Faculty of Management, Economics and Social Science
Chair of Information Systems for Sustainable Society (Prof. Ketter)

Master Thesis

EV Charging-Aware Trip Assignment of Taxis

Ride-Hailing (Taxi) fleets face two paradigm shifts at the same time: Drivers might get replaced by autonomous driving capacities in the near future and the switch to electric vehicles (EV) is already underway. While these changes introduce operational challenges, they also hold great potential for more efficient and thus sustainable operations of these fleets. For this thesis, we assume both changes to be fully implemented: A ride-hailing operator has a fleet of SAEV (shared autonomous electric vehicles). The fleet must be coordinated in such a way that demand and supply is balanced. Because EV taxis are not replenished in an instant like their combustion engine counterparts, supply is highly dependent on an effective and efficient management of charging. Moreover, we consider the availability of charging stations to be restricted spatio-temporally (sometimes there is no capacity in a particular part of the city). Luckily, at the same time, the operator has some knowledge on the demand distribution (in space and time) of its customers as well as the availability of charging stations. With this information at hand, the operator now faces the following problem: How to balance demand-serving and charging (considering constraints of charging capacity and stochastic demand)? The thesis seeks to answer this question by developing a proof-of-work mechanism and evaluating its boundaries (fleet size, charging capacity, service level, e.g.). In particular, the aim is to develop a strategy that efficiently assigns vehicles in a fleet to particular trips to fulfil the above goal, while keeping scalability in mind.

Key tasks and objectives of the thesis

- Getting to know the literature on ride-hailing operations under (exogeneous) constraints
- Deciding on and arguing for a methodology to tackle the operational problem
- Implementing a simple simulation environment with synthetic demands and charging stations
- Developing and evaluating the chosen approach in this environment

Introductory Literature (exemplary):

- Shui, C.S., Chu, J.C., Lin, S.-C., Chien-Hua, S., 2024. Optimization of vehicle charging and dynamic relocation in free-floating electric carsharing systems with advanced reservations. Computers & Industrial Engineering 110072. https://doi.org/10.1016/j.cie.2024.110072
- Jamshidi, H., Correia, G.H.A., Van Essen, J.T., Nökel, K., 2021. Dynamic planning for simultaneous recharging and relocation of shared electric taxies: A sequential MILP approach. Transportation Research Part C: Emerging Technologies 125, 102933. https://doi.org/10.1016/j.trc.2020.102933

Topics

- Electric Vehicles (EV)
- Autonomous Vehicles (AV)
- Demand-Driven Operations

Methods

- Simulation
- One of the following:
  - Reinforcement Learning (RL)
  - Mathematical Programming (Optimization)
  - Genetic Algorithms (GA)

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