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Prediction For DC-AC PWM Inverters DC Pulsed Current Sharing From Passive Parallel Battery-Supercapacitor Energy Storage Systems

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Abstract : Hybrid energy storage systems (HESS) are gaining popularity for grid energy storage (ESS) driven by the increasingly dynamic nature of energy demands, requiring both high energy and high power density. Particularly the ability of energy storage systems via inverters to respond to increasing fluctuation in energy demands, the combination of lithium Iron Phosphate (LFP) battery and supercapacitor (SC) is a particular example of complex electro-chemical devices that may provide benefit to each other for pulse width modulated DC to AC inverter application. This is due to SC's ability to respond to instantaneous, high-current demands and batteries' long-term energy delivery. However, there is a knowledge gap on the current sharing mechanism within a HESS supplying a load powered by high-frequency pulse-width modulation (PWM) switching to understand the mechanism of aging in such HESS. This paper investigates the prediction of current utilizing various equivalent circuits for SC to investigate sharing between battery and SC in MATLAB/Simulink simulation environment. The findings predict a significant reduction of battery current when the battery is used in a hybrid combination with a supercapacitor as compared to a battery-only model. The impact of PWM inverter carrier switching frequency on current requirements was analyzed between 500Hz and 31kHz. While no clear trend emerged, models predicted optimal frequencies for minimized current needs.

Keywords : hybrid energy storage, carrier frequency, PWM switching, equivalent circuit models
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