Technical University of Munich
TUM School of Engineering and Design
Chair of Automotive Technology

Semester‘s Thesis or IDP

Smart Forecasts for Smart Trading: ML Price Prediction for eTruck Flexibility Commercialization

Motivation:

In the realm of European road transport, commercial vehicles stand as substantial contributors to greenhouse gas emissions. The transition to battery-powered commercial vehicles presents the most promising way for achieving sustainable decreases in emissions. This shift is in line with the European Commission's ambitious target to slash CO2 emissions from heavy-duty vehicles by 90 percent by 2040. In addition, many companies will demand a green supply chain in future.

Especially electric truck depots will require high charging power and smart integration into the electricity system. Due to limited grid connection capacities and the slow roll-out of public charging facilities, more and more transport companies are likely to set up private charging stations on their property. Beyond cost-efficient charging, depot flexibility can be commercialized by participating in electricity markets such as balancing services and other flexibility products. In this context, the truck batteries can become an economic asset: electricity can be purchased when prices are low, stored in the vehicles, and later used or sold when prices are high, turning the depot into an active participant in the energy system.

Thesis topic:

The aim of this thesis is to extend an existing open-source optimization framework for the commercialization of flexibility from electric truck depots by integrating data-driven electricity price forecasting. While the current implementation assumes perfect price foresight within the optimization horizon, real-world deployment requires forecast-based decision making. Therefore, you will benchmark forecasting approaches for relevant electricity market prices, including simple baseline methods (e.g., persistence or historical averages) as well as machine learning-based models. You will then integrate the resulting forecasts into the simulation. Finally, you will quantify how forecast accuracy affects trading decisions and economic performance through a case study evaluation and a systematic comparison against the perfect-foresight benchmark.

What you get:

- Contribute to scientific research in a highly future-oriented field of in the intersection of commercial transport mobility and the energy sector
- In case of excellent working performance: Opportunity for a follow-up thesis work (master’s thesis) and co-authorship in a scientific paper

Work packages:

- Literature research on electricity price forecasting and its integration into MPC optimization
- Familiarization with the existing open-source flexibility commercialization framework
- Development and benchmarking of different forecasting approaches (including baseline and machine learning models)
- Integration of the selected forecasting pipeline
- Validation and evaluation based on simple case study scenarios, including a comparison against a perfect-foresight benchmark

Requirements:

- Passion for e-mobility and energy-transition-accelerating technologies
- Programming experience in Python
- Ideally initial experience in Machine Learning / Timeseries forecasting
- Independent and strategic way of working
- 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. **The thesis can be written either in German or English.**

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Start date:
From now

Workplace:
FTM, Garching Forschungszentrum. The thesis can also be done in home office.