

Predicting Cycling Conditions of Lithium-ion Batteries through Air-free Disassembly Imaging

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Introduction

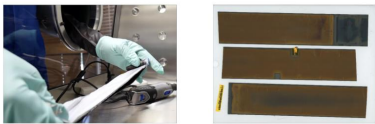
Batteries' degradation mode under different cycling conditions remains puzzled. This project aims to a simple neural network and a CNN to predict batteries' cycling conditions by inputting 12 extracted features and cropped air-free disassembled images respectively.

Predicting

The simple NN showed that batteries' images are highly related to charging rate. The final CNN model achieved high accuracy of 70% on predicting charging rate only (human level performance is 80%)

Data

1. Cycle batteries at different charge/discharge rates and cycle numbers (Ground Truth Labels)
2. Transfer battery into air-free glove box



3. Disassemble and scan the electrode
4. Reconstruct the colored electrode image
5. Normalize pixel values by dividing 255

Simple Neural Network

Features

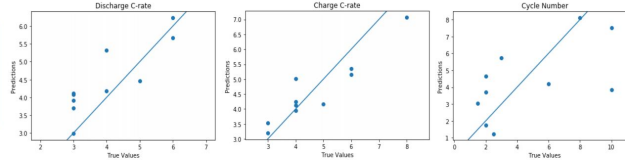
Feature 1-2: Mean, STD of pixel values
Feature 3-8: Mean, SD of R/G/B values
Feature 9-12: Fractions of light/dark pixels
(32 images in training set, 10 images in test set)

Structure

Layer	Number of Nodes	Activation
1	64	ReLU
2	64	ReLU
3	3	Linear



Result

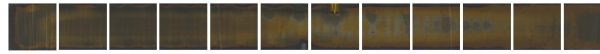


Discussion

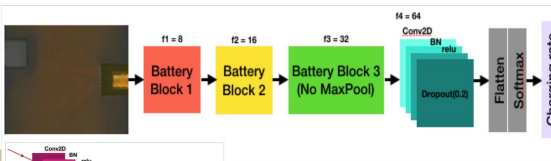
Although the accuracies are erroneous, we found it shocking images are related to charging rates. Next, we will try predicting it by a better deep learning structure – CNN.

Convolutional Neural Network

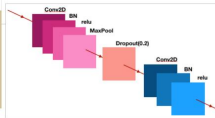
Input



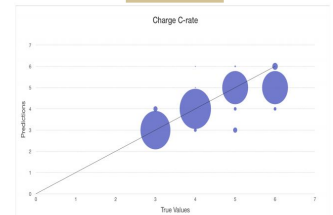
Structure



Battery Block



Result



The CNN achieved not only small error but accurate predictions. Interestingly, 6c is often categorized as 5c. We can study the scientific reasons behind it and maybe go over 80% acc if 6c predictions can be improved.