Investigating the traffic impact of on-demand ride-pooling services with a microscopic traffic simulation

Master‘s Thesis from Christof Pfundstein

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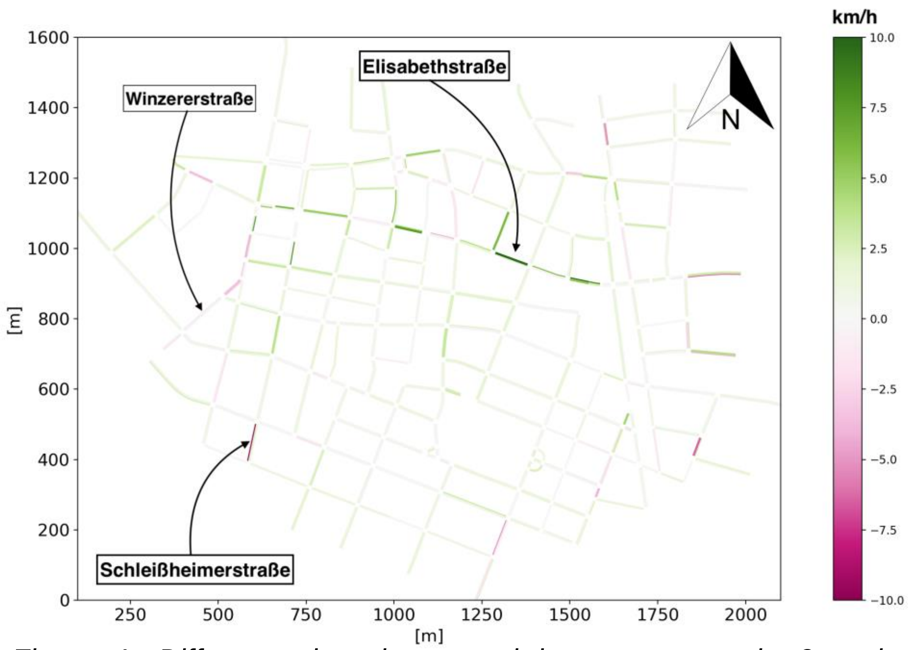

Figure 1: Difference in edge speed between scenario 2 and scenario 0.

Introducing ride-pooling to this network has an overall positive effect as can be seen in Figure 1. The saved distance in the FleetPy Scenario is at about 11.3 %. When coupling the simulation frameworks this saved distance is reduced to 7.9 %. This difference can be explained through a difference between travel times used in FleetPy and the travel times that are the result of the actual simulation in SUMO. It was shown that this positive impact is stronger for major roads. Minor roads may even see an increase in traffic.

Vehicle settings have a noticeable impact on simulation results and should be carefully selected when simulating a real world scenario. It was shown that vehicle-to-vehicle interactions influence the simulation result. This is considered a benefit of using a microscopic traffic simulation. Figure 2 shows a situation in which a ride-pooling vehicle (red) cannot accelerate to its full potential when following a regular vehicle (yellow) with lower acceleration.

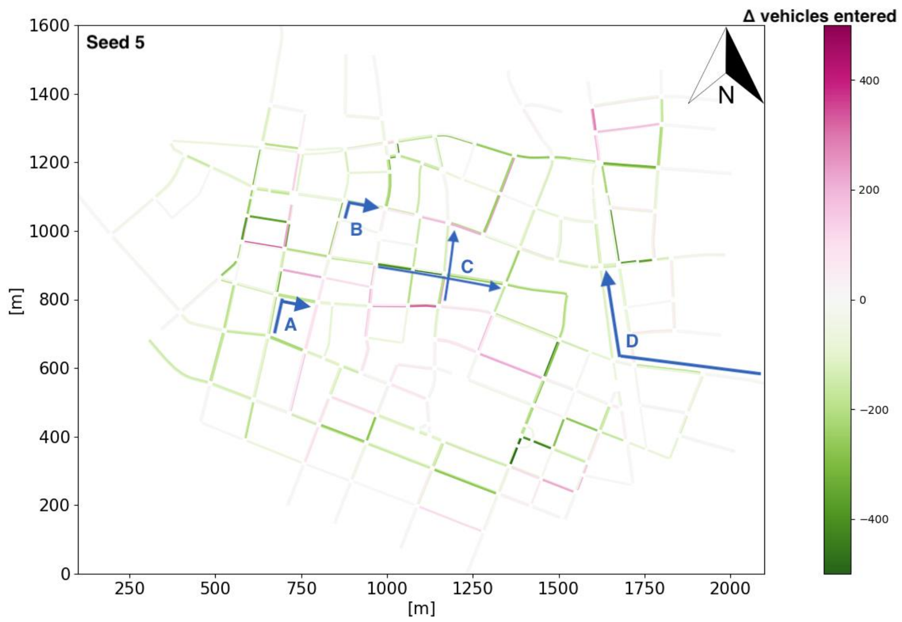

Figure 3: Difference in vehicles entering an edge between scenario 4a and 4b.

Summary

Ride-pooling services are an increasingly important alternative to traditional corporate ride-hailing services. The main promise of ride-pooling lies in its ability to reduce traffic and the associated negative impacts such as space consumption, emissions and time lost due to congestion. Some studies have already been able to show the impact of ride-pooling on traffic, but their main focus so far has been on simulating services using macroscopic traffic simulations. The aim of this thesis is to investigate the traffic impacts of on-demand ride-pooling services with a microscopic traffic simulation. For this purpose, the fleet simulation framework FleetPy is coupled with the microscopic traffic simulation tool SUMO. In scenario 0, no ride-pooling was simulated and only SUMO was used. In scenario 1, only FleetPy is used to simulate a ride-pooling service. In Scenario 2, the same ride-pooling service is simulated using a coupled approach between SUMO and FleetPy. In scenario 3a, the ride-pooling vehicles are set to feature a lower acceleration and a higher one on scenario 3b. Scenario 4a introduced additional traffic, and scenario 4b additional traffic and a continous update of the underlying edge traveltimes.

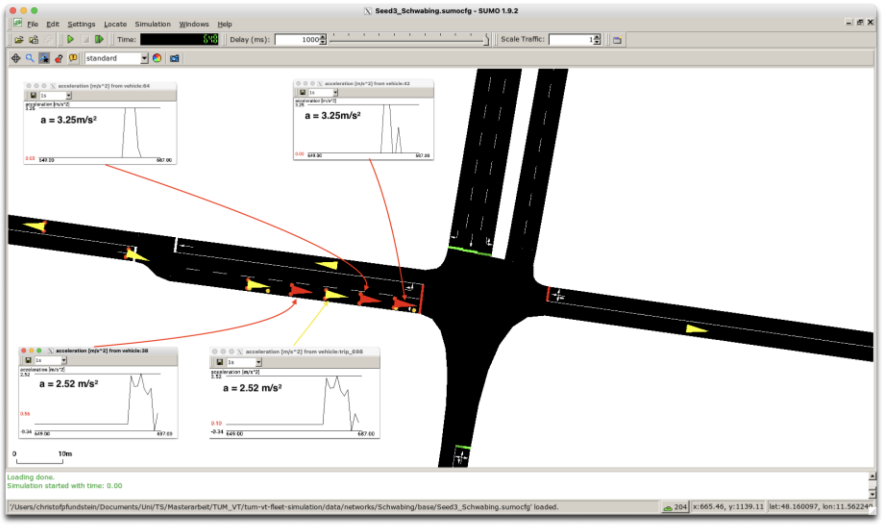

Figure 2: Acceleration of ride-pooling vehicles (red) and non-ride-pooling vehicles (yellow). The last ride-pooling vehicle in the queue cannot accelerate to its full potential, as it is following a non-ride-pooling vehicle with lower acceleration.

Figure 3 shows the difference in vehicles entering an edge between scenario 4a and 4b. The blue arrows show the road sections on which additional traffic was introduced to cause congestiion. In scenario 4b, edge travel times used in FleetPy are updated to match the current edge travel times in SUMO. This calculation leads to longer computation times. SUMO limitations in receiving travel times of edges on junctons and the underlying calculation of the handed over edge travel times lead to an overall much lower saved distance. Still the benefits of this approach show, as seen in Figure 3. The traffic is routed around the congested edges.

All in all the results contribute to a better understanding of the impact of ride-pooling on traffic. With the help of a microscopic traffic simulation, the influencing vehicle interactions are shown.

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