Lehrstuhl für Fahrzeugtechnik
Fakultät für Maschinenwesen
Technische Universität München

Semester/Master thesis

Development of a Machine Learning Model for ECM Parameter Estimation in an Automotive Module Using Impedance Data

Background: Equivalent Circuit Models (ECMs) are widely used in Battery Management Systems (BMS) for estimating key battery states such as State of Charge (SoC) and State of Health (SoH). These models rely on predefined parameters, typically stored in lookup tables and calibrated at the beginning of the battery's life. However, as the battery ages, these static parameters become inaccurate, reducing the effectiveness and accuracy of state estimation algorithms.

With the advent of onboard Electrochemical Impedance Spectroscopy (EIS), there is now a promising opportunity to update ECM parameters dynamically using impedance data. This thesis aims to develop a machine learning approach to estimate and update ECM parameters for individual cells within a series-connected automotive battery module at different stages of aging.

Tasks:

- Comprehensive literature review on the fundamentals of EIS and lithium-ion batteries, ECM parameter estimation methods, and applicable machine learning approaches
- Design of experiments to collect EIS data from an automotive battery module
- Development and comparison of machine learning models for ECM parameter estimation and update
- Analysis and evaluation of results using suitable metrics and validation techniques
- Structured documentation and critical reflection on methodology and findings

Required Profile:

- Strong interest in electromobility and lithium-ion battery technology
- Solid programming skills in Python and/or MATLAB
- 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:

Yilei Lin, M.Sc.

Email: yilei.lin@tum.de

Start date:

As soon as possible

Prof. Dr.-Ing. M. Lienkamp

Supervisor: Yilei Lin, M. Sc.