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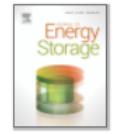

An energy management system for optimal operation of BSS in DC distributed generation environments based on a parallel PSO algorithm

L.F. Grisales-Noreña [a], Oscar Danilo Montoya [b, c], Carlos Andrés Ramos-Paja [d]

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Abstract

This paper proposes an energy management system (EMS) for the day-ahead dispatch of battery storage systems (BSS) under a distributed generation environment for direct current (DC) networks, with the main objective of reducing the cost of the energy purchased to the utility grid. This approach considers the state-of-charge (SOC) of the BSS and the production variation of the renewable generators, in particular of wind and photovoltaic technologies, and the variations in the power consumption and energy costs. The proposed EMS uses a master-slave strategy formed by a parallel implementation of the particle swarm optimizer (PPSO) and a multi-period power flow method based on successive approximations (SA), with the aim of achieving the optimal daily operation of the BSS. The objective function selected for the optimization was the reduction of the energy purchasing costs, also including the power balance, devices capabilities and voltage regulation. The effectiveness of the EMS is evaluated in a test system of 21 buses, comparing the solution quality and speed with three optimization techniques published in literature: a black hole optimizer, a continuous genetic algorithm with matrix structure, and a traditional Chu & Beasley genetic algorithm. In addition, two simulation scenarios were used to identify the optimal final SOC conditions for the BSS. Finally, the results show that the proposed EMS provides the best trade-off between quality solution and speed. The simulations are conducted in MATLAB software using sequential quadratic programming.