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Maximizing Solar Power Output: A Comparative Analysis of PSO and SSA in MPPT

Abstract

This research investigates the utilization of Particle Swarm Optimization (PSO) and the Salp Swarm Algorithm (SSA) for Maximum Power Point Tracking (MPPT) in solar photovoltaic (PV) systems under varying irradiance conditions (200 W/m2, 600 W/m2, and 1000 W/m2). Both algorithms demonstrate commendable MPPT performance, consistently increasing output power as irradiance levels rise. While PSO maintains slightly higher PV voltage values, both algorithms effectively regulate PV current and skillfully manage the duty cycle, keeping it proximate to the Maximum Power Point (MPP). Prompt and stable MPPT operation is evident in both algorithms, ensuring high efficiency and minimal oscillations. These results are crucial for practical PV applications where reliable and efficient power extraction is imperative. The findings underline the robustness and efficiency of both PSO and SSA in MPPT, with only slight distinctions in PV voltage. This comparative analysis offers practical guidance for selecting the most suitable algorithm for specific PV system requirements, contributing to enhanced energy harvesting and MPPT performance. It serves as a valuable resource for researchers and professionals in the renewable energy field, emphasizing the significance of optimization algorithms in optimizing PV system sustainability.

Keywords

MPPT algorithms; MPPT converters; PV systems