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Thermal modeling of li-ion batteries using SP+3D model

An ideal battery model must gather sufficient electrochemical data about the system while remaining being computationally efficient. To prevent failure from thermal runaway, understanding the thermal characteristics of a battery is essential.

To achieve this, we have developed a single particle (SP) model, a simplified but accurate approach to battery modeling, and compared this to a previously designed 3D model. After validating the battery electrochemistry, equations were introduced to calculate the heat generation with a coupled 3D heat transfer component to provide data on the cell temperature. This same model was used to simulate a multi-cell pack.

The results indicate close electrochemical and thermal accuracy between the two models at multiple discharge rates. However, the SP+3D model can reach these results more than 60 times faster than the 3D model. By more efficiently simulating the battery discharge, the SP+3D model can be applied to a variety of future test scenarios.

Derrick Barger is a mechanical engineering student that is passionate about reducing our reliance on fossil fuels. After riding his bicycle across the United States over the summer of 2019, he learned about the power of clean energy firsthand and wanted to make a difference. He joined this research project hoping to make a contribution to the field of battery science, and through the guidance of his mentors Dr. Park and Dr. Landers, Derrick has learned about the research process and is focused on designing simulated battery models to be used for experimentation. Derrick plans to pursue graduate school in Norway at the University of Tromso after graduating from Missouri S&T.