Moth flame optimizer based parameter evaluation of a new reverse two diode model

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Abstract

Over the past few decades, environmental pollution has been a common subject for discussion and study. Several researchers around the world have made a major contribution to developing new emissions control technologies. In addition, the increasing demand for energy, climate change, global warming and fossil fuels have raised additional challenges for society to work with an alternative energy source. The current energy production technologies will be supplemented by the use of renewables. The importance of renewable energy can be explained by having more versatility, refilling it and, most importantly, not polluting the environment in their installations. Carbon, biomass, wind, solar, geothermal, etc. are the key sources in use in these days. Owing to its infinite availability, solar energy in this class has the greatest potential for electricity generation. Most countries worldwide have access to it. The consumer is able to install and use a large degree of versatility. Solar energy made a significant contribution to the growth of distributed generation, and the added benefits include low maintenance, low-cost power and long-term use of electricity.

First of all, its environmentally friendly nature has greatly helped its development because they generate renewable energy. The solar plants are capable of varying from large to small and need a great deal of money to invest. Poor performance and poor energy level are two of the major solar power drawbacks. The equipment used for solar electricity, which needs to be disposed of properly every year, produces a significant quantity of e-waste. Solar power demerits have become a common trend in recent years for research and development. There has been a lot of success. For example, there has been significant growth in-cell efficiency. There are many types of solar panels on the market. Those include solar panels of monocrystalline, polycrystalline, organic and thin film. Single crystal silicone is used in the monocrystalline solar panels, using silicone bars drawn in wafers. Polycrystalline solar panels are built with separate silicone bars melted together for a single wafer. Organic solar panels are used for the manufacture of semiconducting material with carbon-based materials, and may also be referred to as plastic solar cells. The thin-film solar panels that are especially applicable to this article are made of delicate, semiconductor material sheets that are much thinner than the traditional silicone-based panel. They are the lightest and most flexible solar panels available and offer a lot of versatility in operation. In terms of performance they do not have the conventional panels as they range from 6-10%.

It is important to gain an understanding of the accurate behaviour of the panel and its characteristics based on the exact mathematical model for the correct estimation of solar panel efficiency. The exact voltage current plots for the cell can be achieved. Awareness of the activity of the cell is also important to regulate the entire system. The cell's performance and efficiency parameters depend in large measure on the model selected and can be accurately calculated by intrinsic parameters. Due to operating conditions, which include various types of faults or operations, minor changes can occur with passing time. Sadly, the supplier will not have these criteria for the panel assessment. A job is therefore to determine the cell parameters and carry out further calculations. The panel's performance depends on the irradiance level, which is very well established. This fact was used to determine the inherent parameters of manufacturers' data sheet details. The panel's performance evaluation can be used therefore by choosing the right mathematical model and making acceptable calculations.

In the publication for the parameter estimation of the PV cells, various mathematical modelling methods have been presented. Many of the most commonly used versions are a single, double, adjusted, double, and three types of diodes. The reverse two diode model (RTDM) was provided in this paper for the parameter estimate of the thin film cells. Throughout the literature, this model was used for estimating organic solar cell parameters and provided satisfactory performance. RTDM can be interpreted as the SDM and DDM update. The second diode in this model is responsible for the curves of the cells I-V and P-V. Conventional methods for modelling solar cells are not appropriate for the simulation and modification of organic and thin-film cells. The model was not able to offer excellent convergence characteristics according to Pillai et al. who estimated the parameters of organic solar cells using this process. Nonetheless, after the introduction of a diode with a resistor in the circuit, it invented under natural irradiance. Nevertheless, the parameter estimation via this approach showed in this chapter exceptional convergence characteristics along with smooth P-V and I-V curves. Because of the diode location and diode resistance in an unusual spot, the complexity of the computing system has increased. This study shows that this method can be used for the extraction of thin-film solar cell parameters as well. RTDM has been specifically developed for organic cells.

In addition, it is difficult to overcome the complex implicit equations. The tools for analysis and numerical tools have been incorporated. Analytical methods are the least efficient ways of resolving them since the values of the characteristic P-V and I-V curves for solar cells may be required at all points of data. In addition, analytical methods can lead to lower performance. In addition, it takes considerable time to overcome it using computational methods as the equations in question are non-

linear. The other approach is to use the numerical method for the solution but, in many situations, they still produce bad performance. Our solutions rely largely on the initial value, as well as on slow convergence. If issues require several maximums or minimum levels, they may be clustered in each of them. Due to the existence of various maxima and miniatures, they are unable to meet the global limit to offer false results. A subset of quantitative methods is then used, called metaheuristic algorithms, which often act as a form of optimisation. These are population methods, in which the population is called searching agents and stochastically initialized and modified during the iteration. Throughout the iterations the values are slowly improved, and the target is also modified based on measured values. The iterations end by choosing the most suitable agent, assuming that the desired value or value of the issue is the closest to it. Such algorithms have the advantage of being able to answer any dimension problem with them.

The intelligence demonstrated by agents other than humans for carrying out different operations on a variety of problems is Artificial Intelligence (AI). The "intelligence" is defined by numerous capacities, among which decision-making is the most prevalent. Any smart devices like computers are categorized as an AI optimization process. With extensive searches, many engineering problems which require an optimized solution can hardly be solved. The approach to these problems is to use heuristics, in which the agents are initially randomized and then hit the equilibrium point slowly. Advances made in these heuristic algorithms referred to as meta-heuristic algorithms have been commonly used for technical problems and PV cell parameters extraction is one such problem. Such AI-based algorithms are equipped with decision-making abilities and are designed to solve this problem optimally without sticking to the local limit. The parameters for the newly established RTDM are extracted using MFO. Other algorithms are used for comparison, including those developed in 2019 such as Equilibrium Optimizer and Harris Hawk Optimization (HHO).

Keywords: Renewable energy, Reverse two diode model (RTDM), parameter evaluation, moth flame optimizer (MFO).

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