EXTENDED ABSTRACT

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Double Diode Modelling Based Solar Photovoltaics: A Metaheuristic Approach

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The use of renewable energy sources such as solar cell array, wind turbines and fuel cells has dramatically increased over the last decade. Growing cost of and potential depletion of fossil fuels, ozone pollution, global warming, and strict environmental laws have led to the generation of electrical energy from renewable energy sources by many countries. Today, the use of solar power is one of the world's most abundant and powerful sources of renewable energy to meet the increasing demand for electricity. A detailed mathematical model is an important resource for researchers to understand the features, assess the efficiency of photovoltaic systems and thus to optimize them.

Several models were depicted in order to explain the behaviour of the PV system under different operational conditions. The single diode and double diode models are the most commonly used ones. The model of the double diode gives more detailed results in view of the effect of the recombination loss in the depletion field. In order to measure the PV parameters correctly, the actual efficiency of PV parameters is mostly dependent on the parameter of the PV cell.

Existing approaches typically are either classical and metaheuristic. On the data sheet, the supplier usually offers some typical values like the power point voltage, the current at the maximum power point, the current at the short circuitand the voltage at the open circuit. Precision of parameter estimation by analytical methods depends heavily on the exact location of the specified parameters on solar photovoltaic characteristics.

Keywords: Double diode model (DDM); solar photovoltaics, parameter assessment; harris hawks optimization (HHO).

In recent years the metaheuristic methods have been given more attention as they can efficiently yield more reliable results in complex problems. Some metaheuristic technologies used in the literature, such as a modified TLBO algorithm used to estimate solar PV cell parameters through the experimental I-V data. In the parameter estimation of single and double diode models, biogeographic based optimization (BBO) with mutation strategy was used. As a new optimization process, the Flowers Pollination Algorithm (FPA) extracts optimum parameters from a single diode and double diode models using three separate data sources. Differential evolution with integrated iteration mutation, Cat Swarm Optimization (CSO), Fireworks algorithm (FWA), the Hybrid Heterogeneous Cuckoo Search algorithm (BHCS) are also used in literature. While these algorithms provided better results than conventional approaches, other drawbacks are still observed, such as slow performance and premature convergence. Nevertheless, with several of these heuristic methods, further development is still possible.

The research on Harris Hawks Optimisation (HHO) is used for the evaluation of the parameters of the two diode models and for comparing the results with some recent algorithms such as WOA, SSA, GWO. The main inspiration of HHO are cooperative behaviour, and Harris hawks' style of chasing is in nature called surprise pounce. Such complex patterns and actions are mathematically imitated to construct an optimization algorithm.