Machine Learning Project - Remaining Useful Life Prediction for Lithium-Ion Battery

Introduction and Motivation:

In the context of the modern industry booming, lithium-ion battery technology has been widely used in vehicles, household equipment, communications, smartphones ,Laptops and other fields. Compared with traditional batteries, lithium-ion batteries have many advantages including high output voltage, high energy density, low self-discharge, long cycle life, high reliability, etc. . And these advantages have contributed to wider applications of lithium-ion batteries in more areas. At the same time, the safety and reliability of lithium-ion batteries have always been a very important issue in their applications . Battery malfunction may lead to the performance degradation or malfunction of powered equipment or systems, which will increase the cost. Especially if lithium-ion batteries for electric devices (early Samsung handheld devices) are mismanaged, it will cause fire and explosion.]. As a key power source for a variety of industrial systems, lithium-ion battery defects often lead to fatal system failures .

Therefore, accurate prediction of Remaining Useful Life (RUL) of lithium-ion battery plays an increasingly crucial role in lithium-ion battery state estimation and health management

The industry has been conducting research in establishing a battery life model that can accurately predict the remaining life of batteries. The methods vary from using battery physical model and data-driven model. Recently, machine learning techniques have been a trend in research, including the use of SVM, ANN, and RNN, etc.

Problem statement :

This project is aimed at creating an efficient machine learning model for Li-ion battery RUL based on techniques such SVM,Regression and Deep Learning Neural nets. However, the primary focus of the project will be on choosing modeling methods and algorithms to improve the accuracy of prediction.

Dataset:

I have used a set of cycle life test data of Li-ion batteries provided by PCoE (NASA Prognostic Center of Excellence, PCoE) for public use.

Approach:

As per the research paper , the process of designing starts with the data preprocessing . Techniques such as handling missing values, handling null values, (NaN,-9999) values in the dataset.

Then deploy traditional models on the processed data . Models such as Linear Regression, SVM and Bayesian Regression. Then evaluate their accuracy and error. Finally , build and train artificial neural network on the same dataset. And evaluate its accuracy .

Summary

RUL prediction is of great importance to the state estimation and health management of lithium-ion batteries. The developments of AI and deep learning areas provide new promising methods for lithium-ion battery RUL prediction. The main contributions can be summarized as follows:

- Dataset collection and preprocessing
- Feature extraction
- We have demonstrated the whole process of developing machine learning models to the problem of Li-ion battery RUL prediction.

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