Mathematical Modeling and Numerical Simulation of Lithium-Ion Batteries

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ABSTRACT

Due to its high energy density and power density, lithium-ion battery(LIB) is one of the commonly used batteries for electric vehicles (EVs). Many researches have been conducted based on empirical models to take advantage of their simplicity and computational low cost. Nevertheless, physics-based researches are necessary to monitor internal state of a battery and to simulate the battery in different conditions. The Pseudo-two-Dimensional (P2D) model introduced by Doyle and Newman is a well known electrochemical model. We demonstrate that the computational cost of the P2D model can be reduced by using the Taylor series expansion for nonlinear terms and using an adaptive time-stepping method which determines the time step size in accordance with the residual of the cell voltage. Simulation results were verified by comparing them with the results from previously developed toolbox, LIONSIMBA, as a benchmark.