Lehrstuhl Steuerung, Regelung und Systemdynamik

Master Thesis

Practical, Programming, Theory

Prognosis of Lithium-Ion Battery Lifetime

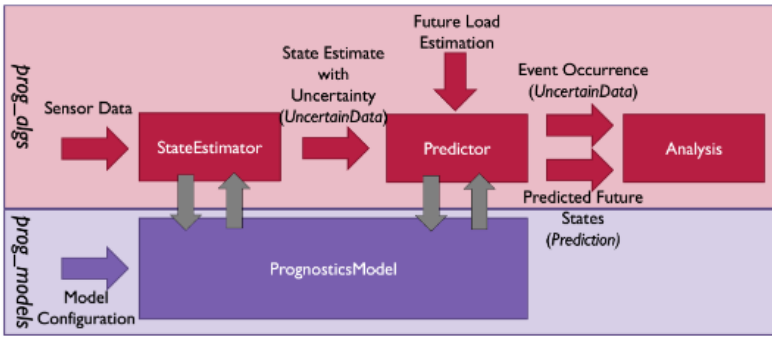
Keywords: Python, Battery, Prognosis

Conditions:

Duration:	6 months
Requirements:	Programming skills in Python
Language:	English
Target group:	Master students

Contents:

Lithium-ion batteries (LIBs) are widely used in electric vehicles, consumer electronics, and electrical grids due to their long cycle lifetime, high energy density, and light weight. However, constant usage leads to material aging and capacity fade, causing battery degradation and potential system malfunctions like thermal runaway or explosions. Battery degradation is a complex electrochemical process influenced by factors such as temperature, current, and cycling depth. Understanding the aging mechanism is crucial for performance and safety reliability.



Prognostics predict the remaining useful lifetime (RUL) and end of life (EoL) of batteries to reduce sudden failure risks and optimize maintenance schedules. Prognostic models can be model-based, data-driven, or hybrid-based. These models analyze aging stages and stress factors to estimate the current state and predict future events. The NASA Prognostics Python Packages (ProgPy) provide a framework for developing prognostics and health management models, including state estimation and RUL prediction. This work aims to use existing LIB datasets from the NASA Ames Centre of Excellence (PcoE) in combination with ProgPy packages for state estimations and RUL predictions. The datasets consist of random usage by applying a dynamic charging and discharging where the battery is receiving a nonconstant energy and demand to charge and discharge in interrupted manner (the charging and discharging cycles are not complete), leading to a simulation of real usage behavior.

Thus, the goals of this work are:

- Analysis of open-source data sets about battery degradation that simulate real usage behavior
- Implementation of models for RUL and EoL predictions using ProgPy
- Analysis of capacity fade to develop the RUL, EOL
- Analyzing model accuracy with respect to training data
- Complete and detailed documentation/presentation of the research results

Supervisors:	Imene Benrabia, Jonathan Liebeton	Univ.-Prof. Dr.-Ing. D. Söffker
Office:	MB 361, MB 351	MB 341
E-Mail	imene.benrabia@uni-due.de, jonathan.liebeton@uni-due.de	soeffker@uni-due.de