Week 1 meeting

07/10/2020

Shawn

Meeting content

- Status update
- clarify actions that need to be done for projects to move forward
  - Goncalo:
    - share the overleaf's
    - start an overleaf for the EIS project
    - give access to WMG's data
    - planning
  - Richard/Shawn: start a Git.Repository for the EIS project
  - Calum: pass on know-how on getting the IR from the WMG data

My slides

Q1: time series of capacity is not consistent with EIS data

According to the statements in that paper ‘Out of all the states of I–IX, the model is most accurate at electrochemically stable states (i.e. the state V/IX, which is fully charged/discharged after resting), where electrochemical measurements on cells are more consistent.’

Therefore, the data of state 9 (25C02) is presented for an example, herein:

- ❑ Capacity data recorded 181 cycles, however, the EIS data recorded 250 cycles

(**very confused, should we use 180 cycles only?)**

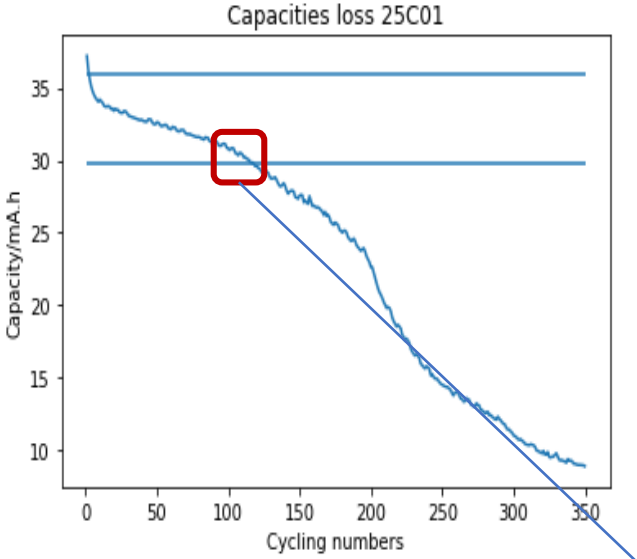
- ❑ In addition, the time span of capacity test (180 cycles) is 2583496.703176448 seconds (y – output, in model)

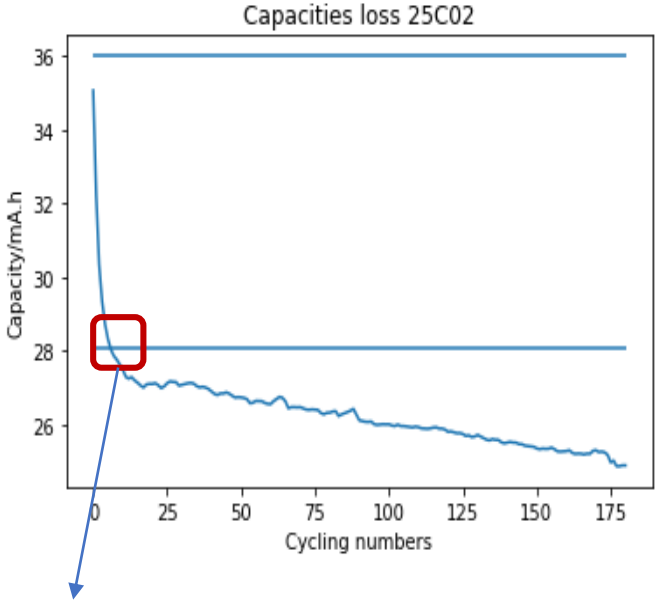
The time span of EIS test (180 cycles) is 2629138.9913500003 seconds (x – input, in model)
The discrepancy is 45642.28817355214 seconds (around 760 minutes)
(imply - **the quality of their data is suspicious and data is incomplete, missing data, should we ignore this time discrepancy between x and y and then assume one set of x does match y?)**

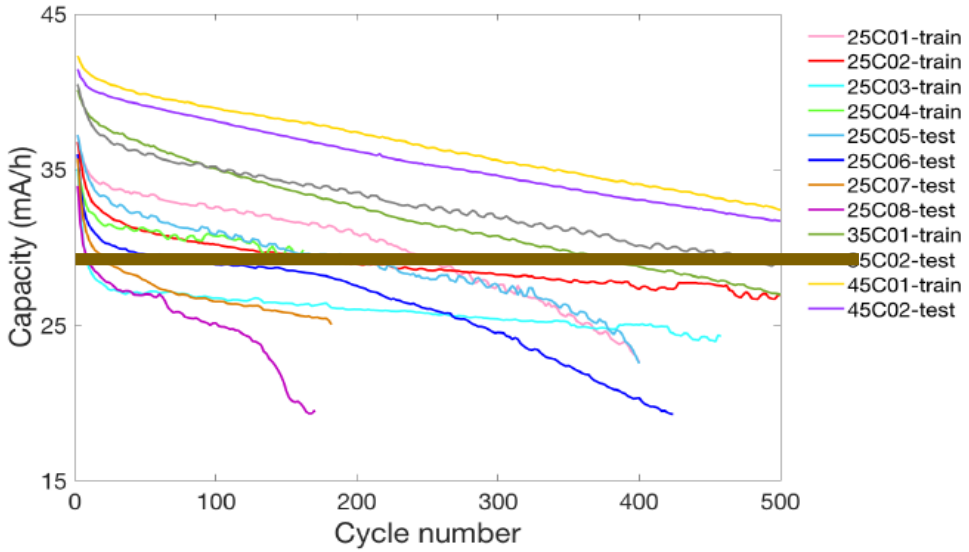
My slides

Q2: initial capacity

According to the statements in that paper ‘All cells underwent 30 cycles at room temperature of 25 °C before different temperatures were set. The battery is cycled until its end of life (EoL), which is defined as when capacity drops below 80% of its initial value after undergoing these 30 cycles.’







I am afraid that the valid capacity data before EoL may be not enough to identify the parameters
Their capacity retention curves are different from the data provided

My slides

Model construction

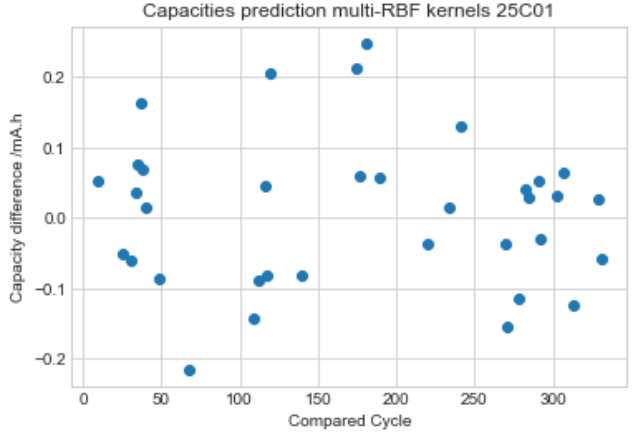
According to the statements in that paper

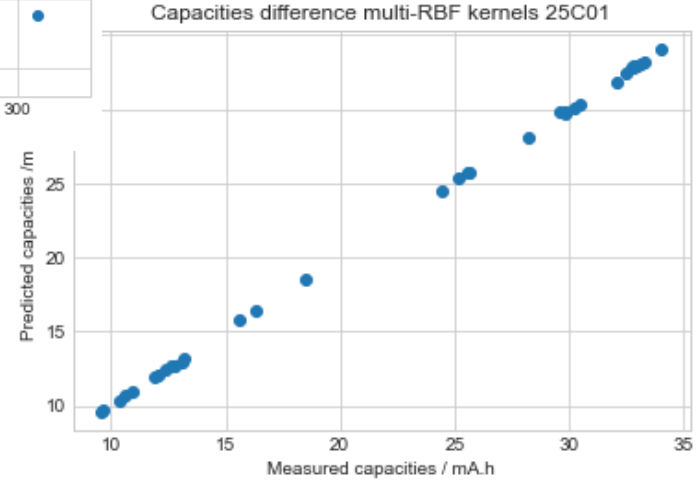
Gaussian process regression is not different, herein, y is the capacity vector and x is a matrix with 120 variables represent the real (Zre) and imaginary (Zim) parts of impedance spectra collected at 60 different frequencies (ωn, n = 1, 2, ..., 60) in the range of 0.02 Hz–20 kHz at the current cvcle

Therefore, I use multi-RBF GPR model with 120 kernels

```
# train / test split
size = len(result_y)
labels = [i for i in range(size)]
import random
random.shuffle(labels)

train_size = size * 9 // 10
train_y = result_y.iloc[labels[:train_size]]
test_y = result_y.iloc[labels[train_size:]]
train_x = result_x.iloc[labels[:train_size],]
test_x = result_x.iloc[labels[train_size:],]

# fit model

from sklearn.gaussian_process.kernels import RBF, WhiteKernel
from sklearn.gaussian_process import GaussianProcessRegressor

kernel = 1.0 * RBF(120*[1.0]) + WhiteKernel()
gpr = GaussianProcessRegressor(kernel = kernel, random_state=0).fit(train_x, train_y)

pred_y=gpr.predict(test_x, return_std=True)
print(gpr.score(train_x, train_y))
print(gpr.predict(test_x, return_std=True))
print(pred_y[0]-test_y)
```

R^2 = 0.9999553372939107





My slides

DC resistance extraction from EIS data

Lib installed, works, loop to extract the resistances – this week

Concern –
Have to compared with the measured impedance Z
May be compromised due to the estimation of Z, I will test the terminal voltage prediction later on

Summaries

Status update (done)
- Richard+Shawn in contact re EIS
- Shawn raises issues with the data EIS data, which makes the action point of figuring out if the data is good or not.

clarify actions that need to be done for projects to move forward
- Goncalo:
  - share the overleaf's (done)
  - start an overleaf for the EIS project (done)
- Richard/Shawn: start a Git.Repository for the EIS project (in progress)
  - **action point:** share the gib repo with goncalo & calum
- Calum: pass on know-how on getting the IR from the WMG data (done; Richard will use this as basis to make progress on getting IR curves)

In terms of task breakdown.

Richard
- WMG data for the internal resistance curves
- catch up with Calum on Friday afternoon
- (possibly continue to look at the EIS data); see MSc dissertation in attchmnt

Shawn
- look into figuring out is the EIS data is good or not
- Attempt to extract internal resistance curves from the EIS data, possibly using the python library shared earlier
- Contribute to the "Where is the data" paper
- Read the Msc dissertation I'm sharing

Calum
- Provide support to Richard
- Continue to do what you are doing

Next meeting
- preliminarily, we're meting back on Tuesday next week