Karlsruher Institut für Technologie

Elektrotechnisches Institut

Bachelor-/ Masterarbeit

Health-Aware Optimal Design and Scheduling of Multi-Use Lithium-Ion Energy Storage Systems

Themenbereich

Design Tool,
Battery Aging,
Multi-Objective Optimization.

Schwerpunkte

- ☑ Theorie
- ☑ Literatur
- ☑ Simulation
- ☑ Programmierung
- ☐ Konstruktion
- ☐ Hardware
- ☐ Versuche

Studiengang

- ☑ Elektrotechnik
- ☐ Maschinenbau
- ☑ Mechatronik
- ☑ Informatik
- ☑ Mathematik

Beginn

Ab sofort

Ansprechpartner

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Unterlagen

CV,
Transcript of Records

Motivation

Battery aging is one of the key challenges in designing and operating modern Battery Energy Storage Systems (BESS). Neglecting degradation effects can lead to suboptimal system sizing and reduced economic efficiency. Yet, modeling degradation within the design framework remains challenging due to the complex nature of aging mechanisms. Within the project “Energy Storage in Production (ESiP)”, this thesis aims to integrate battery health awareness into the optimization process to achieve smarter and more sustainable BESS designs.

Aufgabenstellung

The work is structured into three main steps. First, semi-empirical aging models for major lithium-ion chemistries are to be collected and compared, and their parameters determined from public battery test datasets. Then, these models will be embedded into an existing multi-use BESS sizing and scheduling tool (in Python or Matlab environment). Finally, the extended tool will be applied to realistic case studies, such as industrial peak-shaving, residential PV self-consumption, and dynamic tariff optimization, to identify the optimal battery type, capacity, and operation strategy. By comparing conventional and health-aware design results, the influence of health-aware optimization on long-term economics, reliability, and sustainability will be demonstrated.

- Collect and parameterize semi-empirical aging models of Li-ion batteries.
- Integrate battery aging into the multi-use BESS design tool.
- Evaluate health-aware BESS sizing across realistic application cases.

Good knowledge of MATLAB and Python is beneficial. Background in lithium-ion batteries, battery aging, or optimization algorithms is an advantage.