Battery State of Health estimation, analysis and data visualization for electric vehicles

Thesis background

Li-ion batteries are an essential part of solving the sustainable mobility puzzle. Understanding their chemical, thermal and electrical characteristics is an important pre-requisite to building a reliable Battery Management System (BMS) which in turn allows the cells to last longer and the vehicle to perform efficiently. This is done by designing control algorithms to estimate the battery cell states and parameters (State of Charge (SoC), cell capacity, resistance, State of Health).

The State of Health (SoH) of a battery pack determines how long it can perform optimally in terms of its available energy and power among other parameters using measured voltage, temperature and current. It is thus important to design a robust BMS to estimate the SoH using latest control techniques, keeping in mind the non-linear nature of a battery cell's ageing.

Description of the thesis work

The purpose of this thesis is to implement a scalable battery analytics model which can be easily deployed to generate battery SoH data and predict the remaining life of batteries on electric vehicles.

A literature review shall be performed on the causes for the decrease in cell performance and identify the indicators of battery pack SoH and remaining useful life. A choice shall be made by evaluating different available control techniques (for example linear regression, simple KF, EKF etc.) considering their performance and suitability for the purpose of SoH estimation. Design, simulation, and implementation of the SoH estimation algorithm are to be done once the choice is made, using a vehicle model on MATLAB/ Simulink.

The design shall then be extended to generate vehicle data for an electric vehicle fleet considering different drive cycles, current loads, vehicle and environmental conditions etc. The candidate is free to choose the method of simulation - battery analytics deployment. These data must then be analyzed to convey meaningful insights and alerts about the state of the cells, battery packs. Using the generated vehicle data, a repository is to be developed for use when limited laboratory testing data or driving data is available.

Candidate profile and application information

We are looking for self-motivated students graduating in spring 2023 who are interested in the control and analysis of Li-ion battery systems. Proficiency in model development using MATLAB/ Simulink along with knowledge of Li-ion cells is required. Previous experience in model/simulation deployment is considered beneficial. This thesis is suitable but not limited to master’s students in Electrical, Systems Control & Mechatronics or Chemical engineering.

Please send in your applications with your latest CV and letter of motivation to Peter Aminoff (peter.aminoff@expleogroup.com) or Christian Waxfeldt (christian.waxfeldt@expleogroup.com) titled ‘Thesis 2023 - Expleo’.

If you would like to work together as a group of two students on the thesis, please specify your partner’s name in your letter of motivation and submit your applications separately.

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