State of Health in Lithium-Ion Batteries

NAVFAC EXWC, Energy Management
Corey Theiss | Joseph McCullough | Mr. Andrew Drucker

PIPELINES · UCSB · CSEP · NAVFAC

Project Objective:

Our project's goal is to demonstrate the use of Artificial intelligence (AI) and predictive modeling techniques to monitor and optimize battery health and performance in the immediate term using real-time and open-source data to be implemented in future USN and DoD microgrid testbeds.

Intern Contribution:

The aim of our project was to design a predictive model for lithium-ion battery **State-of-Health** (**SOH**) using Machine Learning (ML) tools. The predictive model of the battery **SOH** is to be integrated into the USN's microgrid systems.

The method we used involved preparing a sample Li-Ion battery dataset from NASA and integrating the data into Python code to organize into a usable dataframe. The dataframe of the charge/discharge cycles would then be used in a **Long Short-Term Memory** (**LSTM**) recurrent neural network to create a predictive model of battery **SOH**.

Coupling the AI-empowered predictive analysis with USN microgrids enables the USN to accurately predict battery **SOH** therein ensuring more resilient, efficient, ride-through power to USN installations.
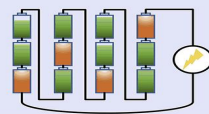

Degradation Mechanisms   **Prognostic Algorithms**

Lifetime / Failure / RUL
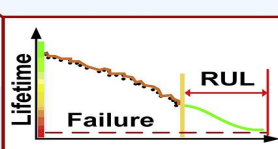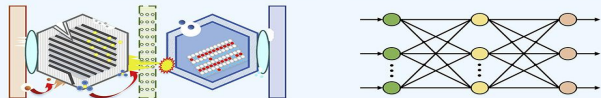
Calendar and Cycle Aging   **Key Challenges**

Capacity
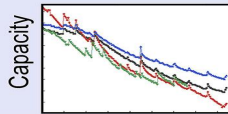
8 Weeks with PIPELINES

What the Team Learned!
- Significantly improved individual skills in the areas of CompSci/Data Analysis/ML/AI/Chemistry.
- Exposure to DoD environment expectations & resources.
- Delegation within a team concept; borrowing expertise from various different sources.
- Time management and how to more effectively utilize project timelines.

Major Takeaways!
- Significant academic work previously conducted in this field-- substantial space for growth!
- Difficulty in organizing several data-points: dozens of variables, extraneous data readings, coordinating various different battery datasets. Complicates future ML/AI development

Advice?
Be naive; Ask to have "simple" concepts explained in detail. Communicate effectively, be proactive, **find** what to do, do not wait to be told. Do "waste time" on topics-- explore everything, play around!

How The Lights Will Stay On

What We Did:
- A. Provided 200+ documents for project literature review to be utilized over next 2 years of project.
- B. Sourced and retrofitted PySci coding program with documentation for NASA battery dataset analysis
- C. Attended/critiqued 12+ hour microgrid academy organized by NAVFAC EXWC for developing in-house microgrid system UFC technical instruction.

Why It Mattered:
- A. Literature review documents to be utilized as reference source by UCLA, USN and DWS partnership team for next 2+ years of project.
- B. Developed skeletal structure for team subject-matter experts to use and adapt over project lifetime.
- C. Provided insight into future microgrid academy instruction and useful notes on current project status

The Future of this Project:
Model datasets accurately → Confirm with real-world data collection → Implement AI in predictive analysis on microgrid → Task automation!

Microgrid Systems Proposal