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Joint Estimation of Ternary Lithium-ion Battery State of Charge and State of Power Based on Dual Polarization Model

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The battery state of charge (SOC) and state of power capability (SOP) are the core elements of a battery management system (BMS) for ensuring efficient and safe driving in electric vehicles. In this paper, the SOC and the SOP are jointly estimated under multiple constraints by using the dual polarization (DP) model for a ternary lithium-ion battery, and the extended Kalman filter (EKF) algorithm has been used to improve the accuracy of state estimation and the calculational simplicity. The calculation equations for the multiple-constraint parameters are deduced. The power capability can be calculated rapidly based on the constraints on the current, voltage and SOC. The simulation and experimental results demonstrate that for both the SOC and the SOP, highly satisfactory prediction accuracy is realized under various operating conditions. The maximum SOP estimation error in the DP model is less than 2.1% for a battery with various SOC states, which corresponds to higher estimation accuracy than that of the Thevenin model. In addition, the SOP estimation model has strong robustness, which renders the joint estimation of the SOC and the SOP more reliable in the practical application of electric vehicles.

Keywords: Ternary lithium-ion battery, dual polarization model, extended Kalman filter, state of charge (SOC), state of power capability (SOP)

FULL TEXT