Multicriterial traffic light control focused on optimization goals efficiency, emissions and cyclist safety

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a SUMO simulation study

Abstract for a technical presentation

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The multicriterial traffic light control (MTLC) is a rule-based control and offers measures focused on three different optimization goals: Efficiency, emissions and cyclist safety. The different measures can be scaled or switched on and off depending on the current traffic conditions or the optimization goals a city administration pursues at a specific period of time.

Connected and autonomous vehicles (CAVs) do not only provide live data such as position and speed, but they can also be influenced via V2X messages. In this manner, the MTLC can influence the CAVs directly, similarly to dynamic road signs, changing parameters like maximum speed and maximum acceleration for a specific area or a specific traffic situation. Cyclists are similarly connected via mobile devices or can be detected by the MTLC with different sensors. Thus, information about cyclists is also available to the MTLC.

Several measures are chosen and analyzed in regards to their influence on the optimization goals of the MTLC. The key performance indicators (KPIs) for the optimization goals are overall emissions and energy usage for the emissions category, overall delay at the junction for traffic efficiency and the post encroachment times of the cyclists for cyclist safety. These measures include changing the vehicles' allowed speed and maximum acceleration in certain areas of the intersection as well as junction control specific measures like preponing green times for cyclists. Once the impact of the measure on the KPIs is analyzed, the findings are used to balance the MTLC for optimal performance.

The measures are developed and tested in a sumo simulation. For this purpose, a real junction and its rule-based traffic light control are rebuilt in a SUMO simulation. The base for the development of the MTLC is this replicated real-world traffic light control which is then modified with the new control measures. The base and the modified traffic light control are used for performance comparison in the same traffic situations in SUMO.

Evaluation of the measures' impact in first simulations shows potential to improve the cyclist safety and reducing dangerous encounters. The next goal is to combine the measures and analyze the MTLC in different traffic scenarios and conditions.