Electrochemical and Thermal Modeling of Lithium-ion Polymer Battery System for State-of-Charge Estimation

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Lithium-ion polymer batteries (LiPB) are extensively used in hybrid electric vehicles and consumer portable electronics. In order to operate these batteries more efficiently, accurate estimation of state-of-charge (SOC) is necessary. Electrochemical and thermal modeling of the battery is important for accurate estimation of SOC. An equivalent-circuit-based battery model which simulates charge and discharge behavior of the battery is proposed. The thermal model is derived from energy balance model. From these models, current-based SOC and voltage-based SOC is estimated. They are compensated for each other by PID control system with current-based criteria. By this controller system, final estimated SOC is calculated. The model parameters and the controller parameters are estimated by neural-network and adaptive filters. These models are validated by experimental data with 60% SOC and standard temperature environment. The result is that proposed model and control system are appropriate for estimation of SOC to various use of LiPB.