SCIENCE · PASSION · TECHNOLOGY

Open Thesis / Project

Physics-Informed Neural Networks for Modeling Aging of Lithium-Ion Batteries

Embedded Learning and Sensing Systems Group

Motivation

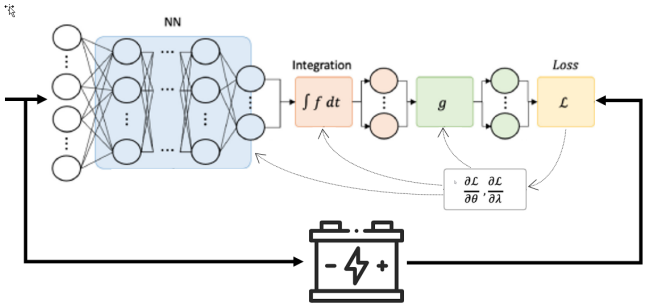
Due to deep learning's success in areas such as image recognition and natural language processing over the past decade, its application in scientific and engineering problems has seen a significant increase. With the challenge of limited data from physical systems, due to high experimental costs, the integration of physics principles into machine learning models is becoming increasingly popular. In this context, Physics-Informed Neural Networks (PINN) have gained significant attention for their effectiveness in tackling complex problems, such as solving dynamic systems (forward problems) and identifying system parameters (inverse problems) across various domains. Estimating the degradation behavior, specifically the aging parameters, of the electronic model of Lithium-Ion Batteries from a limited dataset is crucial for the rapid development of new battery designs.

Target Group

Students in ICE, Computer Science or Software Engineering.

Thesis Type

Master Project / Master Thesis.



Adapted from https://arxiv.org/pdf/2311.16374.pdf.

Goals and Tasks

The goal of this work is to develop data driven digital twin of batteries by combining deep neural networks and electronic models, similarly as proposed in https://arxiv.org/pdf/2311.16374.pdf. Both, synthetic data generator and real measurement data will be available in the course of the project. The project includes the following tasks:

- Familiarize yourself with PINNs and their use in the context of state and parameter estimation of LiB;
- Develop forecasting PINNs based on synthetic data;
- Fine-tune developed PINN models to real data;
- Compare the results to SOTA data-driven and electrochemical models;
- Summarize the results in a written report.

Requirements:

- Eager to learn and explore the utilization of PDE into DeepNN in the context of a real industrial application;
- Proficiency in Python;
- Prior experience with machine learning frameworks (PyTorch, TensorFlow) is highly recommended.

Tools & Equipment

- A laptop (GPU infrastructure will be provided if needed).

Contact Persons

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