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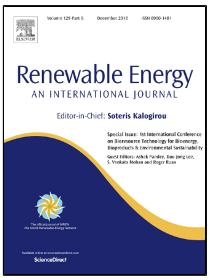

Partial Shading Mitigation of PV Systems via Different Meta-Heuristic Techniques

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Partial Shading Mitigation of PV Systems via Different Meta-Heuristic Techniques

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Abstract-Recently, electricity generation from solar photovoltaic (PV) has gained popularity throughout the world due to its profuse availability and eco-friendly nature. Consequently, extraction of maximum power from solar PV energy systems was the point of interest in the current researches. Various techniques have been proposed to track the maximum power point (MPP) from solar PV energy systems under variable environmental conditions. Conventional maximum power point tracking (MPPT) techniques have demonstrated the ability to track MPP with uniform solar irradiance. However, the ability of these techniques to track the accurate MPP with the condition of partial shading (PS) is not guaranteed. Hence, this paper intended to present novel optimization techniques to mitigate the PS effect and proficiently track the global maximum power point (GMPP). Grey Wolf Optimization (GWO), Moth-Flame Optimization (MFO), Salp Swarm Algorithm (SSA) and Hybrid Particle Swarm Optimization-Gravitational Search Algorithm (PSO-GSA) techniques have been proposed to handle this dilemma. The proposed techniques have been simulated and analyzed using MATLAB/SIMULINK. Furthermore, these techniques have been compared with the conventional PSO algorithm for validation. Statistical and sensitivity analysis have been established to compare the performance, check the stability, and determine the best technique out of the proposed techniques. Results showed the superiority of GWO in the speed of convergence and the time to catch GMPP. Moreover, the sensitivity analysis demonstrated the stability, successfully rate, and tracking efficiency of PSO-GSA technique. Finally, this paper gives an open reference to these optimizers to attempt mass research works in PV systems under PS.

Keywords-partially shaded PV System, global MPPT, Grey Wolf Optimization, Moth-Flame Optimization, Salp Swarm Algorithm, Gravitational Search Algorithm.

1. Introduction

Nowadays, increasing energy demand and decreasing fossil fuels reserves set up one big challenge throughout the world. Therefore, renewable energy (RE) has become the focus of interest of governments in recent years to address this issue. RE technology is considering the state-of-the-art for electricity generation, essentially because this technology is harmless to the environment. Furthermore, electricity generation from renewable energy sources (RES) saves billions of crude oil barrels and prevents CO_2 emission, and other greenhouse gases [1]. Solar photovoltaic (PV) is one of these sources which progresses