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Extraction of Maximum Power from a PV Array under Non Uniform Irradiation Conditions

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ABSTRACT

The series and parallel connected panels, partial shading occurs which decrease output power and introduce multiple peaks in the P-V curve. Therefore, to maximize the power extraction from PV array, the panels need to be reconfigured for minimization of row current difference. Row current minimization via Su Do Ku game theory do physical relocation of panels may cause laborious work and lengthy interconnecting ties. Hence in this paper, an alternative to physical relocation based on particle swarm optimization (PSO) connected modules is proposed. In this method the physical location of the modules remains unchanged, while its electrical connections are altered. Extensive simulations are carried out and thorough analysis with the help of I-V, P-V curves are done to support the usefulness of the proposed method. The effectiveness of proposed PSO technique is evaluated via performance analysis based on energy saving and income generation.

Keywords : Row Current Minimization, Physical Relocation, Different Shade Patterns, I-V,P-V.

I. INTRODUCTION

Solar energy is one of the most abundant renewable energy sources, capable of producing electricity with the help of a PV cell. A PV cell converts light into energy by taking in the energy from photons striking the cell, exciting electrons inside a silicon lattice structure such that the electrons move to holes, and discharge the energy across a resistor attached in series with a PV Cell. This energy source will exist for the lifetime of the sun and is fairly reliable. This effect changes the Maximum Power Point (MPP), by decreasing the amount of incoming voltage. As a result the efficiency of the PV cell reduces, which is disastrous to the Solar Energy Industry Partial shading is simulated by changing the insolation levels, to test how shading effects the maximum power point (MPP). The results show that the Su Do Ku configuration provides better performance as well as higher efficiency, with regard to partial shading. Row current minimization via Su Do Ku game theory do physical relocation of panels may cause laborious work and lengthy interconnecting ties. Hence in this paper, an alternative to physical relocation based on particle swarm optimization (PSO) connected modules is proposed. In this method the physical location of the modules remains unchanged, while its electrical connections are altered.

II. LITERATURE REVIEW

The various PV array configuration have been studied for their I-V and P-V characteristics.

2.1 Series array

The Series array configuration is based on setting up all of the PV modules in series to allow for a single current to flow throughout the array. Characteristic of an Series array, as one module is greatly affected by shading; the losses are distributed to the rest of the modules in the array.

2.1.1 Series Parallel

The SP array configuration has the same amount of modules as the S array configuration, except split into two series strings that are connected in parallel to each other. Similarly, the shading effect on one of the modules of the SP string creates losses that affect all the modules in that string. The main advantage is that only one string of the SP array is negatively impacted, while in series the entire array is compromised.

2.1.2 Total Cross Tied

The TCT array configuration is meant to connect PV modules in parallel with respect to the row they are in, and the rows in series with the other rows. This is to say that each node is connected to all the modules in a row and are then connected in series with other rows. The advantage of the TCT configuration is that shading occurring at a module does not greatly compromise a string or row of modules.

2.2 Proposed System

Particle Swarm Optimisation

Earlier attempts to handle partial shading problem in a PV array involve: 1) skilled labour, 2) complex rewiring and 3) electrical switching arrangement. Among which, the electrical switching arrangement is effective; however, finding the suitable electrical switching combination is a complex and difficult task. Optimization techniques are methods that show superiority in handling multi modal objective function and remain always as a best choice to identify the suitable switching combination especially in case of array reconfiguration. Thus, applying proverbial Genetic Algorithm (GA) method the switching matrix combination to disperse the shade of 9×9 PV array was demonstrated, but the method adopted has the inherent drawback of poor convergence, large computational steps and require wide search

III. BLOCK DIAGRAM

The following figure shows the block diagram of the maximum power extraction using maximum power point tracking.

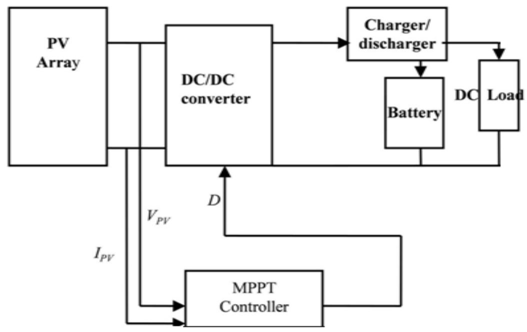

Figure 1. Block Diagram

Maximum power point tracking (MPPT) is an algorithm implemented in photovoltaic (PV) inverters to continuously adjust the impedance seen by the solar array to keep the PV system operating at, or close to, the peak power point of the PV panel under varying conditions, like changing solar irradiance, temperature, and load. solar inverters implement MPPT algorithms to maximize the power generated by PV systems. The algorithms control the voltage to ensure that the system operates at maximum power point. MPPT algorithms are typically used in the controller designs for PV systems. The algorithms account for factors such as variable irradiance (sunlight) and temperature to ensure that the PV system generates maximum power at all times.

IV. WORKING

PSO simulates the behaviours of bird flocking. Suppose the following scenario: a group of birds are randomly searching food in an area. There is only one piece of food in the area being searched. All the birds do not know where the food is. But they know how far the food is in each iteration. PSO is initialized with a group of random particles (solutions) and then searches for optima by updating generations. In every iteration, each particle is updated by following two "best" values. The first one is the best solution (fitness) it has achieved so far. (The fitness value is also stored.) This value is called pbest. Another "best" value that is tracked by the particle swarm optimizer is the best value, obtained so far by any particle in the population. This best value is a global best and called gbest. When a particle takes part of the population as its topological neighbors, the best value is a local best and is called lbest.

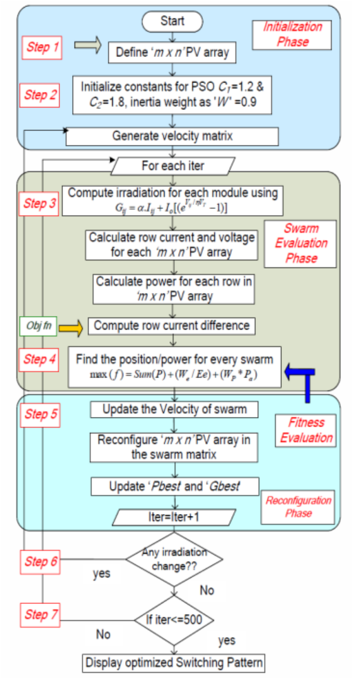

Figure 2. Flow Diagram

V. RESULT

5.1 PV Characteristics Of PSO Algorithm

The curve below shows the PV Characteristics of the solar cell using the PSO algorithm.

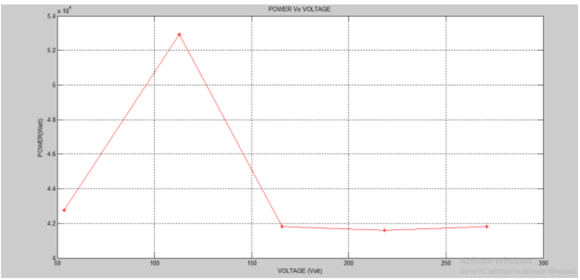

Figure 3. PV Characteristics of a Solar Cell using PSO

5.2 VI Characteristics Of PSO Algorithm

The curve below shows the PV Characteristics of the solar cell using the PSO algorithm.

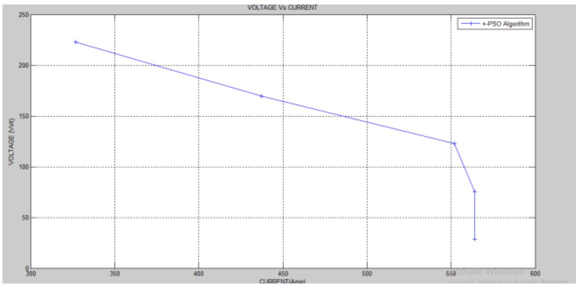

Figure 4. VI Characteristics of a Solar Cell using PSO

It can be seen that the maximum power obtained is higher than the SUDOKUand TCT configuration and GA algorithm.It can also be seen that the greater voltage is obtained at higher current,the power output also bound to increase.

VI. CONCLUSION

This paper presents a PSO based array reconfiguration scheme for the arrangement of PV modules in a PV array, which exhibits increased array power generation under partially shaded conditions. The reconfiguration follows electrical rearrangement for a given shade dispersion, whereas keeping the physical location of the PV modules unchanged. The problem of row current different minimization for PV array for power maximization is proposed as an optimization task and solved using PSO method. The results obtained with PSO method for electrical array reconfiguration for different shades are compared with existing TCT and Su Do Ku and GA methods. From the analysis it is found that the proposed approach is capable of achieving fairly uniform distribution of shade all over the panel. Hence the concentration of shadow on particular area is avoided resulting in higher power output. Moreover the difference in row current is greatly minimized which results in an improved I-V characteristic of PV array. Thus the proposed method is found to be superior and yields maximum power compared to the TCT, Su Do Ku and GA arrangement.

VII. REFERENCES

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