Modelling Traffic Volume Impacts of Shared Automated Vehicles

Thesis proposal for the M.Sc. in Transport, Infrastructure and Logistics

Shared Automated Vehicles (SAVs) are among the most-debated technological and service ideas of the present. Replacing manually driven cars with the driving robots is hoped to reduce road accidents, make travel more pleasant and reliable, and allow the travellers to reclaim the 'lost' time spent travelling. Furthermore, some have argued that replacing private cars with SAVs could theoretically provide a dramatic and immediate solution to congestion problem due to the SAVs being able to safely drive closer to each other than conventional vehicles. At the same time, large-scale gains from this technological upgrade are, in practice, rather unlikely, and many have argued that SAVs may also increase congestion due to several reasons, such as potential shifts from higher-capacity public transport, increased travel demand with new or longer trips, and empty travel. In sum, the impact of SAVs on traffic volume could be either one of the main attractions or deterrents for SAV introduction, and in either way it is a core argument in the policy debate on automation.

How to find out if SAVs will lead to increase or decrease in traffic volume and congestion? What factors determine this outcome? Furthermore, are we able to derive generalizable answers to these questions that are valid even outside of the geographical areas that are well covered with detailed simulation tools? In this thesis project, you will work towards answering such questions by building a minimalistic simulation model. In brief, you will work a simplified city (with a small number of nodes and edges) in which there are three transportation modes: private vehicles, public transport, and SAV. Each of these travel modes have associated monetary costs, travel times, capacities, routes and possibly other factors that together determine their attractiveness to travellers. By representing these aspects first, in a discrete choice model, and then linking the choice model to the simplistic city, you will be able to analyse the impact of SAV on travel demand with the three archetypical modes and the resulting impacts on congestion.

Through this thesis project, you will not only derive insights for a highly sought-after transport policy problem, but you will also further develop your skill-set as a well-rounded transport modeller: you will learn to represent user choices in a simulation framework (using a discrete choice model), mimic on-demand routing decisions, as well as optimise fares and frequencies of mass transport. With guidance from experienced modellers, you will be expected to propose how to model all these characteristics, which parameters to observe, and you will finally build and run the corresponding simulations. The project can be carried out solely in the university or also in cooperation with industry partners.

Desired qualities
- Motivated and independent
- Good programming skills
- Familiar with transport and simulation models

For further questions or to apply, please contact Dr. A. Fielbaum (A.S.FielbaumSchnitzler@tudelft.nl), Associate Prof. Dr. J. Alonso-Mora (j.alonsomora@tudelft.nl), or Asst. Prof. Dr. Baiba Pudane (B.Pudane-2@tudelft.nl). When applying, please provide a short motivation, up to date CV, a transcript of your current degree program and intended start date.

Earliest starting date: December 2021

References:
[1] Alonso-Mora, J., Samaranayake, S., Wallar, A., Frazzoli, E., & Rus, D. (2017). On-demand high-capacity ride-sharing via dynamic trip-vehicle assignment. *Proceedings of the National Academy of Sciences, 114(3)*, 462-467.
[2] Fagnant, D. J., & Kockelman, K. M. (2014). The travel and environmental implications of shared autonomous vehicles, using agent-based model scenarios. *Transportation Research Part C: Emerging Technologies*, *40*, 1-13.
[3] Fielbaum, A., Jara-Diaz, S., & Gschwender, A. (2017). A parametric description of cities for the normative analysis of transport systems. *Networks and Spatial Economics*, *17*(2), 343-365.