Docket #: S17-411

A Data-driven Model for Lithium-ion Battery Capacity Fade and Lifetime Prediction

Battery longevity and performance are critical to all applications yet require the most time to test during development. Battery capacitance degrades non-linearly, which also makes predicting the number of cycles required to reach a specific percentage of remaining capacity difficult. Here, researchers have developed a data-driven model for predicting battery cycle life that only requires early-cycle input data. Most batteries do not exhibit capacity degradation within the first 100 cycles, yet this machine learning model only requires that initial data to accurately predict cell lifetimes. By extracting features from high-rate discharge curves, they were able to produce a test error of 9.1% using the initial 100 cycles, and an error of 4.9% if only data from the first 5 cycles are used. This machine learning model complements other semi-empirical models and without the need for long-term performance inputs, drastically reduces development time.

Stage of Research

- Proof of concept

Applications

- **Battery lifetime prediction: cycles until a given percent of relative capacity remains**
- Battery health monitoring

Advantages

- **Minimal physical testing required**

- Accelerated development of batteries
- Considers temperature, starting capacity, and charging protocol among other factors

Publications

- Severson et al. Nature Energy (2019) Data-driven prediction of battery cycle life before capacity degradation
- Attia et al. Nature (2020) Closed-loop optimization of fast-charging protocols for batteries with machine learning

Patents

- Issued: 11226374 (USA)

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