TECHNISCHE UNIVERSITÄT DRESDEN

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Proposal for Diploma-/Masterthesis

(Multi-Agent) Reinforcement Learning for Joint Control of Vehicles and Traffic Infrastructure

With emerging Vehicle-to-Infrastructure (V2I) communication technologies, such as IEEE 802.11p or 5G, arises the opportunity for intelligent traffic systems that quickly adapt to the current system state. On the one hand, traffic signaling can be tailored to individual vehicles. On the other hand, individual vehicles may adapt driving velocities and driving routes according to the current traffic signaling. These measures could improve traffic flow and therefore mitigate environmental and economic repercussions of traffic systems. However, the optimization of large distributed systems under the availability of intricate knowledge about the system state is not trivial and novel control paradigms need to be explored. In recent years, Deep Reinforcement Learning (DRL) has been successfully applied to the control of traffic signaling in large road networks. Many car manufacturers experiment with speed advice given through the vehicles' cockpits that enables drivers to perfectly catch so-called green waves. In addition, some cities implement adaptive street signs to suggest appropriate velocities. However, velocity advice is usually selected considering a given traffic signaling. Additional efficiency gains could be obtained by jointly optimizing velocities and signaling. In this Diploma-/Masterthesis, the joint optimization of traffic signaling from the infrastructure side and velocity control (and potentially also route selection) with (Multi-Agent) DRL shall be explored.
Subtasks include:

- A literature review of the current state of the art of intelligent traffic control with DRL and of the adaption of vehicle velocity to the traffic signaling.
- Development of a framework for the joint optimization of traffic signaling and vehicle velocity (optional: selection of vehicle routes). Here it is advised to model the traffic system as a Multi-Agent problem with two different types of agents.
- The optimization of the developed simulation with an appropriate Multi-Agent DRL algorithm. The proposed solution should be scalable to large infrastructures.
- An extensive experimental review of the benefits of the developed intelligent V2I-enabled traffic control system. In particular it should be compared to the state of the art of traffic signal control with DRL and without it. Different road layouts and traffic volumes should be studied.

Due to the overhead of learning about (Multi-Agent) DRL, this project is more suited for a Diploma-/Masterthesis. However, with sufficient prior knowledge on the topic, it is also possible to use it as a Student-/Bachelorthesis

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