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Bachelor-/Masterthesis

Parameterization and Comparison of Physics-Based Battery Models

○●●●● Measuring
○○●●● Research
○○○●● Data Analysis
○○●●● Python

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Motivation

Battery model types are typically chosen by means of different demands on the model. Full-order models (FOMs) describe the battery behaviour through partially differential equations (PDEs) in variable levels. These models suffer mostly from high computational complexity and are therefore not computable in reasonable time for many applications. Other models, like the equivalent circuit models (ECMs), are computational efficient and also exist in various shades of complexity but provide less information about inner processes. The reduced-order models (ROMs) are a kind of compromise by means of computation and accuracy. They are physics-based enough to provide insight in inner processes and just simplified enough to be computational efficient. However, the parameterization of ROMs comes with greater effort, containing destructive tests and more or less expensive measurements. This thesis mainly focuses on comparing the effort of parameterization and the accuracy for different model types starting with a given specific cell aiming to find a reasonable fast way from cell to ROM.

Objective

The goal of this thesis is to choose models out of the open source battery model library *PyBaMM* and identitfy the necessary parameters for calibrating the model as well as the possibilities to obtain the parameters, conduct necessary experiments for parameterization and finally validate and compare the models. The experimental effort to obtain the parameters and adapt the battery model, the computational cost and the accuracy of the final models as well as the possibilities infering/using parameters from literature to cut short the experiments should be compared to each other. Furthermore the model should be evaluated by means of how well it can act as data generator of many different possible operational scenarios to create data for machine learning training procedures.

Workflow

- Literature research
  - Reduced Order Models + parameters
  - Experiments for parameterization
  - PyBaMM
- Model parameterization
  - Plan experiments
  - Conduct experiments
  - Data post-processing
- Model validation
  - Analyse results
  - Model tuning
- Model comparison
- Data generation for various scenarios

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Remark: In a master thesis will be an intermediate presentation after the half of the time frame and for bachelor as well as master thesis, there will be a final presentation at the end. The Thesis can be done in english or german.