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PV Array Reconfiguration Using a Genetic Algorithm to Increase Power Production in Partially Shaded Conditions

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Abstract

The issue of partial shade has so far been resolved in the literature. It is a serious and noticeable issue. Partial shadowing has a devastating effect on PV power output and causes several peak spots in PV characteristics. The reconfiguration of an electrical array is one of the most useful methods to address this problem that has been offered in the literature. In order to reduce Partial Shading Conditions (PSCs) and boost power output, this research suggested an electrical array reconfiguration approach based on Genetic Algorithm (GA) for Total-Cross-Tied (TCT) array. The modules in the TCT array are always in the same physical placements in this work, but their electrical connections change based on levels.

Introduction

Traditional methods of producing electricity have a number of drawbacks, such as rising production costs brought on by the importation of fossil fuels and escalating environmental concerns[1] like the dangers of climate change linked to fossil fuel power generation, which has led to the search for alternative methods of producing electricity using renewable sources like solar, wind, tidal, etc [2]. Among renewable energy sources, solar energy is the most widely available, cost-free, and ecologically benign [3]. Although there are many benefits, there has been little progress in PV efficiency [4]. Numerous difficulties that have been raised in the literature lower the PV system's efficiency [5]

Practical PV cell model.

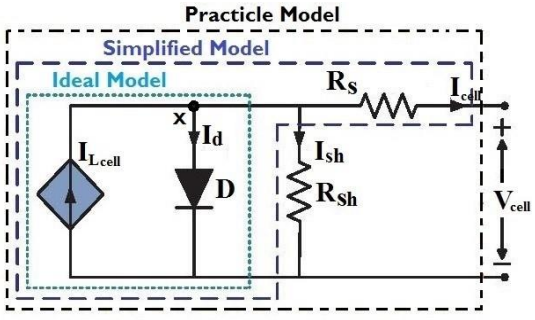

Photo voltaic system modelling

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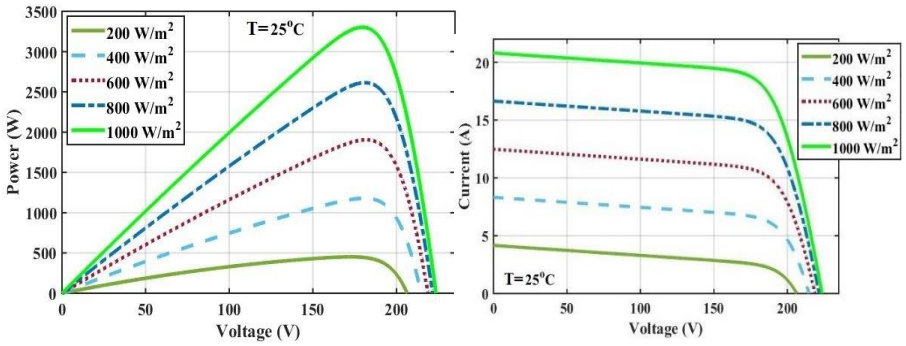
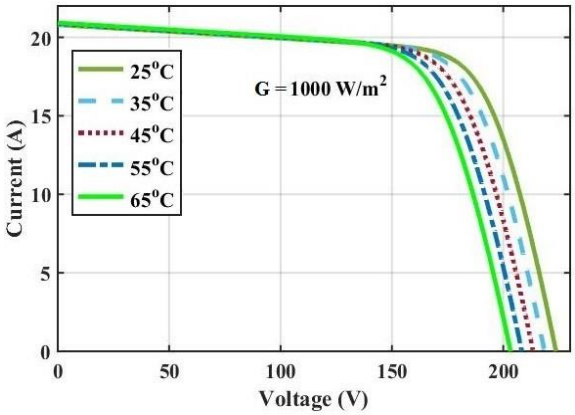
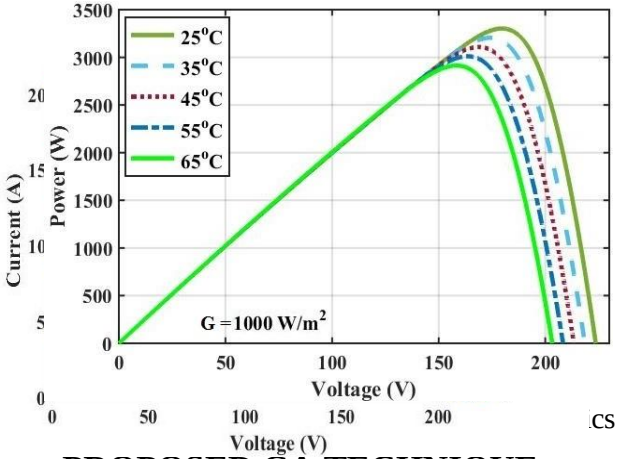


(a) I-V characteristics, (b) P-V characteristics of 5×4PV array at different irradiations.





cs of 5×4PV array at different temperature.

PROPOSED GA TECHNIQUE

Genetic Algorithm (GA) is an iterative technique of optimization that provides the maximization or minimization of a problem solution [6]. This is based on Darwin's fittest survival theory [7].

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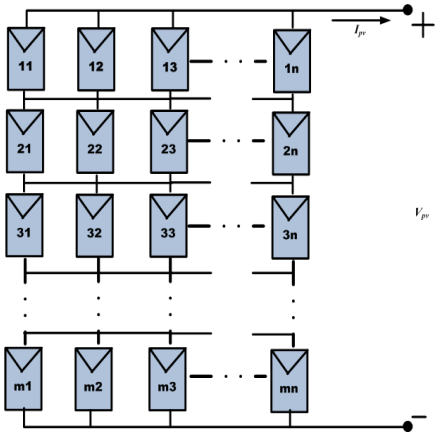
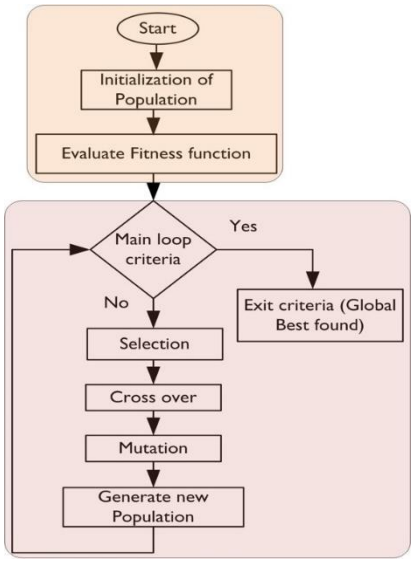
TCT PV array Interconnection.



Proposed genetic algorithm for PV array reconfiguration.



RESULTS AND DISCUSSIONS

Column-Wise Shading

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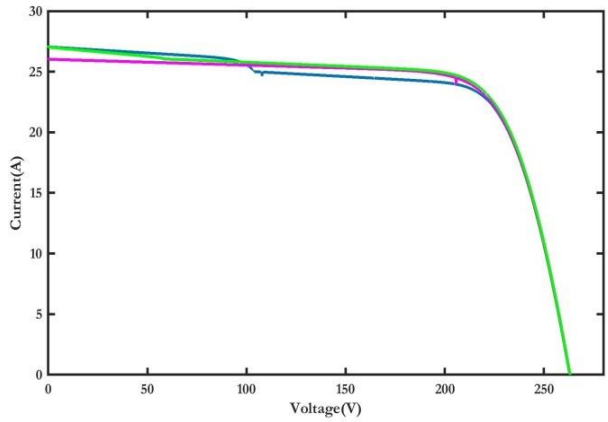
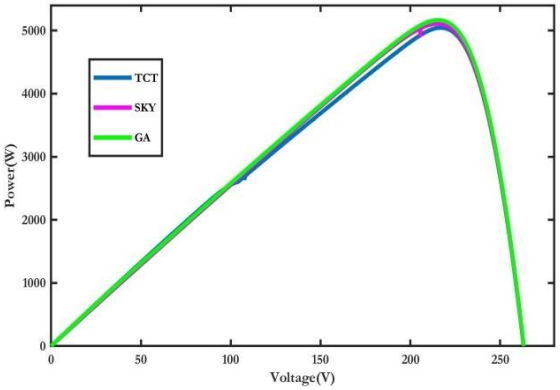


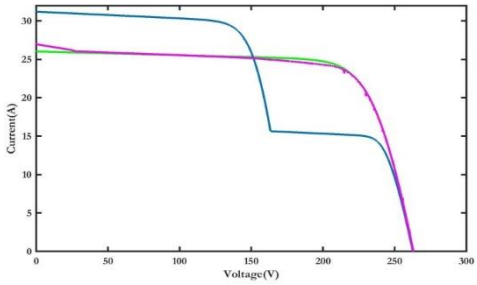
(a) I-V characteristics



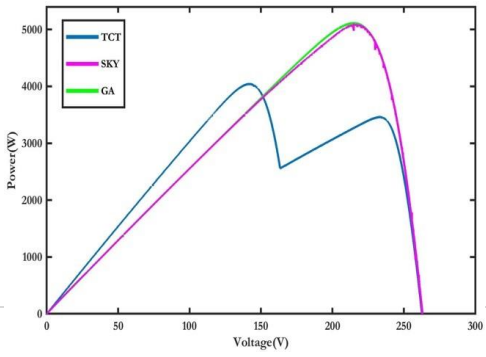
(b) P-V characteristics

(c) P-V characteristics

Row-Wise Shading



(d) I-V characteristics



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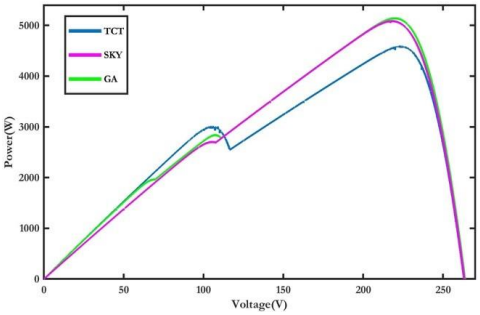
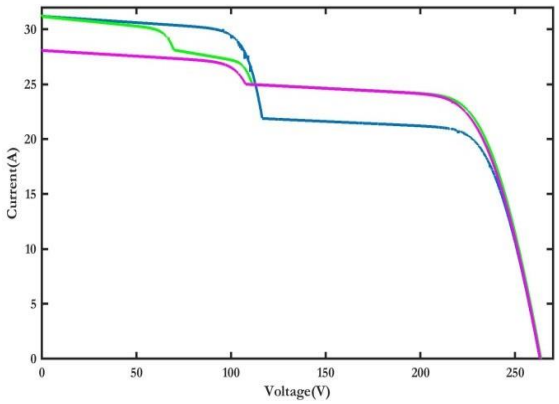
Performance characteristics for row-wise shading.

Comparative Study on Reconfiguration Methods





(a) P-V characteristics

CONCLUSION

This research presented an electrical array reconfiguration for a 66 TCT array based on a genetic algorithm in order to disperse shading effects and improve power efficiency.The TCT array's physical placement of the modules is fixed in this system, but the electrical relationships between them are changed to account for shading effects. This is a one-time connection design that ensures that any shading is distributed uniformly in each row and that the currents remain the same..According to the findings, the suggested GA approach improved power production compared to existing methods and decreased many peak points on PV characteristics.

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