

Master Thesis / Semester Thesis

Optimization of Operation Strategy for Battery Electric Trucks Considering On-route Charging and Charging Point Reservation

Motivation:

Commercial vehicles are significant contributors to greenhouse gas emissions within European road transport. Transitioning to battery-electric commercial vehicles offers one of the most effective pathways to achieving meaningful and sustainable emission reductions. This transformation aligns with the European Commission's ambitious goal to cut CO₂ emissions from heavy-duty vehicles by 90% by 2040. Additionally, the increasing number of companies requiring environmentally responsible supply chains reinforce the urgency of this shift. Especially long-haul electric trucks will have high demands on the public charging infrastructure and its availability. As charging stops on the route will be inevitable, precise scheduling and reliability in operation are of high interest for the freight forwarders. To meet those requirements, smart route planning and charge stop integration including reservation of charge points are promising ideas.

Thesis topic:

To enable smooth and reliable on-route charging for electric trucks, freight forwarders must efficiently plan their routes and charging stops for the battery electric trucks (BET). Ideally, this happens in an optimized manner, including all restrictions of the charging infrastructure.

The objective of this master's thesis is to develop an optimization approach for the operational planning of a single BET, while explicitly considering a given charging infrastructure and the possibility of reserving charging points. The optimization should capture key real-world constraints such as regulatory driver rest requirements, nonlinear charging characteristics, and vehicle-specific time flexibilities and operational restrictions. Given a fixed route for the BET, the optimization aims for the best charging plan in terms of where, how much and how long to charge the battery at possible charging stations along the route. A particular focus lies in the integration of charging point reservations into the optimization process. By incorporating reservation mechanisms, the developed approach should enable more reliable and efficient BET operations. The approach can then be applied to an existing simulation framework to test and evaluate the performance compared to other trucks.



Work packages:

1. Literature review on BET operations optimization and reservation methods
2. Analysis and selection of a suitable optimization approach
3. Conceptualization of an optimized BET operation approach
4. Implementation of the optimized strategy, incorporating reservations
5. Transfer and simplification for the application in an existing agent based simulation
6. Evaluation of the optimized strategy in the agent-based simulation framework

Requirements:

- Passion for e-mobility and energy-transition technologies
- Good programming skills in Python, Basics in Git
- Ideally initial experience with Operations Research
- Independent and strategic way of working
- Enjoy working in a team
- Very good German or English language skills

I look forward to receiving your application with a CV, current overview of grades (+ any other documents) and a brief motivation. I'm happy to discuss the topic with you in detail in a personal meeting. **The thesis can be written either in German or English.**

Contact:

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Start date:

From now on

Workplace:

FTM, Garching Forschungszentrum. The thesis can be done on site or remotely.