Application of Adaptive Estimation Techniques on Battery Fault Diagnosis

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High energy storage systems like Li-ion Batteries are one of the most widely used renewable energy sources today. They find applications in everyday electronic gadgetry, critical medical devices, hybrid & electric vehicles to name a few. Our study aims to observe continuously the state of the Li-ion battery and detect Over Charge (OC) and Over Discharge (OD) failures occurring in real time. Both conditions are detrimental to the health of the battery, while over charge can lead to overheating and thus vaporization of active material and hence explosion, over discharge can short the battery cell. However, these types of failures can be detected before they occur and by raising a flag before the system reaches the failure condition such failure modes can be avoided.
Different battery models based on equivalent circuit approach are constructed using the impedance spectroscopy data from Li-ion battery cells. Kalman filters are used to estimate the state of each system and subsequent residuals are generated for each model. Multiple model adaptive estimation is then used, where the generated residuals are evaluated and the fault probabilities are generated. Based on these probabilities, the system is classified as normal operation, OC fault or OD fault. Simulation results show that the battery faults can be detected and diagnosed in real time, thereby proving to an effective way of Li-ion battery fault diagnosis.

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