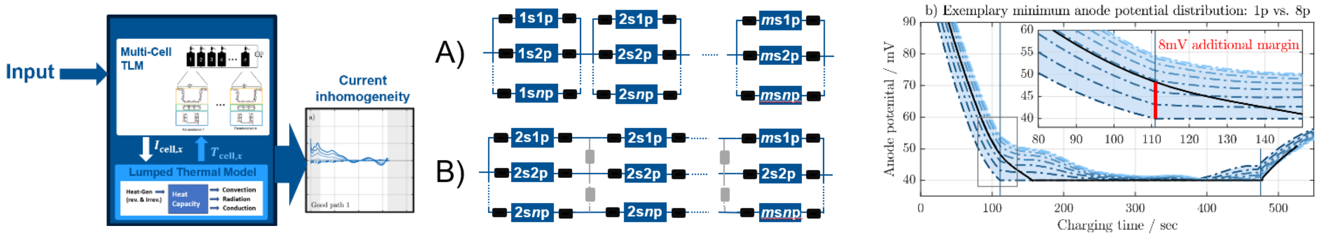
Lehrstuhl für Elektrische Energiespeichertechnik
Fakultät für Elektrotechnik und Informationstechnik
Technische Universität München

– Research Internship / Master Thesis –

Simulation Study on the Impact of Thermal Boundary Conditions on Fast Charging of Battery Packs



Background

Fast charging of electric vehicles is a key factor for widespread adoption of electromobility. Typically, fast-charging strategies are developed at single-cell level. However, real-world battery packs consist of many interconnected cells, both in series and in parallel. In such systems, inhomogeneous boundary conditions can cause individual cells to experience critical conditions, while others remain in safe operating ranges.

During fast charging, battery systems often operate close to their thermal and electrical limits, making uneven conditions across cells particularly critical. In this context, the battery pack's cooling system plays a central role in ensuring efficient and safe operation. Understanding and optimizing thermal management is therefore essential for enabling reliable fast charging on the system level.

Tasks

Within this master's thesis, an existing simulation framework, which allows flexible definition of pack topology (*m*s*n*p) and boundary conditions, will be extended to incorporate thermal interactions between individual cells. Main objective is to investigate the influence of the cooling system on fast-charging of an interconnected battery system:

- AP1. Literature Research on typical cooling strategies in battery packs and their translation into simplified thermal boundary conditions.
- AP2. Implementation of different cooling scenarios and thermal interactions between individual cells within the battery pack.
- AP3. Plan and execution of a systematic simulation study on the influence of thermal boundary conditions during fast charging
- AP4. Data processing and development of suitable analysis methods
- AP5. Written thesis

Requirements

- Prior knowledge in lithium-ion batteries and in thermal modeling of lithium-ion batteries / battery packs
- Good Knowledge in MATLAB

Focus

☐ Cell Characterization
☐ Experimental Test Series
☐ Hardware Development
☐ Software Design
☒ Modelling
☒ Simulation
☒ Literature Review

Degree Program

☒ Electrical/Information Engineering
☐ Computer Science
☒ Mechanical Engineering
☒ Physics
☐ Mathematics
☐ Chemical Engineering
☐ Industrial Engineering

Start Date

From 01.09.2025

Contact

Franz Röhrer
franz.roehrer@tum.de
Phone: +49 (0) 89 / 289 - 26969
Room: 3017
http://www.ees.ei.tum.de