorporation of artificial intelligence into vehicles has the potential to significantly reduce collisions and travel times and increase vehicle fuel efficiency. For example, self-driving cars have already been introduced to urban centers around the world, including Boston, Singapore, and Arizona. However, the technology is far from full adoption, and in the meantime, artificial intelligence can be employed to improve existing traffic infrastructure and create a better traffic experience for pedestrians and drivers alike. The traffic experience is shaped by global traffic patterns, the complex interactions of thousands of people moving around the city over the course of a day. Traffic lights with fixed signal times, by definition, do not account for these hourly fluctuations. In contrast, adaptive lights have the potential to harness the data produced at intersections from detection sources such as traffic cameras and underground induction loops. We investigate the use of machine learning techniques that take in real-time traffic data in order to control traffic light operations at single and multiple connected intersections.

Technical Abstract

Fixed traffic controllers are unable to adapt to fluctuations in traffic patterns throughout the course of a day. Adaptive traffic controllers based on deep learning methods have been shown to effectively reduce simulated traffic congestion in comparison to these fixed controllers. In this work, we test the ability of deep reinforcement learning to process and learn from vehicular traffic on single-lane, no turn intersections. We also explore traffic signal coordination in a multiagent scenario. We implement a convolutional neural network to learn an optimal traffic control policy from real time vehicle information. To improve the stability of our training, we use experience replay and a target network. Results show that our deep neural network controller is able to reduce vehicle delay from a fixed traffic control policy over simulated traffic at a single intersection. For the multi-intersection case we also consider communication between neighboring traffic signals. Our experiments show that our controller reduces delay by approximately 18% and 15% when traffic phase and queue length are passed between intersections respectively, while our naïve controller increases delay by 8%. This seems to suggest that traffic signal coordination provides benefits that would not be obtainable through naïve multi-agent deep reinforcement learning traffic control.