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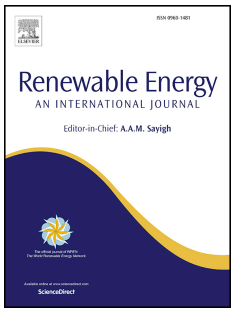

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A statistical approach for hybrid energy storage system sizing based on capacity distributions in an autonomous PV/Wind power generation system

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ABSTRACT:

Hybrid Energy Storage System (HESS) integration with autonomous PV/Wind hybrid power system becomes, currently, an interesting option for the improvement of the storage units' reliability and the life cycle assessment. In this paper, a new method for optimally sizing of HESS based on a statistical approach is proposed. This approach aims to exploit the capacity distribution of hybrid supercapacitor-battery system in an autonomous PV/Wind power generation system. This hybridization, of both slow and fast dynamics, aims to eliminate the power peaks caused by the load consumption. For the power distribution for all coordinated components of the storage system, a frequency management control and a hysteresis strategy are used in order to accomplish two goals: firstly, to delimit this exchanged power for not exceeding the maximum value and, secondly, to keep the States Of Charge (SOC) of the batteries-supercapacitors in a suitable range. Moreover, statistical analysis of several cumulative levels was performed to examine their contribution on the HESS optimal sizing. The obtained results prove that the integration of supercapacitor takes advantage of the complementary characteristics of the batteries, improves the exchanged power flow, extends the battery life cycle and affects on storage system sizing through accommodate the fast power fluctuations.

Keywords:*Optimal sizing; Hybrid Energy Storage System (HESS); probability distributions ; frequency management; capacity distributions*

1. Introduction

Recently, renewable energy sources are increasingly operated in electrical energy production such as wind turbines and photovoltaic panels. To satisfy the need of energy in isolated sites, it is necessary to integrate energy storage batteries. Due to fluctuations of meteorological data (wind