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## A Novel Fading Memory Recursive Least Square Method (FMLS) for Accurate State of Charge Estimation of Lithiumion Batteries Combined with Improved Second Order PNGV M odeling

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As the main energy storage element and power source of electric vehicles, the accurate estimation of the state of charge (SOC) of lithium-ion batteries is very important for the battery management system of electric vehicles, as well as for the driving range and safety. To accurately describe the characteristics of the lithium-ion battery, an improved PNGV model was formed by connecting an RC circuit based on the traditional PNGV lithium battery equivalent model. Considering the aging characteristics of lithium batteries in use, the recursive least square method (FMRLS) with fading memory was adopted to identify parameters to meet the requirements of estimation accuracy, and the Extended Kalman Filter (EKF) algorithm was used to estimate SOC. The accuracy of MAE, MAPE and RMSE was improved by 9.21%, 4.85% and 9.38% respectively under DST condition. The improvement was 34.35%, 36.59% and 31.97%, respectively, Under BBDST condition.

**Keywords:** lithium-ion batteries; state of charge estimation; electrical equivalent circuit model; FMRLS; Extended Kalman filter

## FULL TEXT

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