Automatic Initialization and Model Selection for Li-ion Battery Impedance Identification in the Frequency Domain

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Résumé

Electrochemical Impedance Spectroscopy (EIS) is a useful tool for selecting a pertinent Equivalent Circuit Model (ECM) of a Li-ion battery. Impedance model is designed to describe low, middle and high frequency electrochemical processes involved. When considering low frequency restricted in the Warburg zone, diffusion impedance is modeled thanks to a Constant Phase Element (CPE) which behaves as a fractional integrator of order n close to 0.5. Phenomena observed in middle frequency are described using specific circuits called Zarc which consist in connecting a CPE in parallel with a resistor. Therefore, the global impedance model is characterized by non integer order operators and parameters can be estimated by a Complex Non linear Least Squares (CNLS) algorithm which requires a proper initialization in order to guarantee the convergence to a global optimum. The paper presents a method to analyze EIS data measurements in order to select automatically the number of middle frequency Zarc circuits required (one or two) and to initialize properly the CNLS algorithm. The method is validated
using experimental open source EIS data.

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