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Optimization by Means of Genetic Algorithm of the Equivalent Electrical Circuit Model of Different Order for Li-ion Battery Pack

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Abstract : The purpose of this article is to optimize the Equivalent Electric Circuit Model (EECM) of different orders to obtain greater precision in the modeling of Li-ion battery packs. Optimization includes considering circuits based on 1RC, 2RC and 3RC networks, with a dependent voltage source and a series resistor. The parameters are obtained experimentally using tests in the time domain and in the frequency domain. Due to the high non-linearity of the behavior of the battery pack, Genetic Algorithm (GA) was used to solve and optimize the parameters of each EECM considered (1RC, 2RC and 3RC). The objective of the estimation is to minimize the mean square error between the measured impedance in the real battery pack and those generated by the simulation of different proposed circuit models. The results have been verified by comparing the Nyquist graphs of the estimation of the complex impedance of the pack. As a result of the optimization, the 2RC and 3RC circuit alternatives are considered as viable to represent the battery behavior. These battery pack models are experimentally validated using a hardware-in-the-loop (HIL) simulation platform that reproduces the well-known New York City cycle (NYCC) and Federal Test Procedure (FTP) driving cycles for electric vehicles. The results show that using GA optimization allows obtaining EECs with 2RC or 3RC networks, with high precision to represent the dynamic behavior of a battery pack in vehicular applications.

Keywords : Li-ion battery packs modeling optimized, EECM, GA, electric vehicle applications
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