

Abstract

# Optimal Power Management and Control of Hybrid Solar–Wind Microgrid Including Storage System <sup>†</sup>

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**Abstract:** This paper aims to propose an application of artificial intelligence and nature-inspired optimization algorithms to design an optimal power management and frequency control loop that allows the integration of a large number of distributed generators, such as wind farms and solar PV generators, in isolated and islanded power systems. In addition, the proposed strategy was coordinated with a Hybrid Energy Storage System (HESS) including a redox battery and fuel cells. The HESS was used to support the frequency regulation loop and reduce frequency oscillations during disturbances. An optimal Fuzzy-PID controller was employed to cope with system fluctuation using a recently developed optimization algorithm named Marine Predator Algorithm (MPA). The MPA algorithm was used to optimize the parameters of Fuzzy Logic and the PID controller. Furthermore, the proposed power management method was used to minimize the use of diesel generators by maximizing the participation of wind, PV, and storage systems to satisfy the load. To show the effectiveness and validity of the proposed strategy, various case studies have been simulated and presented in this work. A comparative study between some metaheuristic algorithms such as PSO and GA have been carried out. Finally, robustness analyses have been performed in the presence of high-penetration wind farms and solar PV arrays with different load disturbances.

**Keywords:** microgrid; storage system; wind farm; solar power generation; optimal power management; fuzzy logic control



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