Observer design for a solid diffusion-based ECM of lithium-ion batteries

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Résumé

Ensuring the efficient and safe operation of lithium-ion batteries requires accurate knowledge of its internal states. However, these internal battery variables cannot be measured in general and must therefore be estimated. In this context, we present an observer design that robustly estimates the state of charge of a lithium-ion cell. This design is appealing for several reasons. First, it is based on a reduced-order physics-based model from the literature, which has the distinctive feature to combine the advantages of equivalent circuit models in terms of simplicity and low computational effort, and of single particle electrochemical models, which more faithfully describe the internal dynamics of the battery. Second, the proposed observer is very simple to design and its robust convergence towards the battery internal states is systematically guaranteed based on Lyapunov arguments. Simulation results demonstrate the effectiveness of the designed observer in estimating the state of charge of the battery given data generated by a higher-fidelity model to emulate an experimental setting.

Mots-Clés: Lithium–ion battery, Nonlinear estimation, Observer design, Lyapunov stability

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