Development of a Traffic Control Strategy for Urban Bicycle Highways

Master‘s Thesis of Seyed Abdollah Hosseini

Mentoring:
M.Sc. Georgios Grigoropoulos (TUM)
Dr. rer. nat. Andreas Keler (TUM)

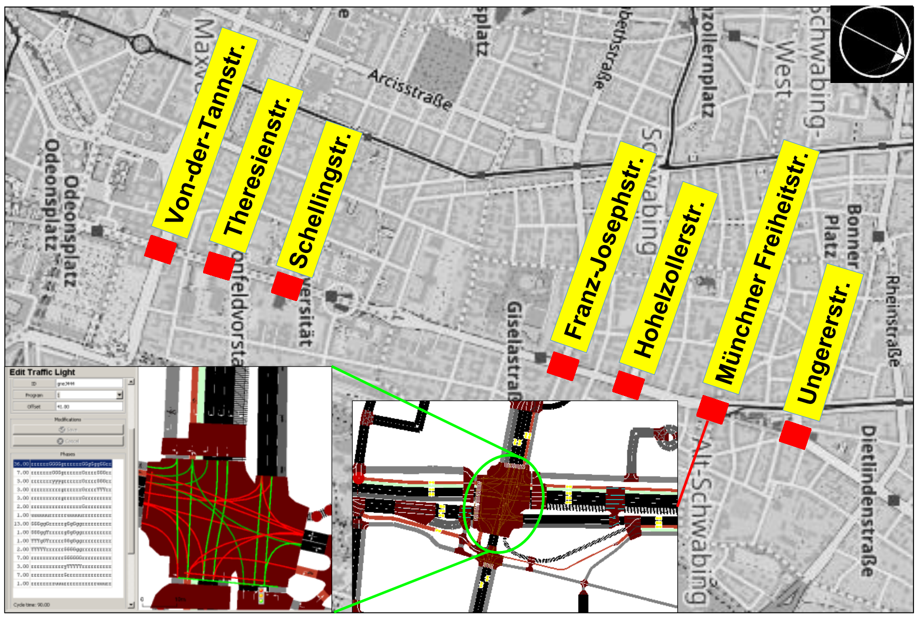

Fig.1 Geographical position of the study area and SUMO environment

Providing a traffic control strategy to increase the fluency of cyclists' movement along the road (or green wave) while at the same time considering other traffic streams, will decrease delay, travel time, and improve safety of cyclists at intersections and bicycle share. The challenge that the control strategy is constantly facing is a prioritized coordination decision. In other words, among all traffic participants in a network, who has the highest right to be coordinated?

The case study dealt with seven consecutive intersections in Munich, in two major streets: Ludwigstraße and Leopoldstraße. SUMO as a traffic microscopic simulation software developed by the Institute of Transportation Research at the German Aerospace Centre (DLR), Python 2.7 programming language, and TraCI as interface were used for simulation and operation the optimization and coordination process. Passenger car, Truck, and bicycle (normal and cargo bicycles) were considered in simulated model with a normal speed distribution function.

In the research, delay, number of stops, and saturation degree at intersections (possible green extension) have been selected as decision making criteria in the new control strategy. First, updated recorded traffic volumes and turning ratios by cameras imported to SUMO microsimulation software (static demand distributipon). Second, to adjust the network parameters, traffic volume and travel time were used to calibrate and validate model by two set of data: 15:00-16:00 (as off-peak hour) and 17:00-18:00 (as peak hour), respectively and the results verified by Root Mean Square Error (RMSE) method with 90 percent confidence interval. Then, nine objective functions defined to find the prioritized direction and eligible road user for coordination strategy. By assigning the same weighting factors for vehicles and bicycles (as a goal to motivate cyclists) and minimization the function of delay and number of stops, the optimal algorithm of new control strategy has been achieved which is based on considering the delay of all traffic participants and simultaneous implementation of green extension.

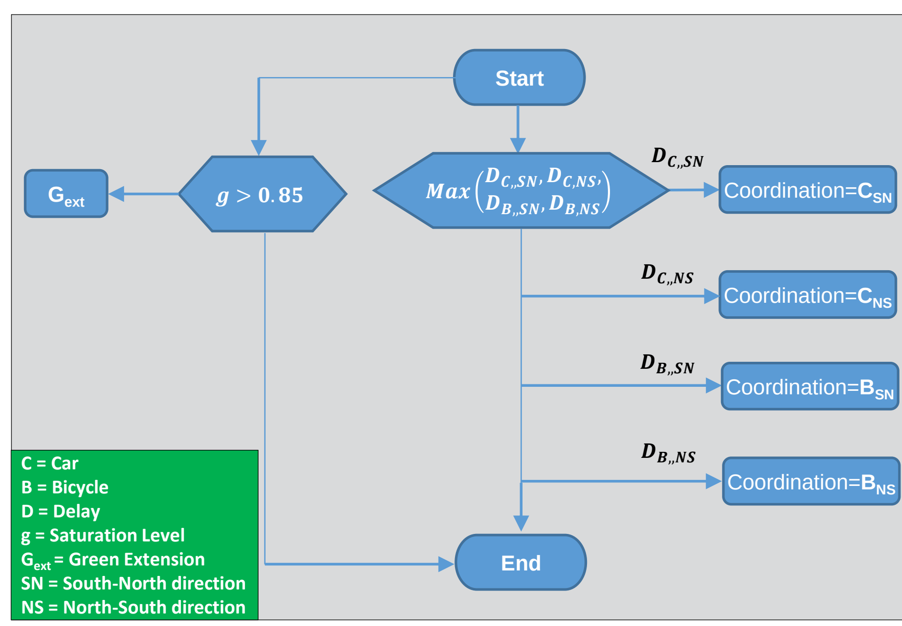

Fig.2 Optimum objective function as the algorithm of the new control strategy

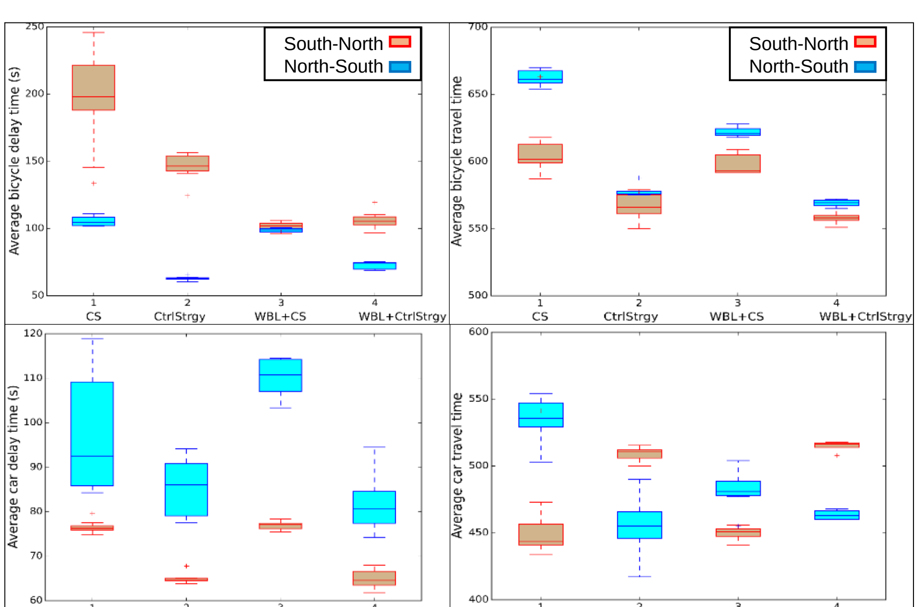

Fig.3 Average delay and travel time of bicycles and cars in different scenarios

To assess the effect of the new control strategy (CtrlStrgy) and possible widening bicycle way with and without the new control strategy (WBL+ CtrlStrgy and WBL+CS respectively) on the network, three scenarios have been defined and compared with current situation (CS). The results have shown significant improvements in decreasing delay, number of stops, and travel time of both cyclists and passenger cars. The results showed that delay of bicycles and cars decreased by 25% and 13% for south-north direction and by 40% and 6% for north-south direction. Although for few road users, some of these indicators have been increased, the average reduction showed the great outperforming the new control strategy to the current situation. The implementation of the new control strategy showed the necessity of green extension for coordination to prevent from queue formation. Any future infrastructural change is suggested to be followed by the new control strategy as a priority action plan to show its optimum effects on the network.