电池生命周期管理系统

简要工作汇报

April 28，2024

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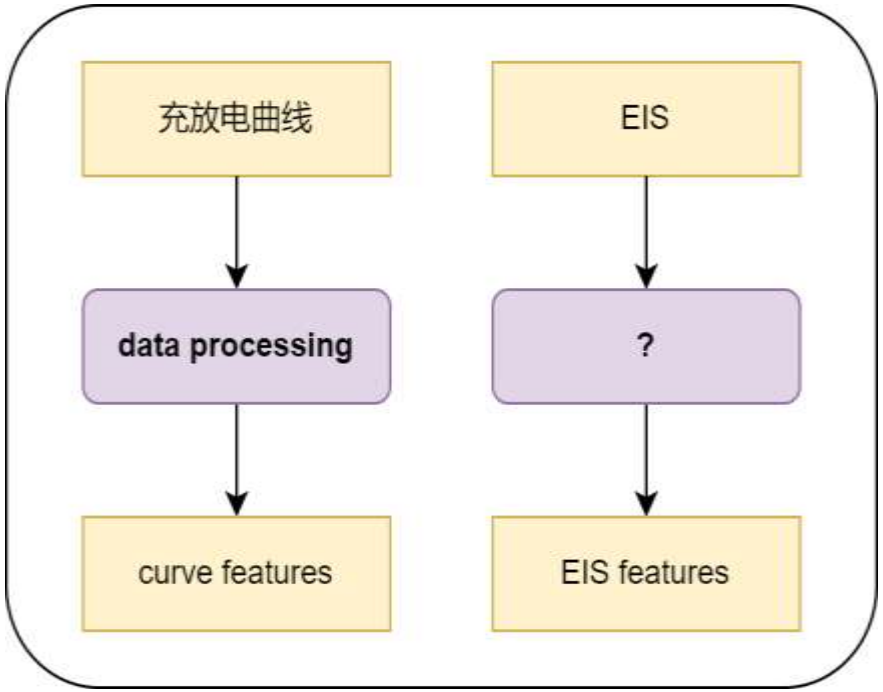
Proposed Methods（原方法）

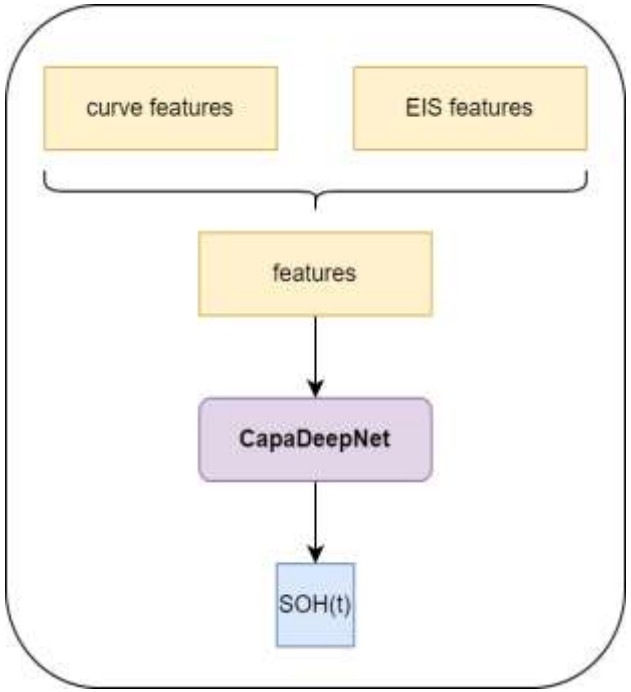
Step1

Data Processing



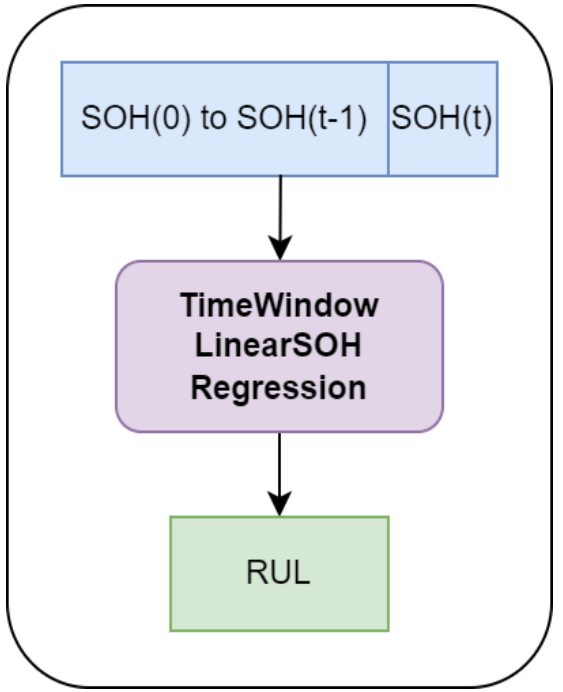
Step2

Predict SOH(t)



Step3

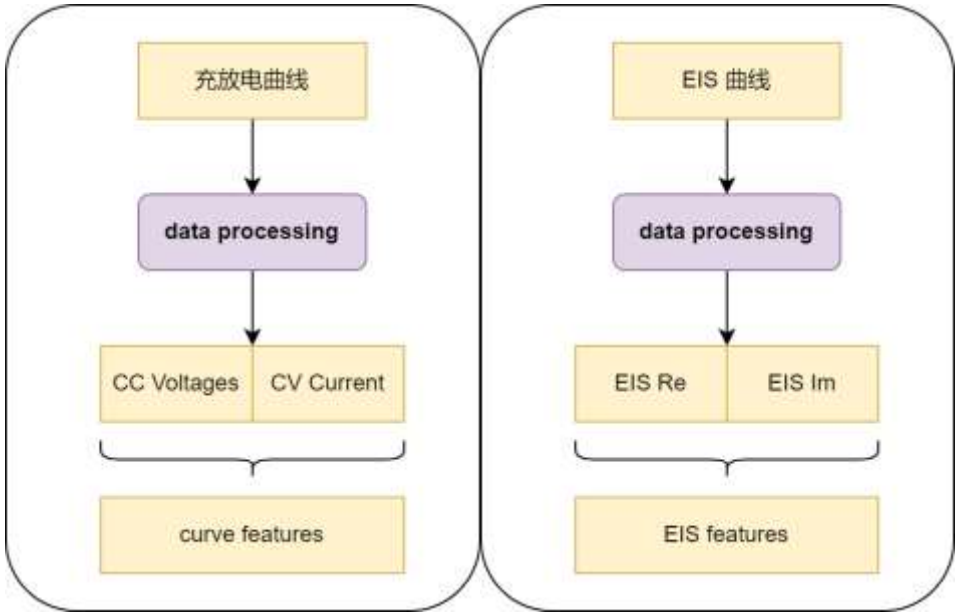
Estimate RUL



Proposed Methods（目前采取的方法）

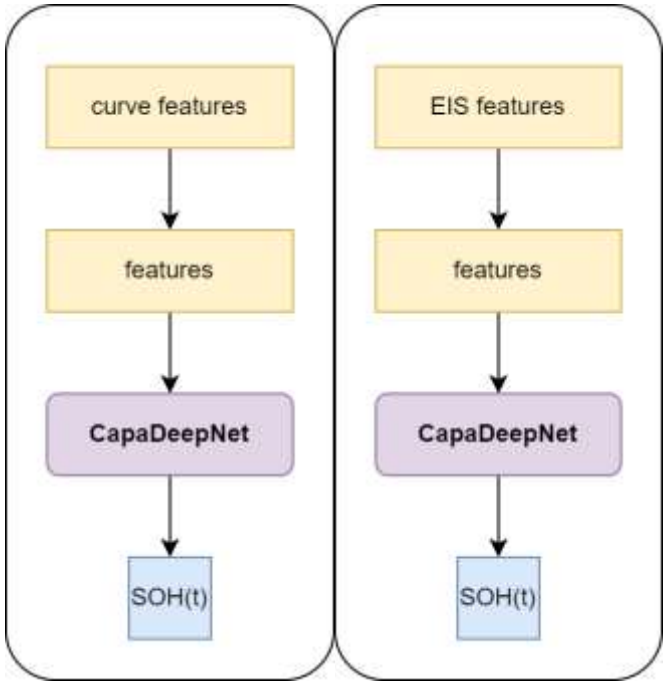
Step1

Data Processing



Step2

Predict SOH(t)



因数据集的限制，
充放电曲线和EIS单独做：我们的数据集只做充放电曲线；3633835数据集只做EIS；NASA数据集暂且弃用

我们测量的数据集

Data Exploration

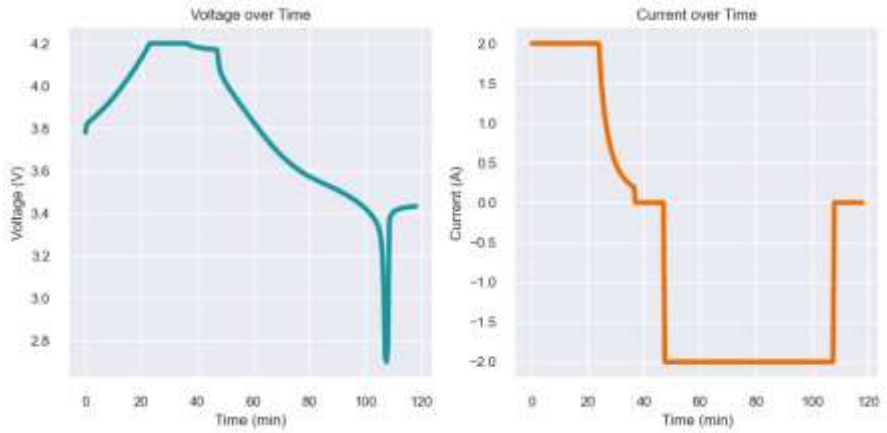
Datasets:

- **6 battery already have**
- **2 battery in future**

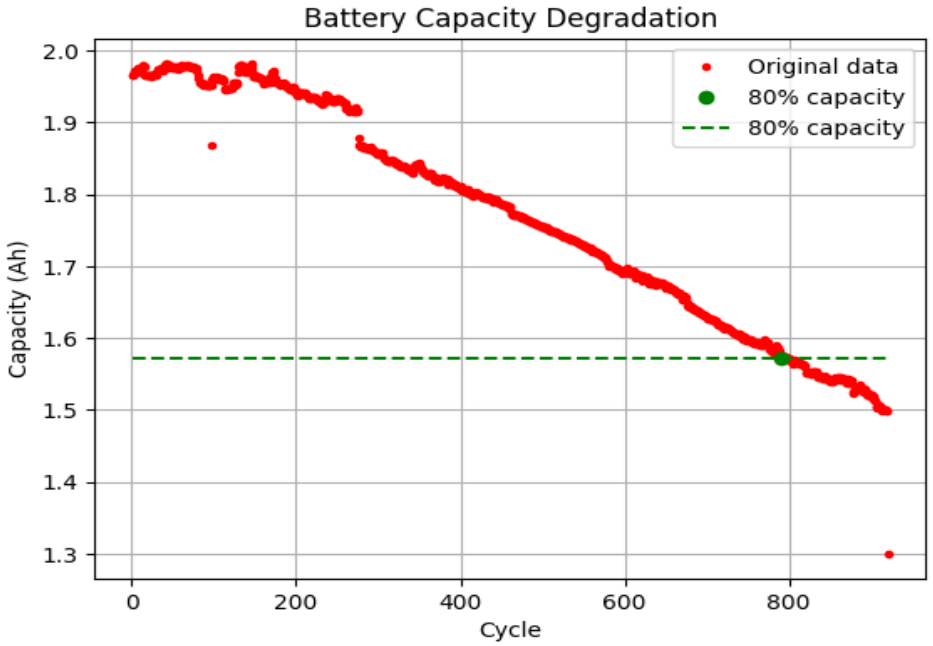
battery	charging protocol	CC current	CV voltage	cycle
0	CC-CV	2.0A	4.2V	859
1	CC-CV	2.0A	4.2V	869
2	CC-CV	2.0A	4.2V	900
3	CC-CV	3.0A	4.2V	894
4	CC-CV	3.0A	4.2V	844
5	CC-CV	3.0A	4.2V	920

Data Exploration

Data in datasets:



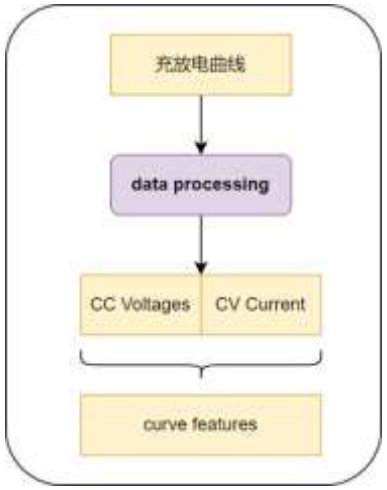
Battery charging curves
(1 curve per cycle)



Discharging capacity

Data Processing

Step1: Data Processing

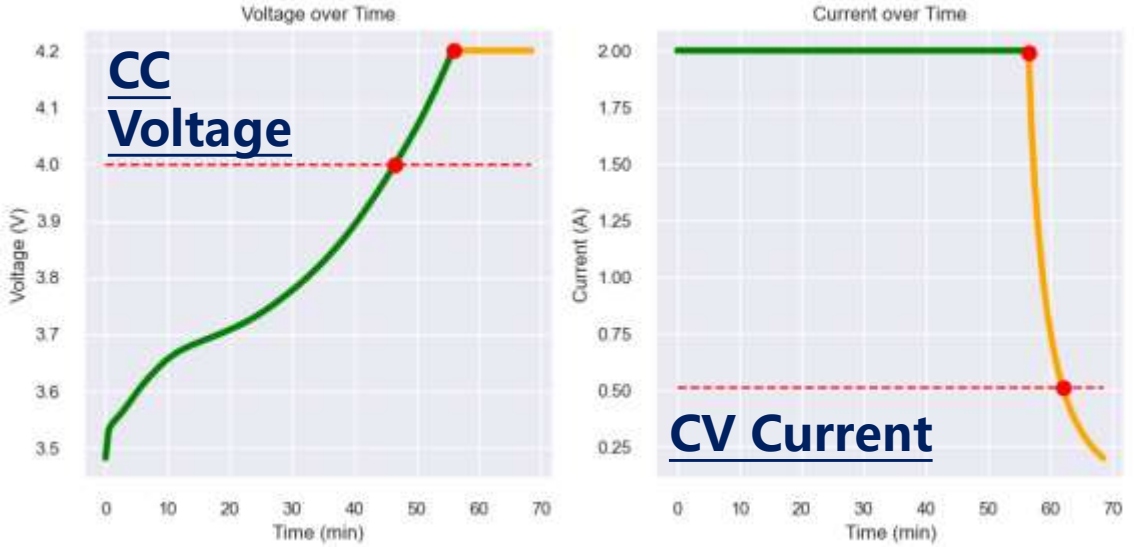


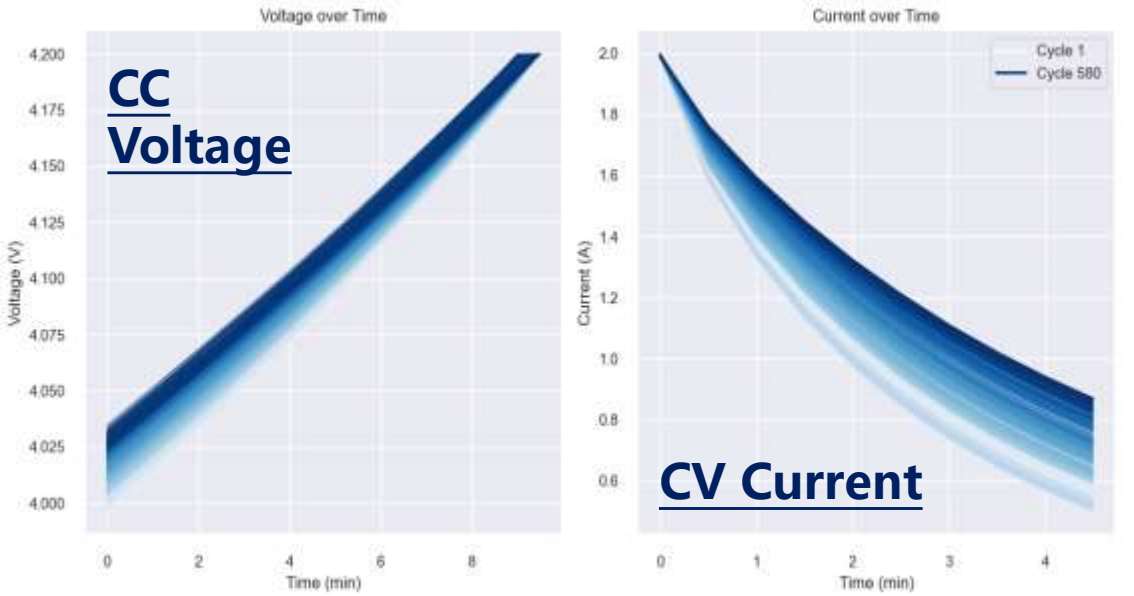
Sample points number

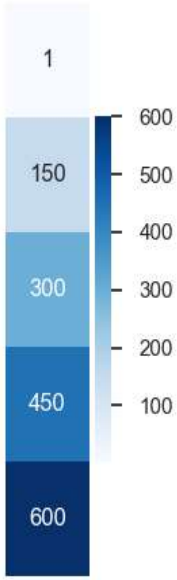
CC -> U: 4.0V ~ 4.2V; I=2.0A
CV -> I: 2.0A ~ 0.5A; U=4.2V

Sample points number

CC Voltage: 20
CV Current: 10

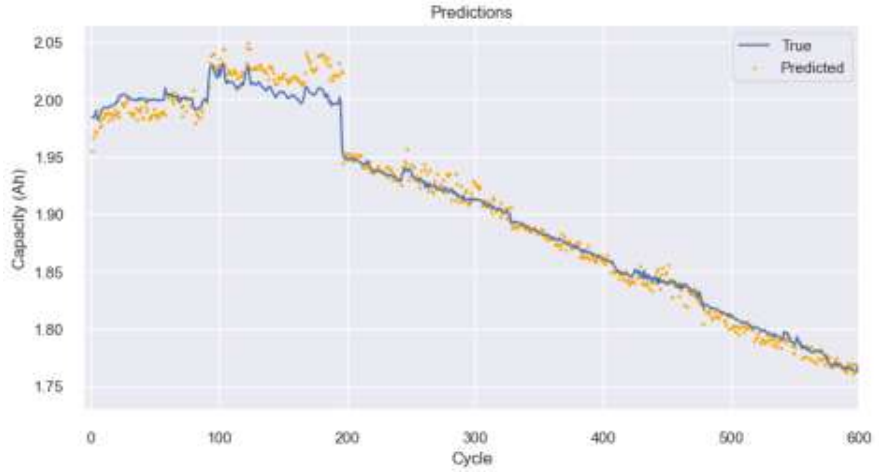




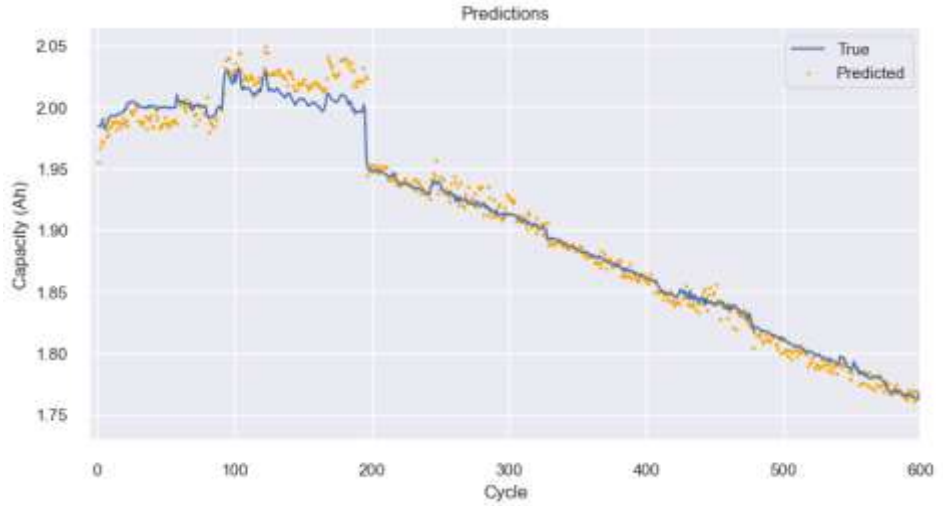


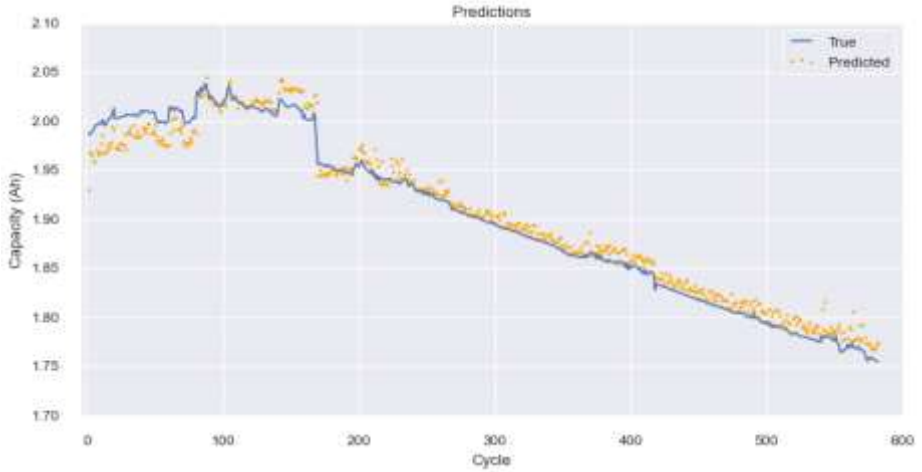
Experimental Results

Step2: CapaDeepNet Results



Battery 0: Training Data (training and validation)

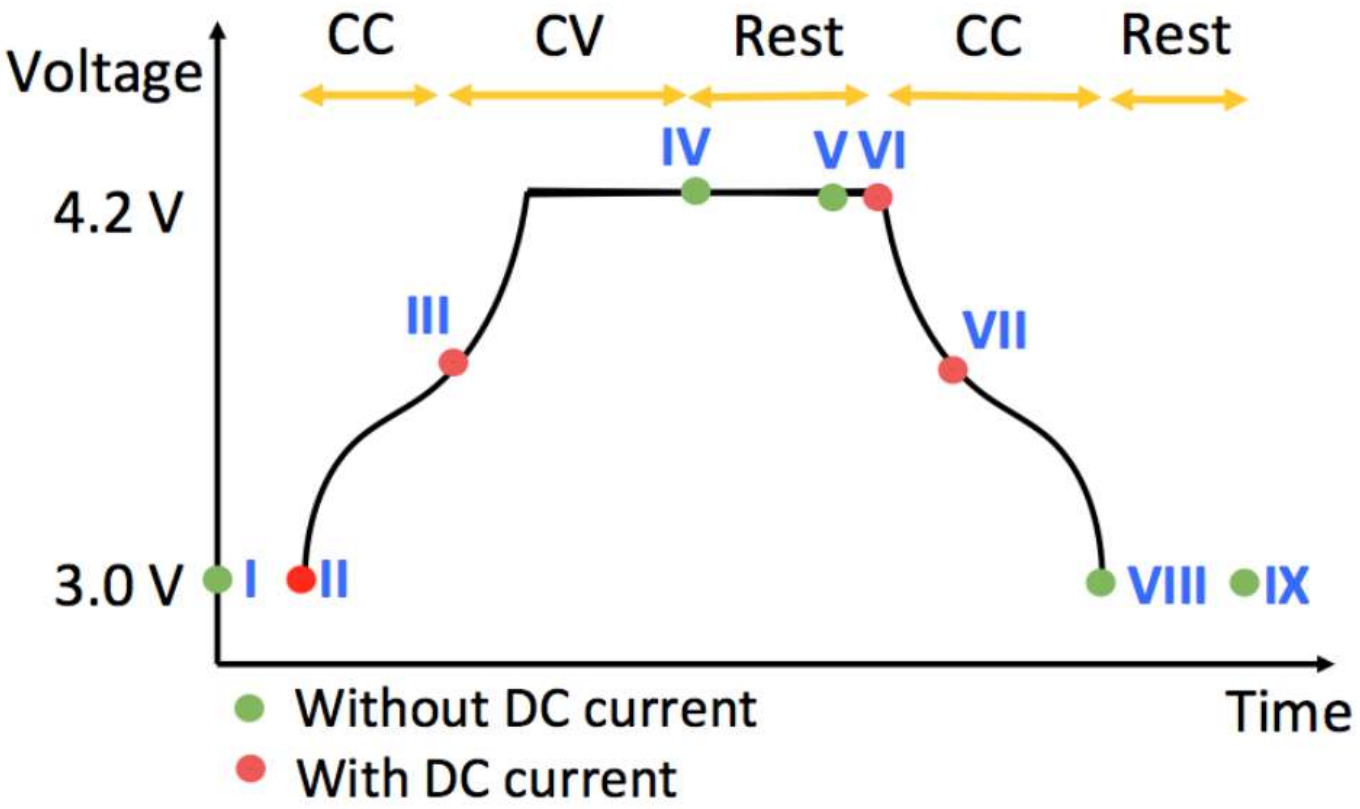




Battery 1 and 2: Evaluation

3633835 数据集

3633835 数据集 – EIS 测量点（State）



本数据集在每一个充放电循环中，
对于每个电池，
测量了共计九个状态（State）的EIS曲线

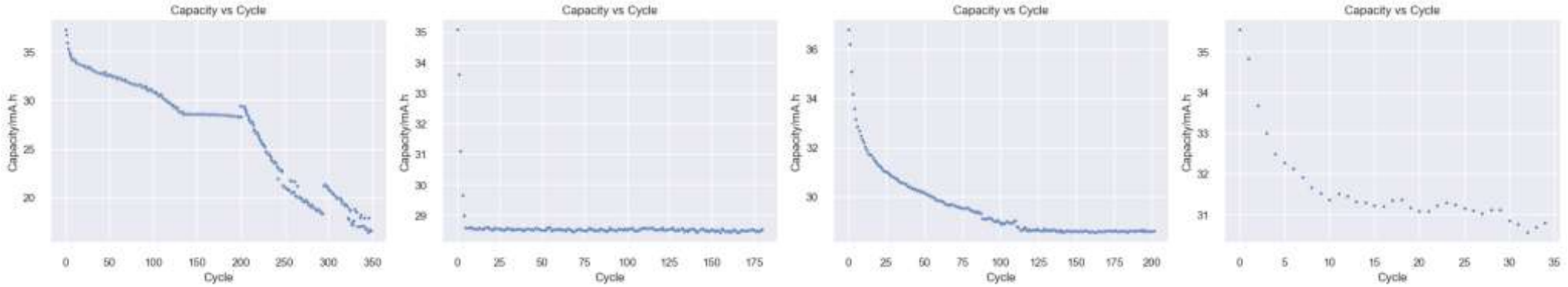
注：某些电池并未测量全部的九个状态，仅测量了1-6，9。

数据来源： https://zenodo.org/records/3633835
图片引用自：Identifying degradation patterns of lithium ion batteries from impedance spectroscopy using machine learning

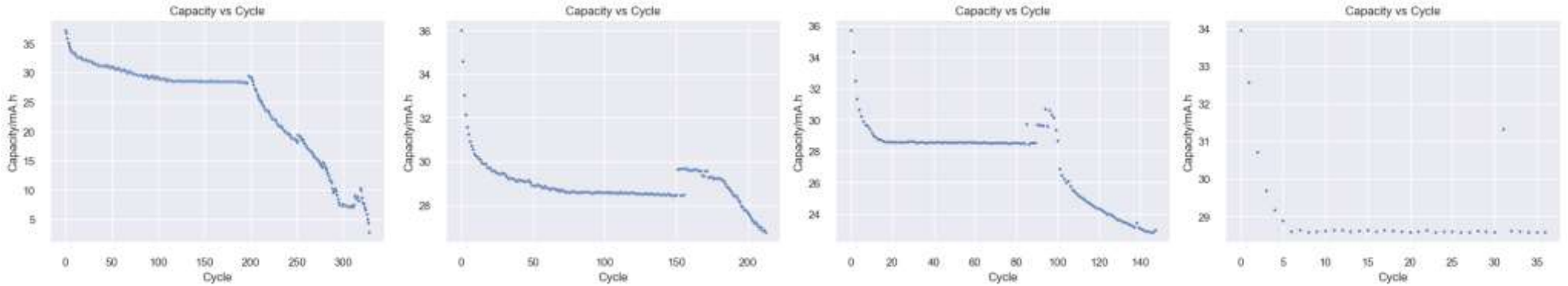
3633835 数据集 – Capacity

本数据集包含8块25 ℃ 、2块35 ℃ 、2块45℃的电池
我们只观察25℃下的八块电池的容量下降

发现容量曲线并不都十分具有参考意义：
电池2、3、6、7在初期发生断崖式下滑；
电池4、8采样点过少；
只有电池1、5曲线较为具有实验价值。
因为电池1的EIS图谱有反常部分，故我们选取电池5进行实验



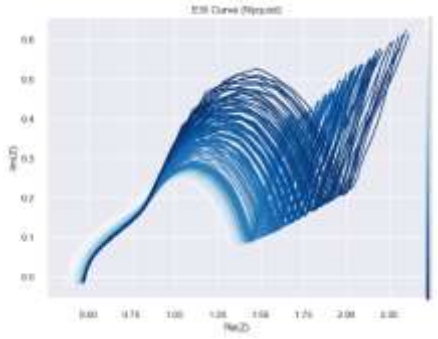
1 2 3 4



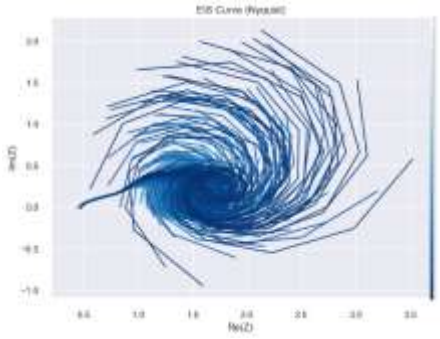
5 6 7 8

3633835 数据集 – 电池5：EIS

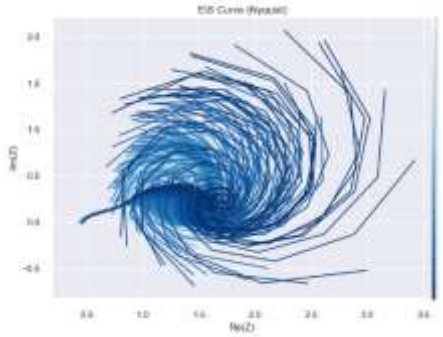
观察电池5在不同State的EIS图谱，因State1、State5的EIS谱线较为清晰且可解释性较好。
又因为根据原论文表述，State5实验结果为最佳。
故选取State5的EIS曲线进行进一步实验



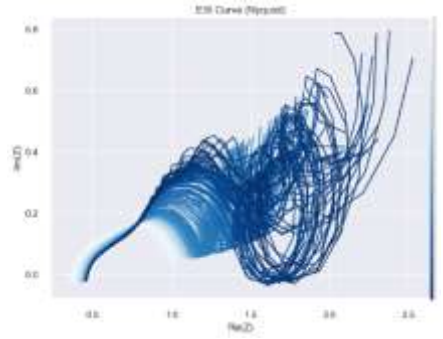
State 1



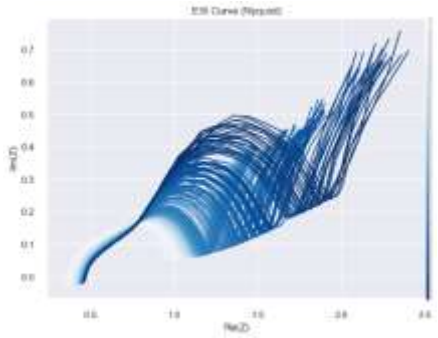
State 2



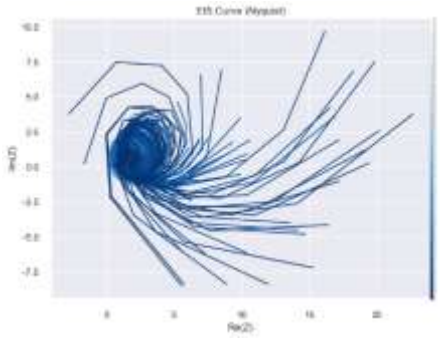
State 3



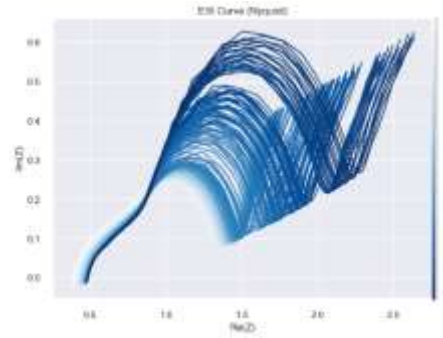
State 4



State 5



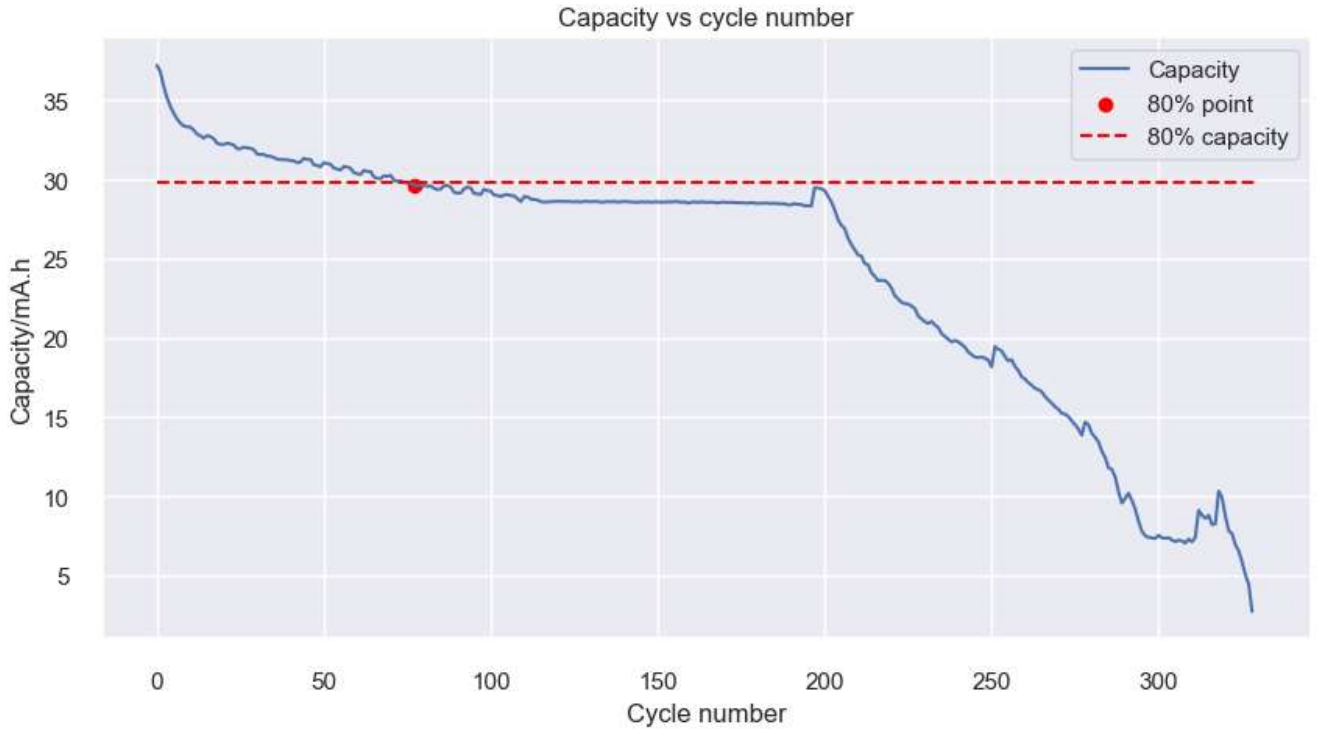
State 6



State 9

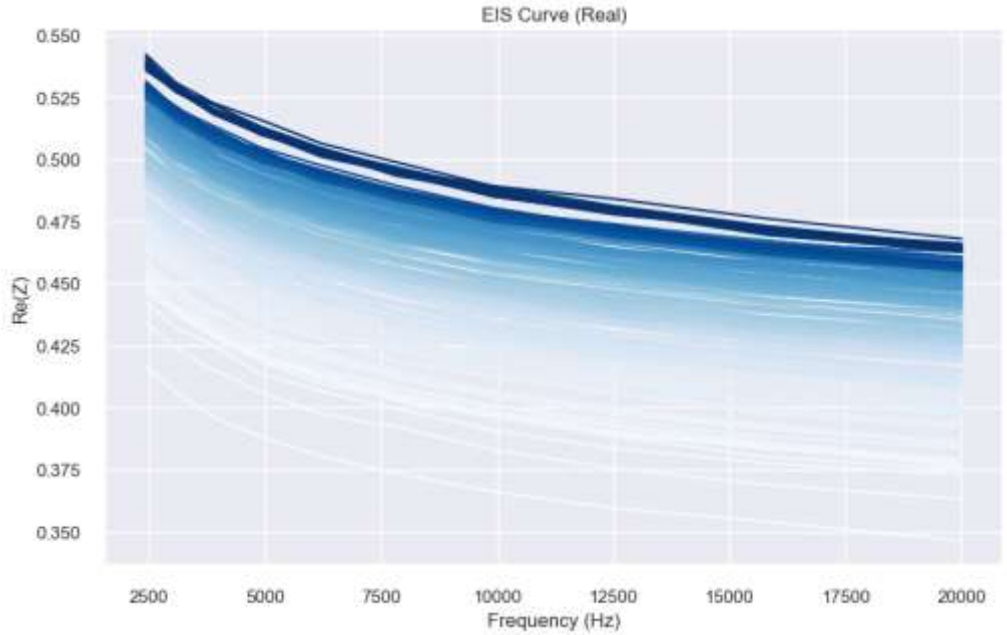
3633835 数据集 – 电池5：容量下降曲线

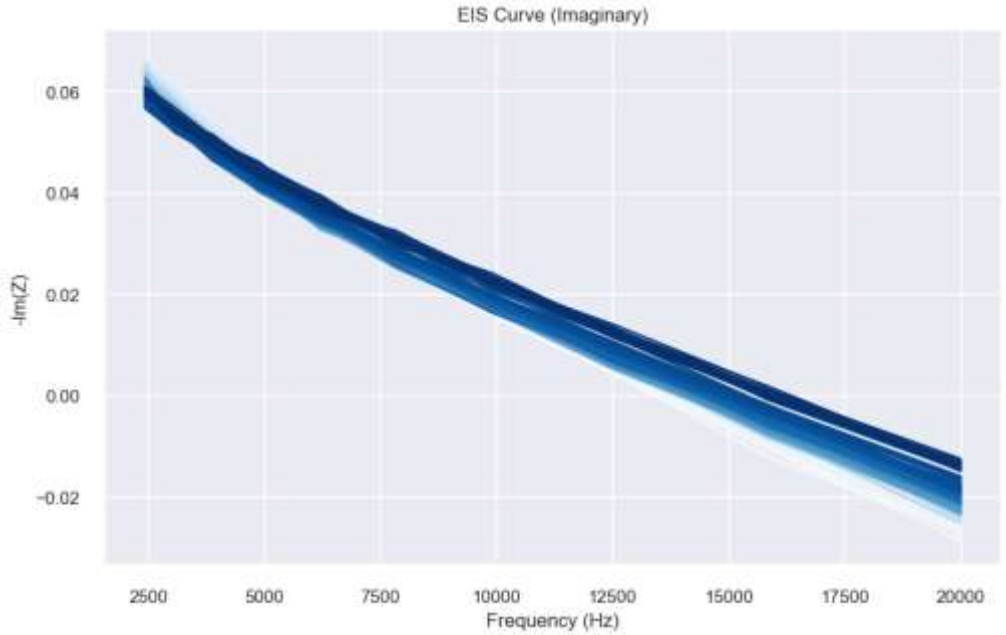
其百分之八十点如图所示，因此我们只关注前125次循环的实验数据



3633835 数据集 – 电池5：特征值与预测结果

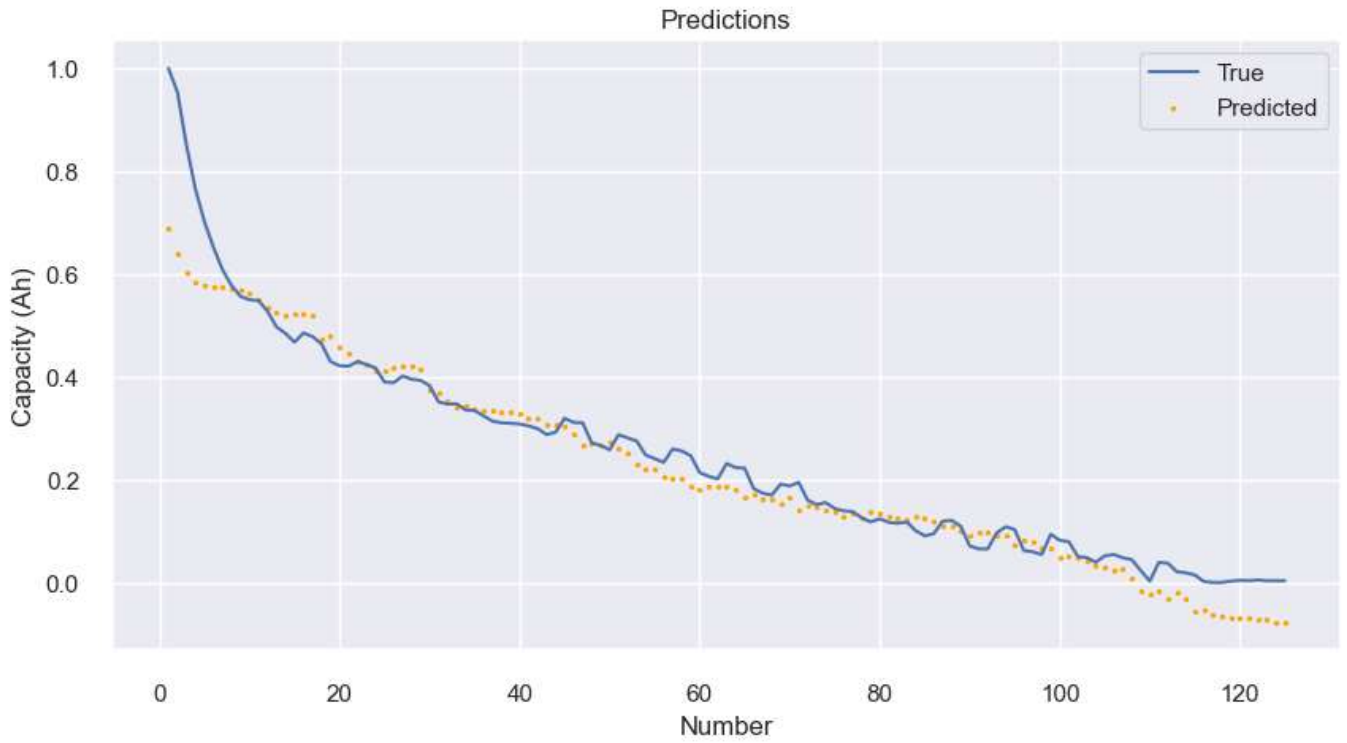
观察EIS发现实部vs频率有良好的特征；
而虚部vs频率有较多重叠的部分。
简单起见，仅选取实部作为特征值（长度为10）输入到预测模型中





3633835 数据集 – 电池5：特征值与预测结果

预测结果如图所示



THANK YOU!