Parameters Extraction of Photovoltaic (PV) cells using a global optimizer inspired from the survival strategies of flying foxes (FFO)

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Abstract

Today the world is facing multiple challenges of energy security, economic recovery and the effect of the Global increase in temperature. Investing in new fossil fuel will only lock-in uneconomic practices, perpetuate existing risks and increase the threats of climate change. By contrast, renewable energies such as Photovoltaic is considered one of the sources of energy not emitting carbon dioxide and other greenhouse gases, contributing to global warming. Seen its simplicity and low maintenance costs, Solar cells are the most prominent alternative to deal with these issues. However, Standard Test Conditions (STC) of Photovoltaic (PV) modules are, in the most cases, not representative of the real working conditions of a solar module. For operating conditions in arid climate, temperature of PV modules considerably increases above the STC temperature and affects PV system performance. In order to effectively predict energy production for a given location, it is of great importance to develop a robust model to take into account the electrical and thermal behaviors of the PV module. Different models have been previously implemented using a single or double diode model. This work focuses on the latest one, which requires the determination of seven parameters .these parameters are : Iph, Rs, Rsh, n_1, n_2, I_{01} and I_{02}. By referring to the estimation methods proposed in the literature such as : Newton-Raphson, Gauss-Seidel and Metaheuristics algorithms. This work introduces a new method of global optimization algorithm based on the use of Flying Foxes Optimization (FFO) technique to estimate the PV cell/module parameters. The proposed population-based approach is inspired from the survival strategies of flying foxes during a heatwave. The two different ways flying foxes move in the search space as well as their replacement mechanism, constitute the main advantages of the proposed optimizer, as they enhance exploration. FFO's probability-based solution replacement assists its escape from local optima, and helps the optimizer avoid wasting time searching bad regions of the search space. The results demonstrate that the proposed FFO optimizer constitutes an attractive alternative optimization approach to the most successful metaheuristic optimizers, considering local and global search capabilities.

Results have been compared with those found by the methods of Newton-Raphson, Gauss-Seidel, Broyden , Genetic algorithm (GA), Particle Swarm Optimization (PSO) and Invasive Weeds Optimization (IWO) to show that the proposed algorithm (FFO) has a high fitting with the experimental data.

Keywords: *PV Model, Parameter Extraction, Double diode Model, Genetic Algorithm (GA), Flying Foxes Optimization (FFO)*

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