Sensitivity analysis of network-based influencing factors of travel speeds on urban road segments with fixed-time traffic signal controlled intersections

Master's Thesis of Mario Sulzinger

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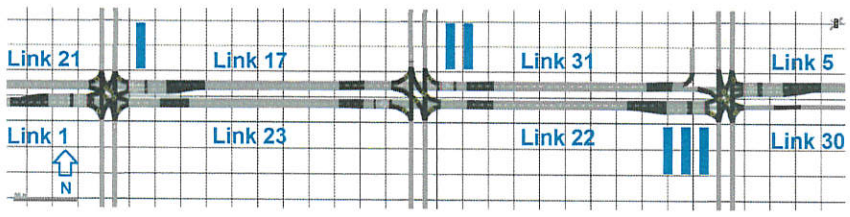

Figure 1: Model layout with three intersections and link labels

Framework conditions

A microscopic traffic model is created in PTV Vissim 7, which is depicted in **Fig. 1**. From this model only the main road on the east-west axis is analyzed in depth. Furthermore, the factors shown in **Tab. 1** are varied to create different scenarios for the evaluation, while factors like pedestrians, public transportation and motorcycles are not considered to minimize interferences.

Single factor evaluation

As a first step only single factors are varied and compared to the baseline of scenario I, to gain insight on the sensitivity the system shows on them (c.f. **Fig. 2**). In this comparison the vehicle input has the highest influence on the speed-volume relationship as well as on the queue lengths. In addition, longer distances between intersections and longer cycle times only develop slightly higher average speeds. In contrast a higher speed limit and heavy traffic share have a minor influence on the results.

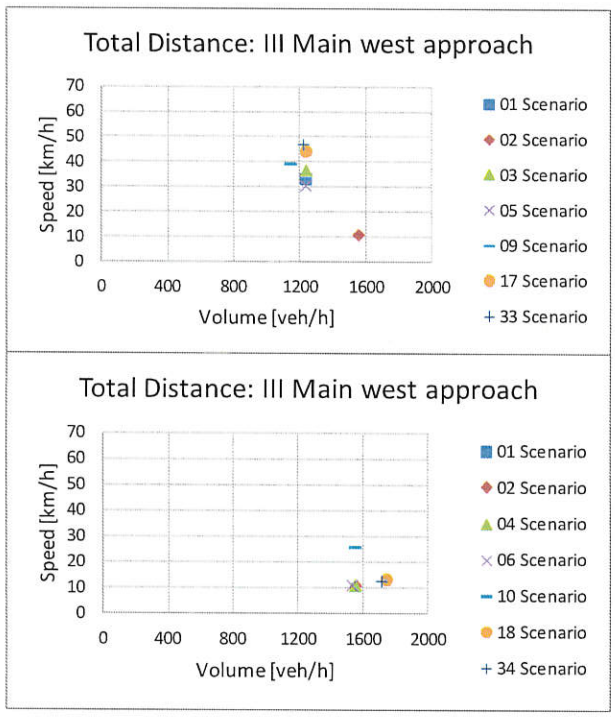

Figure 2: Exemplary speed-volume distribution for single factor analysis

Figure 3: Exemplary speed-volume distribution for combined factor analysis

When compared by links it shows that for 75 percent of all links the results are very accurate, while the highest deviation is still below 14 percent (c.f. **Fig. 4**). In a network wide comparison the results show below 8 percent deviation. The variations of this study are not complementary, and further variations and in depth analysis of the circumstances that produce different traffic patterns have to be conducted.

In urban environments space is the limiting factor for new road developments. Thus traffic management gets more important as an option, to cope with rising numbers of vehicles. One of the most important factors for a successful operation of a traffic management system is the detection of traffic states. As these states depend mainly on intersections in the urban context the knowledge of influence factors on these road elements is of vital importance.

Scenario	Cycle length [s]	Distance [m]	Heavy traffic share [%]	Speed limit [km/h]	Vehicle input [veh/h]
Single factor evaluation					
I [B]	60	200	2	50	1,200
II	60	200	2	50	1,800
III	60	200	2	60	1,200
V	60	200	5	50	1,200
IX	120	200	2	50	1,200
XVII	60	600	2	50	1,200
XXXIII	60	800	2	50	1,200
Combined factor evaluation					
II [B]	60	200	2	50	1,800
IV	60	200	2	60	1,800
VI	60	200	5	50	1,800
X	120	200	2	50	1,800
XVIII	60	600	2	50	1,800
XXXIV	60	800	2	50	1,800

Table 1: Evaluated scenarios ([B]: Baseline for the respective evaluation)

Combined factor evaluation

As a consequence from this analysis all factors are combined with a higher vehicle input to compare the scenarios for their ability to cope with higher traffic loads (c.f. **Fig. 3**). For this comparison scenario II is used as a new baseline. In combination with a high vehicle input the prolonged cycle time leads to additional green time on the main road, which allows for the highest top speeds and lowers the traffic load. Longer intersection distances showed the shortest queues, but had a lower average speed on the road segments. Scenarios with increased heavy traffic as well as a faster speed limits performed very close to the baseline scenario.

Floating car data (FCD)

Additionally an investigation of the influences of different factors on the accuracy of the average speed detection by floating car data is conducted. A low penetration rate of equipped vehicles of two percent is tested. The FCD analysis shows, an average deviation of below four percent across all scenarios except for the prolonged cycle time, which shows twice as much. In the mentioned cases FCD can deliver quite accurate results (c.f. **Fig. 4**).

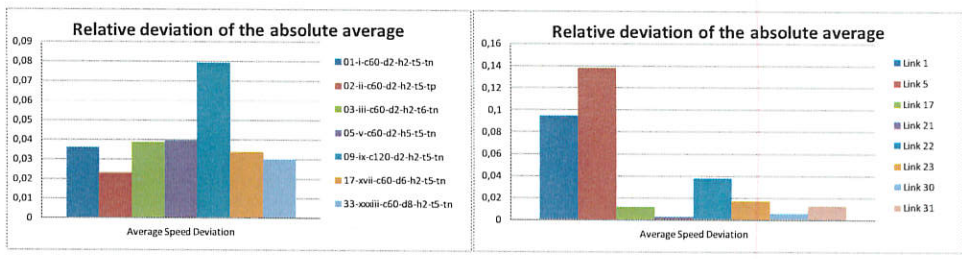

Figure 4: Magnitude of deviations from floating car data to detector data