Review of the diploma thesis of Vít Obrusník

Title: Simulating the impact of prioritization of emergency vehicles at traffic light controlled junctions on the other traffic

The presented diploma thesis deals with simulation of passing of an emergency vehicle through a signalized intersection. The simulated scenarios are of two types: without intersection controller action and with an active change in the signal plan – a pre-emption (or priority). The goal of the thesis was to simulate passing of emergency vehicle in different scenarios and assess the effect of the priority type on several measurable quantities: the travel time of the emergency vehicle, the travel time of the other vehicles and their waiting time at intersections.

The author selected the program SUMO as the main simulation tool. This program was supported by several other tools and add-ons to enable simulation of the scenarios. I think that the choice of the SW tools was right, and the thesis shows author's good understanding of the simulation environment.

To make the simulation trustworthy, the author based the simulation setting on real data. The data was obtained from induction detectors. As it is often the case in practice, the data was not complete and not all useful measured quantities were provided. However, the author successfully coped with this problem and the comparison of simulated and real data presented in the thesis shows a good match.

The thesis describes two ways of giving a priority to the emergency vehicle: the standard and widely used virtual boundary and a newly proposed queue-discharge based algorithm. In the latter the author even improved an approach presented in a recent publication. In addition, the new approach enables a more automatic and less-tedious deployment of priority algorithms at individual intersections.

The last chapter of the thesis presents an extensive comparison of the presented approaches for priority. As the simulations show, the proposed priority method has lower effect on the other vehicles than the virtual-boundary approach, while keeping the travel time of the emergency vehicle comparable. Quite logically, giving no priority at intersection results in the lowest travel time of other vehicles. All the results make sense and I believe that such a thorough simulation analysis might contribute to more frequent deployment of emergency vehicle priority by municipalities. I think that the simulation results are of interest of the traffic-control community.

The thesis is well written and organized. The level of the English language is very good. There are of course some typos and some imprecise statements, but they do not complicate reading and understanding. I only have a few remarks to the presenting of the theoretical results. In chapter 4 I did not like the way the author switches between simulated and theoretical findings, since this makes the derivation of the final formulas (4.14, 4.16) quite difficult to follow. In addition, I think that the two driver models in section 2.2 should be discussed in more details (their advantages, disadvantages).

The thesis shows that the author has the abilities which a good control engineer should have: understand the problem domain, process incomplete data, create a simulation model of the given problem, verify the proposed solution by such simulation and present the result in a written form.

I recommend the thesis for defense and I propose the grade A – excellent (95 points).

Questions:

1. The simulation results show only small difference between virtual boundary and queue-discharge model algorithms. Would the difference be more apparent when less conservative setting is used? For instance, to use better estimate of emergency vehicle speed (not 50 instead of 75), no 5 seconds rule when not necessary?
2. There are different types of emergency vehicles with different properties, mainly different approach speeds (from heavy trucks of fire brigade to light and fast police cars). Different vehicles might require different treatment. What would have to be changed in the presented priority algorithms to incorporate the differences among vehicles?

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