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HYBRID SALP SWARM–GAINING AND SHARING KNOWLEDGE (SSA-GSK) METAHEURISTIC ALGORITHM FOR EXTRACTING PHOTOVOLTAIC CELL PARAMETERS

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Abstract

Maximizing the energy output of photovoltaic cells depends firstly on accurately estimating their parameters using one of the three models. This parameter estimation is a multi-variable, nonlinear, and multi-modal problem. Developing more accurate and advanced solutions for this remains a challenging research problem. This study aims to develop a hybrid algorithm to precisely extract the parameters from photovoltaic cells and improve the results of the Salp Swarm Algorithm (SSA). To achieve this goal, a hybridization approach is implemented by combining two metaheuristic algorithms, SSA and Gaining and Sharing Knowledge (GSK), to extract parameters. The hybrid SSA-GSK algorithm was tested on RTC France photovoltaic cells, amorphous silicon photovoltaic cells (aSi), and STM6-40 using single and double diode models. The performance of the SSA-GSK hybrid algorithm is comparatively analyzed using the root mean square error (RMSE) and statistical analysis. RMSE was calculated using a hybrid SSA-GSK algorithm and obtained as 0.00261 for RTC SDM and 0.00844439 for RTC DDM, 6.3614×10^{-5} for aSi SDM and 9.4936×10^{-5} for aSi DDM, 2.0349×10^{-3} for STM6-40/36 SDM and, 2.0740×10^{-3} for STM6-40/36 DDM. The results demonstrated that the hybrid SSA-GSK algorithm achieved a lower rate of RMSE in comparison to SAA and other literature-reported algorithms. The algorithm was more proficient in search space, leading to superior optimization results in lesser execution time after hybridization. The proposed algorithm increases the probability of generating high-quality solutions and outperforms some other optimization algorithms while maintaining ease of implementation.

Key words: algorithm, photovoltaic cell, parameters, performance, statistical tests

Received: November, 2023; Revised final: September, 2024; Accepted: October, 2024; Published in final edited form: May, 2025

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