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A Novel Dual Correction Extended Kalman Filtering Algorithm for The State of Charge Real-Time Estimation of Packing Lithium-Ion Batteries

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This paper explores the state estimation method of lithium-ion battery pack through theoretical analysis and experimental research. Combining the advantages of the empirical models of various electrochemical models, a new type of composite electrochemistry-dual circuit polarization (E-DCP) model is proposed to better reflect the dynamic performance of the power lithium-ion battery under the conditions of meeting its safe and reliable energy supply requirements. Using the multi-innovation least squares (MILS) algorithm to identify the parameters in the E-DCP model online, so that it has the characteristics of high data utilization efficiency and high parameter identification accuracy. The battery charge and discharge efficiency function is introduced to dynamically modify the battery capacity, and the dynamic function is used to improve the Kalman gain in the extended Kalman filter (EKF), a new type of based on dynamic function improvement and combined with actual capacity correction (FC-DEKF) algorithm is applied to the estimation of battery pack operating characteristics, which solves the problem that the traditional EKF algorithm is difficult to estimate errors when the system input change rate is large. The experimental results of urban dynamometer driving schedule (UDDS) and complex charge-discharge cycle test show that the maximum error of terminal voltage does not exceed 0.04V, the accuracy is 99.05%, and the errors of MILS algorithm combined with FC-DEKF algorithm for SOC estimation are all within 1%. The proposed equivalent circuit modeling method and state estimation correction strategy provide a theoretical basis for the reliable application of high-power lithium-ion battery packs.

Keywords: electrochemistry-dual circuit polarization model; parameter identification; multi-innovation least squares; improved extended Kalman filter; dynamic function optimization; lithium-ion batteries

FULL TEXT