Predicting Lithium-ion battery lifetimes using LSTM and RNNs

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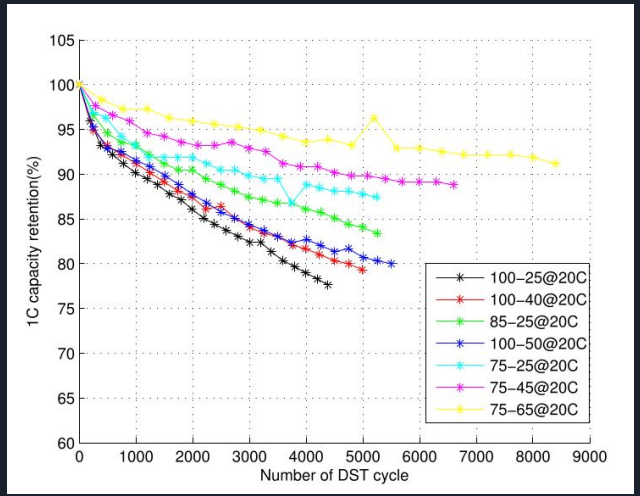
Introduction

- Lithium-ion rechargeable batteries are used everywhere
  - Electric cars
  - Phones
  - Computers
- Movement of ions causes mechanical strain
- Measurable decline in battery capacity over many charge/discharge cycles
- Main idea: use ML to model the decline



Xu, B., Oudalov, A., Ulbig, A., Andersson, G., & Kirschen, D. S. (2018). Modeling of Lithium-Ion Battery Degradation for Cell Life Assessment. IEEE Transactions on Smart Grid, 9(2), 1131–1140. doi:10.1109/tsg.2016.2578950

Methods

- NASA DASHlink battery aging dataset for Li-ion 18650 sized rechargeable batteries
  - Terminal & charger voltage
  - Output & charger current
  - Cycle time
  - Impedance data
- Clean using a Savitzky-Golay filter
- Recurrent neural network (RNN)
  - One- and two-stage
  - Long short-term memory (LSTM)
  - Desired prediction: remaining useful life for the battery
- Implement in TensorFlow using Python
- Choose parameters based on experiments and performance of the model

Potential Results

- Predict remaining battery lifespan
- Show that RNNs work well with time-based data
- Determine most effective metaparameters
  - Number of nodes
  - Number of stages
  - Length of training session in epochs
  - Batch size

Discussion

- Battery life predictions can help prevent failure
  - Samsung battery fires
- Understanding how battery parameters affect their lifespan
- What can be done with restricted resources?
  - No GPUs
  - Edge computing
- Are RNNs best for modelling time series data?
  - Applicable to other problems, e.g. COVID-19, heart disease onset, Alzheimer's

References

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