The opponent report

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Summery

As the world population grows, the need for better methods managing the flow of vehicles in traffic increases. In order to obtain a smoother movement on the road, bottlenecks such as traffic signals are desired to be optimized. GLOSA (Green Light Optimal Speed Advisory) is an intelligent transport systems technology which can guide road users more effectively through intersections. GLOSA presents speed advices to vehicles, whom of which are connected to GLOSA, based on surrounding and influencing parameters, such as infrastructure and other vehicles.

This thesis, made by Hossam Anany, presents traffic micro-simulations with three different traffic scenarios for investigation of the impact of GLOSA. The first scenario includes a traffic environment with only conventional vehicles, the second scenario covers a mixed environment of both conventional and automated vehicles and the third and last environment is comprised of only automated vehicles. The first scenario, i.e. the scenario including only the conventional vehicles, is represented by two separate cases; case A and case B. Case A tested the GLOSA impact with different degrees (0%, 25%, 50%, 75%, 100%) of penetration rates and case B tested the GLOSA impact with different degrees (0%, 25%, 50%, 75%, 100%) of compliance. The penetration rate reflects the quantity of all vehicles connected to GLOSA of which have adapted its speed to the GLOSA recommendation. GLOSA compliance, on the other hand, reflects how much a vehicle has adapted its speed with respect to the GLOSA advised speed. For the sake of simplicity, case A is set to have full compliance and case B is set to have full penetration. If a vehicle is automated, it adapts to the speed advice automatically with full compliance.

For the scenarios with automated vehicles, a large part of the study was also to investigate the effect of the distance to the vehicle in front, i.e. the time headway. The time headway, represented in seconds, in automated vehicles is regulated by and incorporated in the vehicle's software. In reality, for safety reasons, this distance is kept at a higher value than the approximate mean of a human driver in a conventional car. The effect of large a headway time is a lowered capacity on the road. The purpose of this inquiry has thus been to find out the effect of a shortened time headway for a possible implementation in future automated vehicles. In the simulations, automated vehicles were tested with time headways of 1.8, 1,3, 0,8 and 0.3 seconds. All scenarios that included conventional cars, on the other hand, was based on the approximate average of a human driver and set at 1.3 seconds.

To be able to determine the impact of GLOSA, three average values were collected for all scenarios and its subsections. The average values which were obtain was waiting time, trip delay and travel time. The waiting time reflects the time a vehicle spend standing involuntarily, the trip delay is the average time lost for a vehicle when driving at a slower speed than aspired and travel time is simply the time a vehicle spends on getting to its destination. To conclude the better simulation results, the sought-after averages were the values which had the lowest waiting time.

The retrieved results from the first scenario displays the difference between case A and B which respectively have different degrees of penetration rates and compliances. Case A shows the effect of penetration rate only becomes visible after 75%, and then merely with an 18% reduction in waiting time. In case B, the effect of compliance shows earlier signs of impact on the waiting time. Already at 50% compliance it is a reduction of 64% in waiting time. At 100% compliance and 100% penetration rate, the waiting time reduction is 66%

When comparing the second and third scenario, the conclusion was that there were no advantages of having automatic vehicles if there were no reduction in their time headways. The result showed that the smaller time headway, the better traffic situations. The overall best result from the simulations was retrieved from the third scenario in the case of 0.3 in time headway, having a 95% reduction in waiting time .

The simulations analysis in this thesis has also included the study of the effect of the communication range. The communication range is the distance between the vehicle and the intersection and reflects the distance of which the vehicle start broadcasting the speed recommendations from GLOSA. The results achieved from the tests are based on vehicles with both full penetration and compliance. The seek for communication range is the distance which leads to the least time spent standing involuntarily, i.e. having the lowest waiting time. The test exercised in this thesis for achieving the communication range gave the lowest waiting time at a distance of 250 meters.

Assessment

In general, I thought the report was good! For me, who is not very familiar with the subject, some stuff was a bit hard to grasp. But when I did read it through a couple of times some/most stuff fell into place.

- ## Abstract:

Reading the abstract, I do get a good idea of what the report contains. However, as words like, headway, waiting time and etc. are being used, and not yet explained, it is hard to wrap my head around essentials.

Very nicely organized with "List of tables" as well as having the "table of content".

- ## 1. Introduction:

Naming the need of this type of technology is good.

- ## 1.1 Background:

I think it is a bit unclear in this section if all automated vehicles are connected?

Good that you name what GLOSA can contribute with.

- ## 1.2 Problem Formulation:

"The need for more research arises since drivers are not obliged to comply and follow the speed recommendation received, conversely to fully compliance on the side of automated vehicles." Q: Here it is a bit unclear when you write "on the side of", but you do mean fully compliance for automated vehicles?

Q: You say "non-automated vehicles", you mean conventional vehicle or is it a different category?

- ## 1.3 Study objectives:

Straight forward on what is going to be investigated.

- **1.7 Outline**

The "Outline" is very presentable what will be included in the report.

- ## 2. Traffic signal control:

Good and explanatory about expressions which were mentioned later in the thesis.

Good that you mention current situation of traffic control in intersections.

- ## 3 Vehicle Connectivity and Automation

Facts about connectivity, why CV is good.

Nice to have Figure 1 showing the different types of automation vehicles. For me, who is not really familiar with the subject, would have liked to have that explained a bit earlier..
Also, as you speak about automated vehicles earlier than in this chapter, what kind of automation is spoken about? Even if this will be mentioned later, I would have liked to know earlier.

- ## 4 Green Light speed advisory GLOSA

How GLOSA work. Good with an explanatory picture.

Think it would be good to have all positive and negative effects of GLOSA collected in a table.

- ## 5 Traffic simulation

Good information about the three categorizations.

Q: Is SUMO a headline under traffic simulation?

Both 'network building' and 'Demand generation' are inputs in the SUMO BASE MODEL.
Q: What is 'Car following model'? One would expect this to be an input as well as it has the same numbering's.

There should be a numbering on: the driver imperfection, minimum gap, reaction time, time headway?

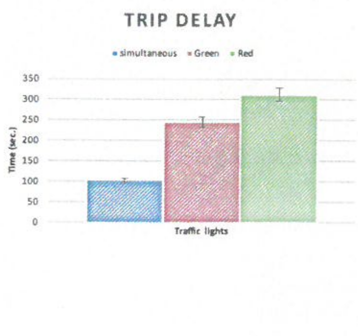
- ## 6 Description of the simulation Model

Nice description of the simulation model. And figure 4 is a good explanatory picture of all cases. However, penetration and compliance are two words which I think need an explanation before mention this much.

Q: Why does Automated cars have higher reaction time?

- ## 7 Simulation Analysis

Very clear written about the communication range analysis.



I wonder if you are talking about the wrong bar in this text?
Your written comparison is hard to follow due to wrong coloring (Red is the green bar and vice versa).

- ## 7.2 GLOSA algorithm analysis:

"There is a plain inverse relation between the penetration rate and the trip delay, which is a good indicator that **increasing the percentage of GLOSA connectivity** causes a decrease in trip delay ranging…."
Q: Should be increasing the penetration? As the connectivity is 100% in scenario 1A?

When comparing between numbers from different tables it would be better to collect them to a new table or having the nubers in the text. It is too hard to jump between tables if they are far apart.

- ## 8 Discussion

"After running the simulations and obtaining the output results, there are some topics that may be discussed, for instance; it is hard to judge the outcome of different compliance rates due to having minimum speed bounding constraint and drivers will always be tempted to adapt the minimum speed instead of the very low speed advice in those cases. **And that's why the results of most compliance rates are very close in terms of waiting times."**
Q: What do you mean with the last sentence (the bolded letters)?

Otherwise, a good summery of the report in this section.

- **9 Conclusions and Future work**

A good summery of how GLOSA can assist regarding traffic scenarios.

Questions

1. Q: When do you think, we will have a situation with only fully automated vehicles?

2. Q: Why do you think that scenario 1B showed earlier better results in waiting time and trip delay than scenario 1A?

3. "For the safety reasons mentioned earlier, most recent studies used larger desired time gap settings of values between 1.2 and 1.8 seconds for partial automated vehicles using ACC. Even though desired time gaps of human drivers are generally around a range of 0.5-1.5 seconds, this means that introducing partial automated vehicles will lead to higher average time headways and consequently lower capacities"
Q: Why is it that much higher? I mean, are partial automated vehicles considered to be less concentrated?

4. Q: Position and speed are the two parameters of which GLOSA is using. What parameter do you think should be the next parameter which should be integrated in GLOSA?

5. Q: Will GLOSA consider any obstacles on the road? Unexpected obstacles like a roadkill?

6. Q: Can an automated car choose to not have full-compliance?

7. Q: Why does Automated cars have higher reaction time?

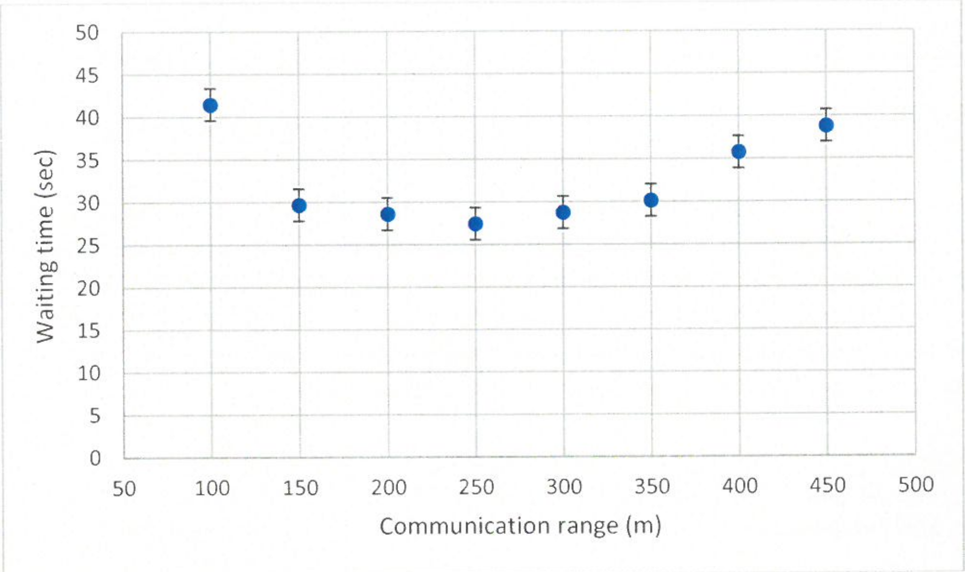


figure 12.

8. Q: for conventional cars (which case?) or automated?

9. Q: What results did you expect before you started the project?

10: Are you happy with the outcome?

11. If you had more time, what more would you incorporate in the report?

12. As GLOSA do contribute to better traffic scenarios for all scenarios (mostly automated but also conventional), when do you think that we will see the product on the market?