A test of meta-heuristic algorithms for parameter extraction of next-generation solar cells with S-shaped current-voltage curves

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ARTICLE INFO

Keywords:
S–shaped IV characteristics
Opposed two-diode model
Parameter estimation
Meta–heuristic algorithms
Nonparametric statistical procedure
Solar cell models

ABSTRACT

Identifying the parameters of photovoltaic (PV) models based on measured current-voltage (IV) characteristic curves is crucial for simulating, evaluating, and controlling PV systems. IV characteristics of new-generation solar cells (SCs) often exhibit an S-shaped deformation. In this paper, the potential of using meta–heuristic algorithms to solve the parameter estimation problems of PV cells with S–shaped IV characteristics has been explored. The parameter estimation has been performed within the framework of the opposed two-diode model. A total of 14 algorithms from various classes were implemented to extract the SC parameters from synthetic IV curves, which were generated with a range of parameter values. The obtained results have been compared using nonparametric statistical methods, including Wilcoxon signed-rank test for pairwise comparisons, Friedman, Friedman Aligned, and Quade tests for multiple comparisons, and post–hoc Finner, Holm, Hochberg, Holland, Shaffer, and Nemenyi procedures. Research has demonstrated that utilizing a squared error-based fitness function offers clear advantages in tackling a provided problem. Comprehensive results and analyses indicate that STLBO and ADELI algorithms have highly competitive performance in terms of accuracy and reliability.

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