



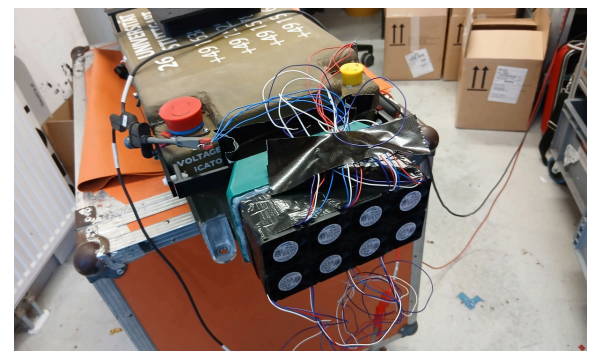
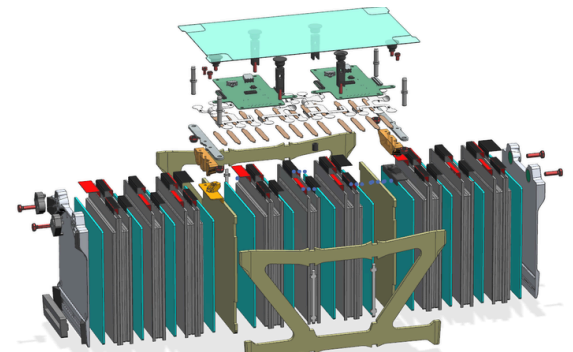
MECHANICAL AND ELECTRICAL CHARACTERIZATION OF LITHIUM-ION POUCH CELLS

Mechanical and Electrical Characterization of Lithium-Ion Pouch Cells

The performance and reliability of a high-voltage accumulator strongly depend on the electrical and mechanical behavior of the individual battery cells. Especially in a Formula Student race car, the cells are exposed to highly dynamic current profiles, high C-rates and changing thermal conditions. At the same time, pouch cells can expand during charging, discharging and aging, directly influencing the mechanical design and required compression of the battery module.

The objective of this thesis is to experimentally characterize the lithium-ion pouch cells used in the HV accumulator from both a mechanical and an electrical perspective. Mechanical investigations may include cell swelling, compression force and force-displacement behavior under different operating conditions. In parallel, electrical characterization can be performed using capacity tests, OCV measurements, pulse tests and internal resistance measurements at different states of charge and temperatures. The measurement data can subsequently be used to develop and improve models for the battery management system. A particular focus may be placed on state-of-charge estimation by combining methods such as Coulomb counting, OCV-based correction and temperature-dependent cell data. Depending on the scope of the thesis, the developed SOC estimation can be validated using dynamic current profiles representative of Formula Student operation.

The final objective is to establish a reproducible characterization procedure, derive relevant mechanical and electrical cell parameters and improve the understanding and estimation of the cell state during vehicle operation.



Tasks:

- Develop and conduct mechanical and electrical characterization tests for lithium-ion pouch cells
- Investigate cell behavior as a function of SOC, temperature, current load, preload and aging
- Evaluate capacity, OCV characteristics, internal resistance and dynamic voltage response
- Develop or improve a state-of-charge estimation algorithm using the measured cell data
- Derive relevant parameters and recommendations for the BMS and mechanical accumulator design

Requirements:

- Basic knowledge of battery technology, electrical engineering and measurement technology
- Interest in experimental testing, data analysis and battery management systems
- MATLAB, Python or comparable programming and data-analysis skills
- Experience with SOC estimation, signal processing or mechanical testing is beneficial
- Become a Rennteam member