VRIJE UNIVERSITEIT BRUSSEL

Reducing Urban Private Vehicle Dependency With Shared Autonomous Vehicles

Agent-based Simulation As A Digital Testbed for Transport Policy Evaluations

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Abstract:

Conventional Private vehicles (CPVs) give rise to many problems and challenges in urban mobility networks, such as air pollution, traffic congestion, traffic accidents and parking shortages. Shared Autonomous Vehicles (SAVs) have recently been put forward as a potential alleviation to these challenges. For urban planners and policymakers, it is crucial to prepare for such a transformative technology to investigate the impact of SAVs on the mobility network under different operational patterns. Hence, using Agent-based Modelling (ABM), this dissertation investigates the extent to which SAVs can be integrated into current metropolitan regions' mobility systems to reduce the usage of CPVs and the respective impacts on society as a whole.

We develop an ABM generation pipeline based on raw social-spatial data and cellphone matrices that generate simulation data representative of real-life travel patterns. The input data all adhere to privacy regulations, which shows the significant transferability of our methods. We demonstrate the proposed pipeline in MATSim with a case study in the Brussels Capital Region, Belgium, serving as a digital testbed for SAV transport policy assessments. To test the impact of substituting CPV trips with SAVs, SAVs are introduced as a new mode in the developed MATSim Brussels scenario integrated with the Park-and-Ride (PnR) initiatives. The proposed policies for eliminating current CPV trips bring notable benefits, including substantially reduced CPV usage, increased Public Transport utilisation ratio, reduced travel demand in the city centre and significant urban transport emission reductions. However, there are also drawbacks with the increase in PnR users, such as lower SAV service levels, longer travel time and increased congestion in Brussels' suburban regions.

Overall, this research presents a benchmark from social-spatial and cellphone data towards the digital testbed for SAV policy evaluations for reducing CPV trips in metropolitan regions towards more sustainable mobility networks. Using a case study for Brussels, we offer several recommendations for effectively integrating SAVs into future transport systems, emphasising that the SAV technology itself is not enough to reduce the current reliance on CPVs. Collaborative efforts and coordination among various stakeholders are necessary to achieve the full potential of SAVs towards a more sustainable, accessible and efficient future.