Predicting Remaining Useful Life (RUL) of Lithium-Ion Batteries Using Artificial Neural Networks

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Project Goals/Objectives/Novelty

This project aims to develop a traditional machine learning model using sklearn to predict the lithium-ion battery's state of health (SoH) and useful life (RUL), using voltage and temperature profiles from given discharging & charging cycles. Given data and cycle, our goal is to predict the battery's remaining useful life (RUL) in Ah.

Description of Datasets

Experiments on Li-Ion batteries. This dataset records the impedance as the damage criterion by charging and discharging the batteries at different temperatures. "The data set was provided by the Prognostics CoE at NASA Ames. [1]"

Data Source: NASA Battery Datasets.

Project Methods and Packages

Methods:

- The team will leverage the Sequential Neural Networks, Recurrent Neural Networks, Long Short-Term Memory (LSTM), and Gated Recurrent Networks to predict lithium-ion batteries remaining useful life (RUL).
- In addition to that, different visualization techniques will be leveraged to visualize actual vs. predicted scores and models' performance.

Packages:

- Preprocessing and loading the Matlab dataset (scipy and loadmat).
- Model Building (Keras and TensorFlow).
- Hyper Parameterization (sklearn, Keras and TensorFlow).
- Visualization (Shapley and seaborn) TensorFlow, sklearn, matplotlib, pandas, and NumPy.

Expected Learning Outcomes:

"The continuous changes in the battery's internal and external environmental conditions and the generalization problem of the prediction method itself are still difficult to accurately predict the remaining life in practical applications.[2]" However, the expected outcomes include effectively predicting batteries' useful life (RUL) based on their charging and discharging cycle using ANN within a real-world scenario of NASA's battery data**.**

References:

[1] B. Saha and K. Goebel (2007). "Battery Data Set," NASA Ames Prognostics Data Repository (http://ti.arc.nasa.gov/project/prognostic-data-repository), NASA Ames Research Center, Moffett Field, CA

[2] Wang S, Jin S, Deng D and Fernandez C (2021) A Critical Review of Online Battery Remaining Useful Lifetime Prediction Methods. *Front. Mech. Eng* 7:719718. doi: 10.3389/fmech.2021.719718