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

Semester Thesis / IDP

Data Driven Engineering: Framework for Optimizing Truck Fleet and Logistics Depot Electrification

The electrification of heavy-duty truck fleets is essential for achieving the EU's CO_2 reduction targets, which aim for a 90% reduction in commercial vehicle emissions by 2040 compared to 2019 levels. Transitioning from fossil-fuel-powered trucks to battery electric trucks (BETs) presents significant challenges for freight forwarding companies, particularly in adapting their fleets and depot infrastructure sustainably and cost-effectively. Telemetry data, capturing operational details such as daily routes, depot dwell times, and fleet behavior, provides a foundation for informed decision-making in this process.

This thesis aims to optimize an existing database-backend-frontend toolchain that processes telemetry data from ICE truck fleets stored in a PostgreSQL database. The toolchain supports mobility data analysis, frontend visualization, and electrification simulations using longitudinal dynamics models to estimate optimal depot charging infrastructure. The output will be actionable, step-by-step transformation pathways to guide freight forwarding companies in electrifying their fleets and upgrading depot energy systems, balancing technical and economic considerations.

The following work packages are included in the thesis to be assigned:

1. **Literature Review**
   - Review research on heavy-duty truck fleet electrification and depot energy infrastructure adaptations.
   - Summarize findings to provide a scientific foundation.
2. **Optimization of Existing Toolchain**
   - Enhance the Python-based backend (PostgreSQL) and frontend toolchain for processing telemetry data and simulating electrification pathways.
   - Improve performance, usability, and integration of longitudinal dynamics models.
3. **Customization for Freight Forwarding**
   - Adapt the framework to freight forwarding needs and develop intuitive visualizations (e.g., dashboards, timelines) for step-by-step transformation pathways.
4. **Validation and Recommendations:**
   - Test the framework based on real telemetry datasets to ensure accuracy.
   - Refine visualizations for clarity and derive actionable recommendations for electrification

Requirements

- **Skills**: Proficiency in Python, familiarity with PostgreSQL, and interest in data analysis/visualization. Web development experience (e.g., JavaScript or Dash) is a plus.
- **Deliverables**: A documented thesis with code, visualizations, and a report. The candidate must work independently, citing all sources.

Why This Thesis?

- Contribute to sustainable logistics with real-world impact.
- Gain experience in data engineering, software optimization, and visualization.
- In case of good work, option to write a master thesis afterward.

Announcement: _____ Submission: _____

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Please send your application including your current CV and your current transcript of records to
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