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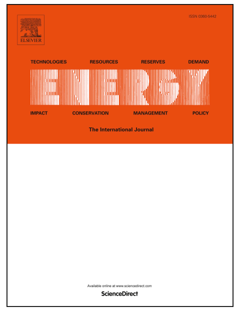

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Optimal energy management strategy for self-reconfigurable batteries

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Abstract

This paper proposes a novel energy management strategy for multi-cell high voltage batteries where the current through each cell can be controlled, called self-reconfigurable batteries. An optimized control strategy further enhances the energy efficiency gained by the hardware architecture of those batteries. Currently, achieving cell equalization by using the active balancing circuits is considered as the best way to optimize the energy efficiency of the battery pack. This study demonstrates that optimizing the energy efficiency of self-reconfigurable batteries is no more strongly correlated to the cell balancing. According to the features of this novel battery architecture, the energy management strategy is formulated as nonlinear dynamic optimization problem. To solve this optimal control, an optimization algorithm that generates the optimal discharge policy for a given driving cycle is developed based on dynamic programming and code vectorization. The simulation results show that the designed energy management strategy maximizes the system efficiency across the battery lifetime over conventional approaches. Furthermore, the present energy management strategy can be implemented online due to the reduced complexity of the optimization algorithm.

Keywords: Self-reconfigurable Li-ion batteries, Energy management strategy, Dynamic programming, Optimal control, Energy equalization,

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