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Research on SOC Estimation for Lithium ion batteries Based on Improved PNGV Equivalence Model and AF-UKF Algorithm

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Accurately estimating the state of charge of lithium-ion batteries is of great significance for real-time monitoring and safety control of batteries. To solve the problems of difficult real-time estimation and low estimation accuracy of lithium batteries under various operating conditions, the ternary lithium-ion battery is used as the research object to establish an improved partnership for a new generation of vehicles(PNGV) equivalent circuit model to characterize the operating characteristics of the battery and to study and analyze the operating characteristics of the lithium battery by comprehensive experiments under various operating conditions. Considering the importance of state of charge accuracy at the early stage of estimation for the later estimation, the initial value of estimation is firstly calibrated using the open-circuit voltage method, and then the adaptive fading unscented Kalman filter algorithm is used for estimation tracking to achieve high accuracy estimation of lithium battery state of charge in real-time. A simulation model is built in MATLAB/Simulink and the performance analysis is carried out with a variety of operating conditions. The experimental results show that the improved PNGV model can better estimate the state of charge of lithium batteries with fast convergence, good tracking effect, and a maximum error of 0.485%. Comparing the state of charge results estimated using the adaptive fading unscented Kalman filter (AF-UKF) algorithm with the unscented Kalman filter algorithm, the maximum error was reduced by 0.354% in the HPPC condition and 1.978% in the BBDST condition, improving the accuracy and convergence speed of the filter.

Keywords: Lithium-ion battery; Improve PNGV model; State of charge; Adaptive Fading Unscented Kalman filtering algorithm;

FULL TEXT