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A Novel Odd Even Configuration to Reduce Solar Power Mismatch under Partial Shading Condition

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ABSTRACT: In this project the effect of Partial Shading Condition (PSC) on various solar photovoltaic (PV) array topologies has been studied extensively. PSC reduces the maximum power of a PV array and produces multiple Maximum Power Points (MPPs) in the PV characteristics. A novel PV array configuration, as the Odd Even Configuration (OEC) named has been proposed to mitigate the effects of PSC under a diagonally progressing shadowing scenario and performance parameters like mismatch power loss, Fill Factor (FF) and Performance Ratio (PR), have been measured. The performance of the proposed OEC has been compared with pre-existing standard configurations such as TCT, SP-TCT, BL-TCT and BL-HC. Another recently proposed configuration has also been used for comparison. The effect of variation in temperature on the shade dispersion effect has also been studied. All the considered PV array configurations have been modelled configuration is found to be superior to other configurations for all the PSCs considered, with minimum power loss and improved FF.

KEYWORDS: Photovoltaic, Partial shading condition, Reconfiguration strategy, Global Maximum Point, Mismatch Power loss

I. INTRODUCTION

In the present scenario, the world is spiralling down into an energy crisis. Conventional energy resources like fossil fuels are being depleted at an alarming rate and may be completely exhausted in the next few decades. In a situation like this, it is only logical to look for an alternate source to meet our energy demands. A feasible alternative can be found in renewable energy resources, which offer easy availability and get replenished over time, so they would not be depleted. Though the renewable energy sources might be easily available, harnessing them to their full extent still remains a challenge. Some strides have been made in renewable energy technology, especially in the field of solar photovoltaic (PV) based power generation Out of all the renewable energy generation technologies, solar PV energy is the most dominant technology, owing to availability of sunlight over wide geographical area and direct conversion of sunlight to electricity. In the year 2018, the total renewable energy generation capacity was at 2195 GW, which represents 18.2% of global human energy consumption. Of this, the solar PV energy generation capacity is at 402 GW which accounts for 1.73% of global energy generation.

II.METHODOLOGY

2.1MATHEMATICAL MODEL OF PV SYSTEM

To study the effects of partial shading conditions (PSCs) and their mitigation on solar PV system a mathematical model of the solar PV array has been developed in MATLAB /Simulink environment. First a model for a single PV module is developed and then multiple such module are interconnected in different configuration to construct a solar PV array.Fig 1 shows the mathematical model of PVsystem.Where the equivalent circuit model of a solar PV module.

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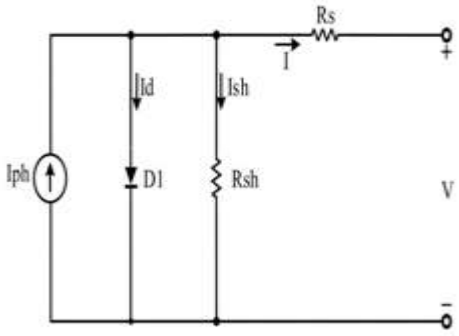

Fig 1. Equivalent circuit model of a solar PV module

2.2 ODD EVEN CONFIGURATION

In this project a Novel configuration named the Odd Even Configuration (OEC), is presented as depicted in figure 2. The electrical connections between the PV modules like the ASY configuration, are made in a manner which is exactly the same as TCT configuration. But within a series column string all the PV modules belonging to the odd numbered row according to their electrical connection are clumped together physically within a PV array. After placing all the odd numbered module in this manner within a column they are followed by modules belonging to even numbered rows according the electrical connections which are again clumped together. Furthermore, the physical position of module connected in the first row of a given column is shifted by a certain number of rows after every column in arithmetic position.

For an m*n PV array the row index of a module which is electrically connected in the ith and jth is determined by the following method

For a module which is connected in the first row of any given column its row index can be expressed as: R1j=1+ (j-1)2

For all other modules electrically connected in an odd numbered of rows, Rij = R1j+ (i-1) /2

For all the order modules electrically connected in an even numbered of rows,

Rij = R1j +m/2+i/2 – 1

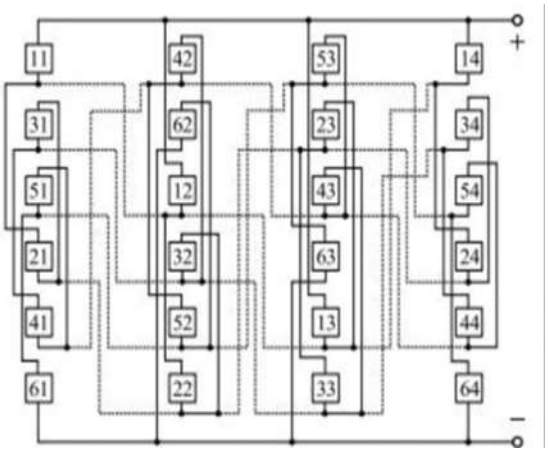

Fig 2. The interconnection of PV module within a 6 * 4 PV array with OEC

2.3 MISMATCH LOSSES

Mismatch losses are caused by the interconnection of solar cells or modules which do not have identical properties or which experience different conditions from one another. Mismatch losses are a serious problem in PV modules and arrays under some conditions because the output of the entire PV module under worst case conditions is determined by the solar cell with the lowest output. For example, when one solar cell is shaded while the remainder in the module are not, the power being generated by the "good" solar cells can be dissipated by the lower performance cell rather than powering the load. This in turn can lead to highly localized power dissipation and the resultant local heating may cause irreversible damage to the module.

Fig 3. Partial shading

Mismatch in PV modules occurs when theelectrical parameters of one solar cell are significantly altered from those of the remaining devices. The impact and power loss due to mismatch depend on:

- the operating point of the PV module;
- the circuit configuration; and

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➢ the parameter (or parameters) which are different from the remainder of the solar cells.

III. REQUIREMENT

3.1 SOFTWARE REQUIREMENT

- **MATLAB**

MATLAB (an abbreviation of Matrix Laboratory) is a proprietary multi paradigm programming language and numeric computing environment developed by MathWorks. MATLAB allows matrix manipulation, plotting of functions and data, implementation of algorithm creation of user interfaces and interfacing with program written in other language

Strengths of MATLAB:

- MATLAB is relatively easy to learn.
- MATLAB code is optimized to be relatively quick when performing matrix operations.
- MATLAB may behave like a calculator or as a programming language.
- MATLAB is interpreted, errors are easier to fix.
- Although primarily procedural, MATLAB does have some object-oriented elements

- **SIMULINK**

Simulink is a simulation and model-based design environment for dynamic and embedded systems, integrated with MATLAB. Simulink, also developed by MathWorks, is a data flow graphical programming language tool for modelling, simulating and analysing multi-domain dynamic systems. It is basically a graphical block diagramming tool with customizable set of block libraries.

It allows you to incorporate MATLAB algorithms into models as well as export the simulation results into MATLAB for further analysis**.**

Simulink supports −

- system-level design
- simulation
- automatic code generation
- testing and verification of embedded systems

Key Features

1. Graphical editor for building and managing hierarchical block diagrams
2. Libraries of predefined blocks for modelling continuous-time and discrete-time systems
3. Simulation engine with fixed-step and variable-step ODE solvers
4. Scopes and data displays for viewing simulation results
5. Project and data management tools for managing model files and data
6. Model analysis tools for refining model architecture and increasing simulation speed
7. MATLAB Function block for importing MATLAB algorithms into models
8. Legacy Code Tool for importing C and C++ code into models.

3.2 HARDWARE REQUIREMENT

I. CPU I3 processor
II. RAM 4GB
III. ROM 250 GB

i.CPU I3 processor

A central processing unit (CPU), also called a central processor, main processor or just processor, is the electronic circuitry that executes instructions comprising a computer program. The CPU performs basic arithmetic, logic, controlling, and input/output (I/O) operations specified by the instructions in the program. This contrasts with external components such as main memory and I/O circuitry,[1] and specialized processors such as graphics processing units (GPUs).

ii. RAM

Random-access memory (RAM; /raem/) is a form of computer memory that can be read and changed in any order, typically used store working data and machine code. [1][2] A random-access memory device allows data items to be read or written in almost the same amount of time irrespective of the physical location of data inside the memory, in contrast with other direct-access data storage media (such as hard disks, CD-RWs, DVD-RWs and the older magnetic tapes and drum memory), where the time required to read and write data items varies significantly depending on their physical locations on the recording medium, due to mechanical limitations such as media rotation speeds and arm movement.

iii. ROM

Read-only memory (ROM) is a type of non-volatile memory used in computers and other electronic devices. Data stored in ROM cannot be electronically modified after the manufacture of the memory device. Read-only memory is useful for storing software that is rarely changed during the life of the system, also known as firmware. Software applications (like video games) for programmable devices can be distributed as plug-in cartridges containing ROM.

IV. PROBLEM FORMULATION

The results of the branched and limited algorithm showed great importance insolving the problems of the PV array reconfiguring. Based on

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the radiation equation, optimization intelligence for the PV array reconfiguring is performed by hierarchical sorting based on repetition. In this method, continuous switching and complex calculation reduce the reliability of the installation method.

V. SIMULATION WORK

This is the partial shading diagram in MATLAB/Simulink.This is the model of one PV module in a novel odd even configuration to reduce solar power mismatch under partial shading condition.From this diagram we can understand the model of one PV module for odd even configuration

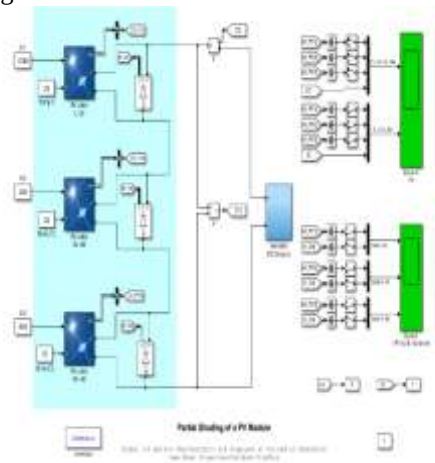

Fig 4. Simulation diagram

VI. RESULT

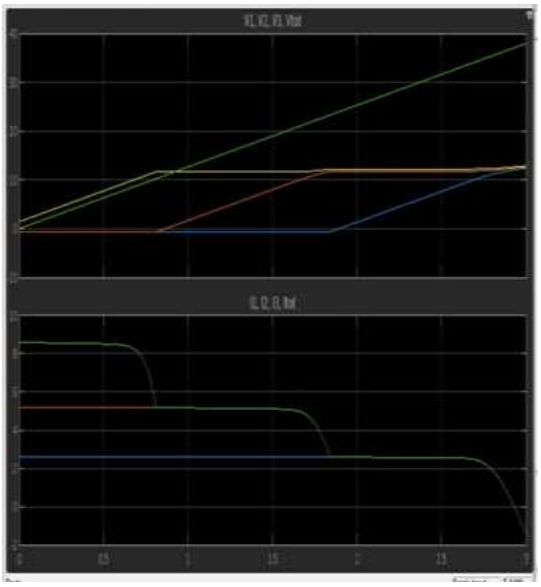

Fig.5slope 1

In this graphical representation we show the two graphs from voltage and current with respect to time. Here the first graph shows the voltage of all three errors with total voltage generation and in the second graph shows current of all 3 arrays. and total current generated by the system. In the first graphic features all the array shows the drastically changed in linear motion at 0.8sec which again goes changed by 1.75sec.

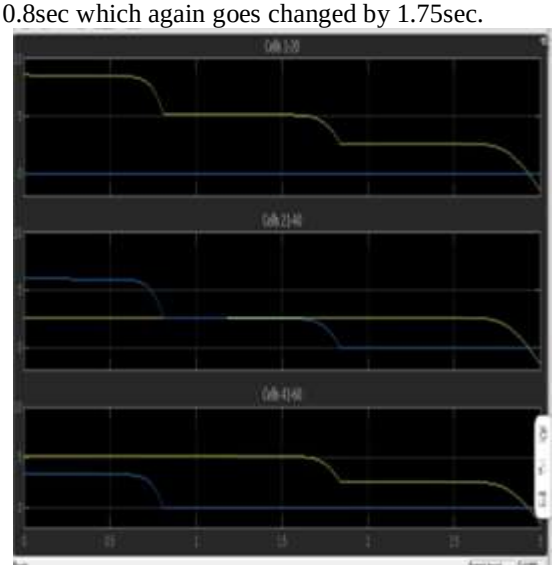

Fig 6 slope 2

In the second graphical representation shows total current generated by PV array in odd even configuration which is selected by the switchingbox presented at the output site. So here we can see the drastic change in current decreased to 9.5A the again at 2.5A. In this we can see the representation of active PB sales in odd even configuration which is selected by the which gear used in trigger circuit. A isa total number used for single array is and with the configuration of odd or even at a single point of time only maximum 10 PV sales are active and next 10-degree cells are inactive.So, by selecting the PV cells from trigger circuit we can see the activated PV cells which produce energy at a single point of time for all three arrays.

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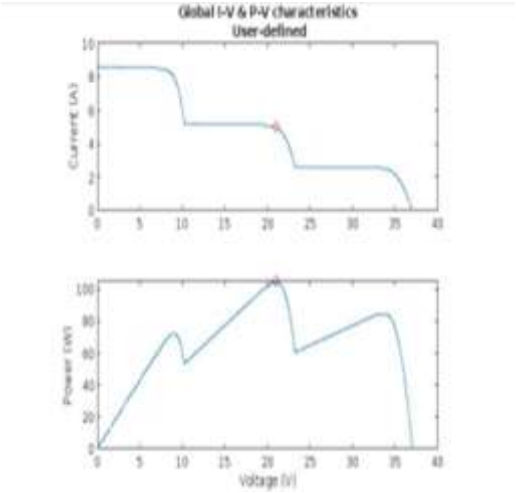

Fig.7 GlobalI-V & P-V Characteristics User Defined

Result we can show the characteristics of power and current with respect to voltage throughout cycle time. Using of odd even configuration, we can generate the maximum power of 100 watt.

VII. APPLICATION

1. Solar Water Heating:
2. Solar Heating of Buildings:
3. Solar-distillation:
4. Solar-pumping:
5. Solar Drying of Agricultural and Animal Products:
6. Solar Furnaces:
7. Solar Cooking:
8. Solar Electric Power Generation:
9. Solar Thermal Power Production:
10. Solar Green Houses:

VIII. ADVANTAGES

1. Solar power is pollution free and causes no greenhouse gases to be emitted after installation.
2. Reduce dependence on foreign oil and fossil fuels.
3. Renewable clean power that is available every day of the year, even cloudy days produced some power.
4. Return on investment unlike paying for utility bills.
5. Virtually no maintenance as a solar panel last over 30 years.
6. Creates jobs by employing solar panel manufactures, solar installers, etc. and in turn helps the economy.
7. Access power can be sold back to the power company if the grid inner tied.
8. Ability to live grid free if all power generated provides enough for the home/building.
9. Can be installed virtually anywhere; in a field to on a building.
10. Use batteries to store extra power for use at night.
11. Solar can be used to heat water, power homes and building, even power cars
12. Safer than traditional electric current.

IX. CONCLUSION

Different PV array configuration, namely TCT, SP-TCT, BL-TCT, BL-HC, ASY and proposed novel configuration, OEC has been extensively studied and analysed. Various PSCs pertaining to a diagonally progressing shadow movements have been applied to the above configuration and the obtained parameters like maximum power, voltage, current, mismatch power loss fill factor and % performance ratio have been used to assess and compare their performance. The effect of varying temperature on partially shaded PV modules has also been investigated. The extensive simulation results so obtained have been analysed.

REFERENCE

[1]. A.D. Dhass1, N. Beemkumar2, S. Harikrishan3 and Hafiz Muhammad Ali4 “a Review on factors Influencing the Mismatch Losses in Solar Photovoltaic System” International Journal of Photo energy Volume 2022, Article ID 2986004, 27 pages.

[2]. M. Akrami, K. Pourhossein (2018) “A novel reconfiguration procedure to extract maximum power from partially shaded photovoltaic arrays.” Sol Energy 173:110-119.

[3]. Dhanlakshmi B, Rajasekar N (2018) “A novel competence square based PV array reconfiguration technique for solar PV maximum power extraction.” Energy conversion and management 174:897-912.

[4]. M. Dhimisha, Li Zhangb (2017) “seven indicators for multiple PV array configurations under partial shading and faulty PV conditions.” Renew Energy 113:438-460.

[5]. Karan Yadava, Bhavnesh kumarb, *, Swaroop D.b “Mitigation of Mismatch Power Losses of PV Array under Partial Condition using novel Odd Even Configuration.”

[6]. Alex J. Hanson; Christopher A. Deline; Member, IEEE, Sara M. and Charles R. Sullivan, Senior member, IEEE. “Partial

Shading Assessment of Photovoltaic Installations via Module Level monitoring".

[7]. Shubhankar Niranjakr Deshkar, Sumedh Bhaskar Dhale, Mukherjee Jishnu Shekar, T Sudhakar Babu, N. Rajasekar "Solar PV array reconfiguration under partial shading conditions for maximum power extraction using genetic algorithm."