Lehrstuhl für Fahrzeugtechnik
Fakultät für Maschinenwesen
Technische Universität München

Semester/Master thesis

Development of a Machine Learning Model for SoH Estimation at Cell Level Using Impedance Data

Background: Electrochemical Impedance Spectroscopy (EIS) offers valuable insights into the internal state and degradation mechanisms of lithium-ion batteries, without the need to physically open or damage the cells. With ongoing advancements in hardware, EIS measurement chips can now be integrated onboard within battery systems. While the hardware is becoming available for real-world use, corresponding algorithms for practical applications are still lacking.

One of the most promising applications of onboard EIS is the estimation of a battery cell's State of Health (SoH), and potentially its dominant aging mode. This information is crucial for enhancing battery diagnostics, optimizing usage strategies, and ensuring safety and reliability throughout the battery's lifecycle.

The goal of this thesis is to develop a machine learning model that estimates the SoH and potentially the aging mode of individual lithium-ion cells based on impedance data.

Tasks:

- Literature review on lithium-ion battery aging, EIS fundamentals, and machine learning approaches for battery diagnostics
- Data acquisition planning and/or use of existing EIS datasets
- Development of machine learning models to estimate SoH (and potentially aging mode) based on EIS data
- Evaluation of model performance using suitable metrics and validation methods
- Documentation of methodology, results, and critical reflections in a scientific format

Required Profile:

- Strong interest in battery systems and machine learning
- Solid programming skills in Python
- Independent, structured, and solution-oriented working style
- Very good English or German language skills

The student is expected to conduct the thesis independently and cite all scientific sources and tools used.

The submitted thesis will remain the property of the institute.

Contact Person:

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Start date:

As soon as possible

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