Local level routing to reduce travel times in urban networks

by

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Review by

Dr. Claudia Dieckmann

The thesis is written in a well structured and very good understandable way. The quality of the language is, apart form some typos, high. The structure of the thesis is well thought through, which makes it easy to read and understand.
After an introduction to the topics and scope of the thesis, the author reviews and categorizes in detail the state of the art of automated vehicle routing.In chapter 3 and 4, the optimal route problem and the edge cost estimation, respectively are discussed. These two topics are the basis for the understanding of the local level routing system which is proposed in chapter 5. Chapters 6 and 7 explain the simulation and results and sum up the work with conclusions, respectively.

Elaboration topics:

1. Review the state-of-the-art on automated vehicle routing. Try to find existing local level routing approaches.

   This was elaborated in detail, the author researched and summarized a large number of papers on that topic. The categorization can be found in Table 2.1. The investigation of the different route guiding systems is kept on a descriptive level. It would have also been nice to relate the different approaches of the systems and state their advantages/disadvantages in different settings.

2. Formulate the problem taking into account specifics of the MAVEN project (SPaT, lane dependent queues, platooning, etc.)

   The problem was formulated by taking lane dependent queues and platooning into account, however, I'm missing the link to the

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MAVEN project. I expected an explanation of what the MAVEN project is about and how the local level routing is used within the project.

3. Propose an algorithm for local level routing solving the problem as stated in the previous section.

   The local level routing algorithm was proposed and explained in a highly elaborate and very good understandable way. The description is split into well thought through subsections. The explanations of each of these subsections are easy to follow and are additionally equipped with helpful pictures and diagrams.

4. Evaluate the proposed algorithm using SUMO micro-simulator.

   In the evaluation of the local level routing algorithm very promising results are shown. In average, 93% of the LLR routed vehicles use a different route from the base scenario. In many cases the mean route duration of the vehicles that are rerouted by LLR is smaller than the mean route duration using HTT.

Overall evaluation:

In my opinion, the elaboration of the individual topics is too detailed in some places. It would have been more useful to focus on the systems and algorithms used in the developed local level routing system. Thus, the reader quickly loses track of which terms and algorithms are important for understanding the very core of the work. There are a couple uncertainties in terms of formal definitions, especially regarding graph theory, some of them are even wrong. Apart from that, I enjoyed very much reading this thesis. All the tasks were properly, clearly and extensively treated and answered. The reader gets a broad overview of route guidance and routing algorithms. In particular, the local level routing system developed by the author is self-explanatory and comprehensible, so that the reader can follow without any problems.

I recommend as overall mark for this thesis: A

Best regards,

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Questions to the author:

1. As far as I understood, the signal plans of the traffic lights are fixed and given beforehand. Assume the signal plans change due to the traffic, e.g. if a long queue of vehicles arises in front of a red light, the traffic light would change earlier to green and / or lengthens the phase of green light. How would that effect the LLR? The more or less same question arises, when stop-signs are added to the scenario.
2. The results of the simulation are very promising. Is there a possibility to confirm these results in a real life?

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Dear Ondrej,
on this page are some comments just for you and the commission.
I liked the thesis very much and I think it is very good. However there where some points which could be improved, so in my opinion it is not a 100% score. If it would have been possible, I would have graded it by A^-.
There is one fundamental error in the definition of the directed weighted graph. First I had the whole explanation in the review, but since the work is not mainly about graph theory, I deleted it from the review. However, I would like to share my thoughts about this with you, so that you may discuss it with the student:

The definition on page 15, is not the definition of a directed weighted graph G, but rather the one of a special path within G.
The definition of a directed, weighted graph is as follows:
$G = (V, E, c)$, where V is the set of vertices of size $|V| = n$, $E \subset V^2$ is a set of edges, where $(v, w) \in E$ for $v, w \in V$, if and only if there is an edge starting at v and ending at w. $c : E \mapsto L$ is a mapping from the set of edges to a set of weights.
The definition of the edge set E on page 15 is wrong. It only allows edges between vertices v_j and v_{j+1}, which means, that the graph can only have $n - 1$ edges. This implies, that no edge between other pairs of vertices, e.g. v_1 and v_3 is possible. This is inconsistent with the example graph shown in figure 3.1.
Also the indexing of the costs of the edges is mathematically wrong. In the way it it written, the costs are indexed by edges, not by numbers. Either write $C = \{c_1, \ldots, c_m\}$ where c_i is the cost of e_i, f.a. $i \in \{1, \ldots, m\}$ or use the mapping approach I stated earlier.

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