Strong tracking adaptive window Multi-innovation cubature Kalman filter algorithm for lithium-ion battery state of energy estimation

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November 22, 2023

Abstract

Accurate estimation of lithium-ion battery state of energy (SOE) is an important prerequisite for prolonging battery life and ensuring battery safety. To achieve a high-precision estimation of SOE, this study focuses on ternary lithium-ion batteries and proposes an SOE estimation method that combines limited-memory recursive least squares (LM-RLS) with strong tracking adaptive window Multi-innovation cubature Kalman filtering (STF-MCKF). A finite set of data is used for model parameter updates at the current time to solve the problem of data saturation and improve the identification accuracy of the RLS algorithm. By utilizing the STF algorithm, the CKF algorithm is optimized to enhance its robustness under strong disturbances. An adaptive window Multi-innovation strategy is proposed to improve the accuracy of SOE estimation and the stability of the CKF algorithm while maintaining a balance between computational complexity and estimation accuracy. To validate the effectiveness of the algorithm, experiments are conducted under DST and BBDST conditions. The results show that the STF-MCKF algorithm has a maximum convergence time of 4s and an SOE estimation error within 1.04% under DST conditions. Under BBDST conditions, the STF-MCKF algorithm has a maximum convergence time of 3s and an SOE estimation error within 2.34%. Furthermore, the STF-MCKF algorithm demonstrates good stability under both the two conditions, indicating the effectiveness of the proposed improved algorithm for lithium battery SOE estimation.

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