SimSAEV Simulating the Socio-economic and Environmental Effects of Shared Autonomous Electric Vehicles

A Case Study of Vienna

Background and motivation



Objectives

• To identify environmental and socioeconomic effects of SAEVs, as wells as synergies and trade-offs between them.

• To extend an agent-based model (ABM) of Vienna's transport system with a module that allows for the simulation of scenarios related to SAEVs.

• To support the formation of transport policies that lead to a reduction in transport-related emissions, while maintaining an efficient and inclusive transport system



Project-related Sustainable Development Goals (SGDs)



Work Package 2 - Literature Review

- SAEVs have important **implications** for the **environment**, the transport system, public space, public finance, and inequality (in particular regarding accessibility)
- Whether SAEVs exacerbate or solve existing urban challenges is largely dependent on km driven by SAEVs and the overall number of cars present
- Without appropriate **policy interventions**, both the **km driven** by SAEVs and the overall number of cars present will be higher than socially optimal
- The introduction of road tolls in line with "user pays" and "polluter pays" principles will become more attractive

Work Package 3 - Transport Simulation



10BILITY DATA

• Österreich unterwegs (öu) mobility survey Contains statistical population characteristics

Work Package 4 - Policy Scenarios

- Price structures of SAEVs and preference structure of individuals
- distance- vs travel time-based pricing
- income distributions, locations, and preference structures

Environmental impacts of SAEVs





Population Synthesis

The goal of the population synthesis is to generate an artificial but realistic population for the simulation which matches the real population (öu data), e.g. has the same age distribution or modal split.

Baseline synthesis methods

- Randomized sub-sampling from Österreich Unterwegs data
 - For realistic performance tests on the multi-agent simulation
 - For comparison with more refined synthesis approaches

• Iterative proportional fitting

Advanced synthesis methods

• Artificial neural networks applying variational autoencoders

Next steps

- Use alternate data sources to check regional data set for possible corrections regarding demography
- Refine advanced synthesis methods and comparisons

Simulations:

The goal of the traffic simulation is to evaluate the impact of different policies and impact factors (e.g. pricing scheme of SAEVs) for the creation of policy scenarios in WP4

Multi-agent transport simulation based on the

COVERAGE AREA

- Metropolitan area of Vienna
- ~30km radius around center
- ~2.3m inhabitants

And the second second

ROUTING DATA

- OpenStreetMaps street network
- OGD Public Transport timetables



- Heat islands (parking lots) versus emptry rides Energy use of SAEVs
- Socioeconomic implications for • Non-car owners, poorly connected neighborhoods
 - Different age and income groups



Meso and Macro implications of SAEVs • Ownership structures, public finance and regulation • Impacts on urban sprawl and infrastructure

Dissemination

Working papers

- Peer, S., Naqvi, A., Schöggl, A. (2019). Shared, autonomous, electric vehicles (SAEVs): Solving urban challenges?
- Adler, M., Peer, S., Sinozic, T. (2019). Autonomous, Connected, Electric Shared vehicles (ACES) and public finance: an explorative analysis.

Presentations

• Richter, G., Rudloff, C., Straub, M. (2019). Enriching the features of a synthesised population – using generative neural networks for population synthesis. Presented at Stochastic Models, Statistics and their Application (SMSA), Dresden, 6. – 8.3.2019.

open-source framework MATSim* • Built upon MATSim core + AV module • Direct simulation of car + SAEV traffic

- AIT Ariadne routing framework for intermodal routing (foot, bicycle, public transport)
- Integration of intermodal mode choice model

MatSIM simulation interface

* Widely used transport simulation in the research context, intitally developed at ETH Zurich.

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