Institut für Verkehrsplanung und Transportsysteme (IVT)

ETH Hönggerberg
CH-8093 Zürich

Dr. Milos Balac
+41 44 633 37 30
balacm@ethz.ch

Zurich, 07 August 2023

Optimization of Mobile Charging Infrastructure in Dynamic Urban Environments

Thesis description

The organization and optimization of product and service distribution are critical factors for cost-efficient businesses. In the context of electric vehicles (EV) charging infrastructure, this involves determining optimal locations for mobile charging stations based on demand patterns, as well as predicting future demand to ensure adequate supply. This research proposal focuses on developing a predictive method that allows operators to adapt the number of available units at each station based on anticipated demand.

Existing work has successfully utilized MATSim to optimize charger distribution. This thesis should take a step further and utilize realistic scenarios where operators must adapt their assignment strategies according to registered demand from the past.

Within this thesis, the plan is to enrich the existing optimization framework by integrating a predictive method. This approach will draw on the historical charging behavior data provided by the MATSim simulation. A prediction methodology should be selected based on their ability to forecast future EV charging demands effectively. Integrating such a predictive system will enable dynamic adjustment of charger availability at different stations, aligning with forecasted demand. This method is expected to improve efficiency and customer satisfaction by reducing waiting times at chargers and facilitating a more precise match between supply and demand in dynamic urban environments.

Performance evaluation for available transport simulations like Sao Paolo, San Francisco, or Ile-de-France will be compared against standard heuristic approaches and static charging scenarios; system parameter fine-tuning for optimal performance under various conditions; documentation and dissemination of research outcomes in scientific papers contributing towards development efficient EV infrastructure planning tools form part of our comprehensive approach.

Specific Tasks

- Understanding Existing System (0.5 months): Familiarize with the MATSim-based optimization framework and its data.
- Literature Review and Methodology Selection (1 month): Conduct a literature review and choose a suitable predictive method for EV charging demand forecasting.

- Model Development and Integration (1 month):** Develop the predictive method and integrate it into the existing optimization framework.
- Simulations and Performance Evaluation (1 month): Run simulations, compare performance against standard approaches, and fine-tune system parameters.
- Analysis and Documentation (0.5 months): Analyze the simulation results and document the research outcomes.

Supervisors

- Milos Balac (ETH)
- Sebastian Brulin (Honda Research Institute)
- Matthieu Mastio (Odyssee)