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

TUM

Seminar Thesis or Master's Thesis

Data-Driven Anomaly Detection and Predictive Maintenance for EV Charging Infrastructure

Motivation

The growth of electric mobility increases the demands on the availability and reliability of charging infrastructure. In practice, charging sessions often fail not because of the power electronics themselves, but due to disruptions in the communication between charge point, backend, and vehicle. Although the OCPP protocol standardizes the communication between charging station and backend, the way states and faults are reported differs considerably between protocol versions.

For diagnostics and operation, this results in a heterogeneous, manufacturer-dependent data space that can hardly be handled manually. In the KI-LOAD research project at the Chair of Automotive Technology, real operational and charging data are used to systematically capture fault patterns and analyze them using machine learning methods.

Thesis topic

The aim of this master's thesis is to develop an end-to-end data pipeline ranging from the automatic detection of anomalous charging sessions (anomaly detection) to the predictive forecasting of faults before they lead to failures. Fault patterns are to be classified in a data-driven way, their causes narrowed down, and predictive models for the predictive maintenance of the charging infrastructure developed and evaluated.

What you get

- Contribute to applied research in the KI-LOAD project using real field data from charging infrastructure
- Creative freedom at the interface of electric mobility, charging infrastructure, and machine learning
- In case of excellent working performance: opportunity for co-authorship in a scientific paper
- Close supervision with regular meetings

Work packages

- Literature research and state of the art on fault analysis, anomaly detection, and predictive maintenance for charging infrastructure
- Preparation and structuring of real charging data as well as OCPP event and fault data from field operation
- Development of a standardized fault taxonomy and classification of typical fault patterns based on charging profile, error codes, and history
- Anomaly detection of conspicuous charging sessions using statistical and learning-based methods (e.g., clustering, unsupervised approaches)
- Development and evaluation of predictive models for fault and failure forecasting (predictive maintenance)
- Definition of suitable evaluation metrics and evaluation of the models against the project targets

Requirements

- Programming: advanced proficiency in Python and time series analysis
- Machine learning: solid theoretical and practical understanding of neural networks and clustering algorithms
- Independent and structured way of working
- Very good German or English language skills

I am looking forward to receiving your complete application with a CV, current overview of grades, a brief motivation, and any other documents. **The thesis can be written either in German or English.**

Contact

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Start date

From now

Workplace

FTM (Garching Forschungszentrum) or remote