ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, 2021

Novel Reconfiguration Approach to Reduce Photovoltaic Array Line Losses Under Different Shading Conditions

Dr.B.Loveswara.Rao

[1]**Department of Electrical and Electronics Engineering,**

Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India 522502. loveswararao@kluniversity.in

Abstract

The suggested method is based on the Skyscraper (SS) technique, which denotes that the PV modules in the array are physically organized in a Skyscraper pattern to distribute the effects of shadowing across the array and enhance energy yields. The impacts of different types of partial shade conditions on the suggested technique in a 66 array have been investigated. Additionally, by obtaining several parameters such as "global maximum power point (GMPP), the voltage at the global maximum power point (GMPP), and the frequency at the global maximum power point (GMPP), the performance of the proposed arrangement is compared with the other existing array interconnections, such as "series-parallel (SP), total-cross- tied (TCT), bridge-link (BL), honey-comb (HC), and Arrow-SuDoKu (AS)".

INTRODUCTION

Power generation from renewable sources plays a vital role in the integrated power systemfor providing adequate power supply to consumers[1]. Solar PV generation is leading the green energy revolution as scientists continue to improve the performance characteristics [2] of transferring bulk power with maximum achievable efficiency[3].

Wiring Losses

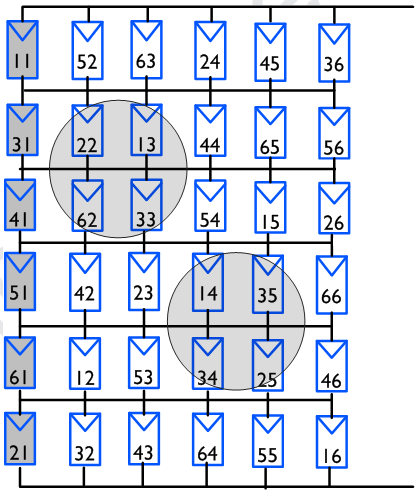
In the reconfiguration, the PV modules physical location varies from one place to another to distribute partial shading effects and improve power output[4]. Due to the change in the position of the module increases the length of the wire for the arrangement[5]. The additional wiring increases the wiring resistance; further, the voltage drop occurs in the PV system[6].

Shading Distribution Effect

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, 2021

Arrow-SuDoKu PV array arrangement



Novelty of the Paper

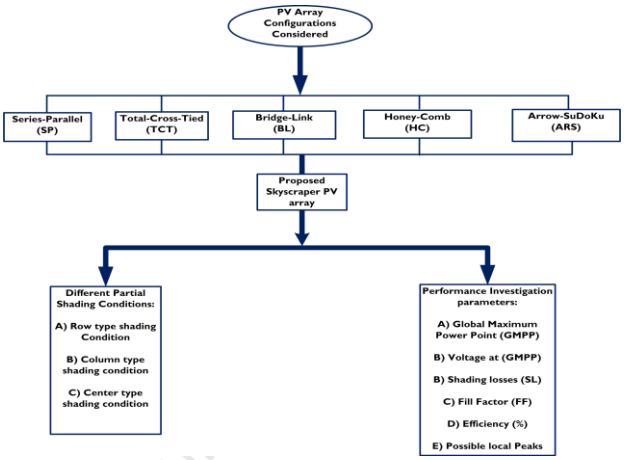
According to the literature, this article suggested a new skyscraper scheme to distribute partial shading impacts and boost the energy output for the 6 ×6 TCT array [7]. In this method, the physical position of the PV modules is rearranged without modifying the electrical connections depending on the skyscraper structure [8].

MODELLING OF PV ARRAY

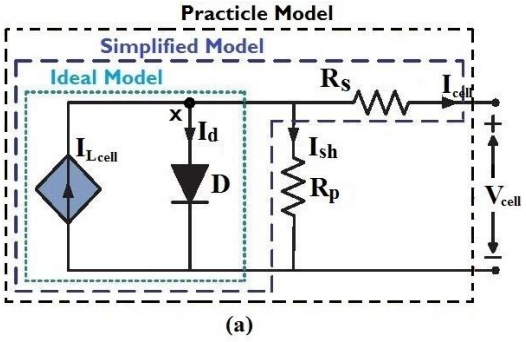
Modelling is a well-known method to study the behaviour of any of the system [9]. When it comes to Photovoltaic modelling, the first step is to analyse the output ”I-V and P-V characteristics”of a PV module [10]. Modelling a PV module begins with a single PV cell’s mathematical modelling [11].

ISSN PRINT 2319 1775 Online 2320 7876

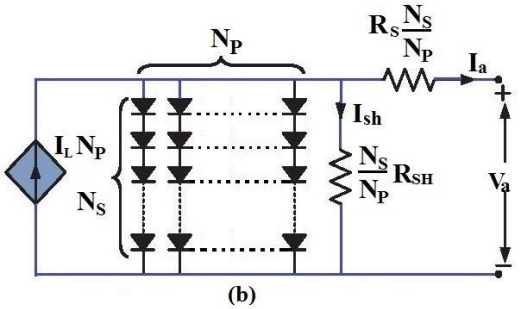
Research paper UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, 2021



SINGLE DIODE PV CELL MODEL



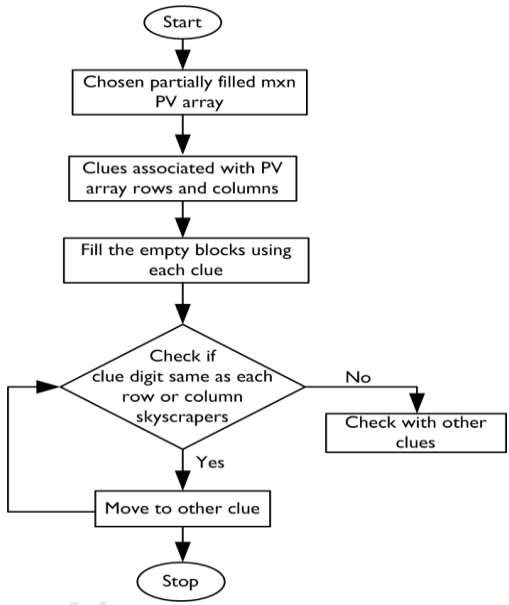
(a)



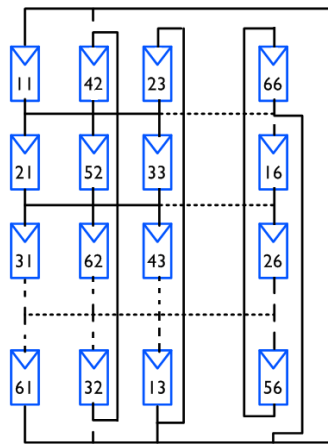
(b)

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal
Volume 10, Iss 1, 2021



Physical relocation of the modules using skyscraper technique

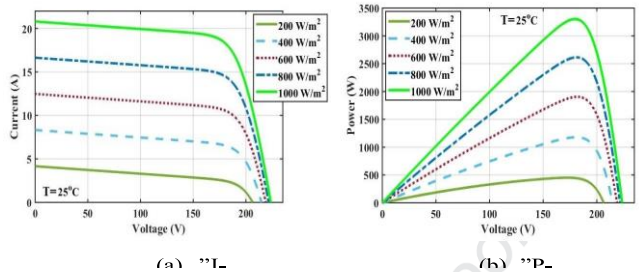


ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, 2021

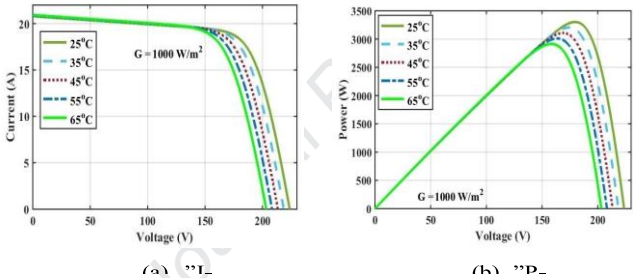
RESULTS AND DISCUSSIONS

simulation results for row type shading case-



(a) "I- (b) "P-

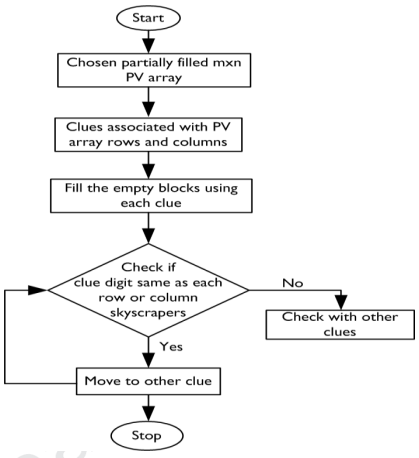
Figure 5: output 5×4 TCT PV



(a) "I- (b) "P-

Figure 6: output 5×4 TCT PV

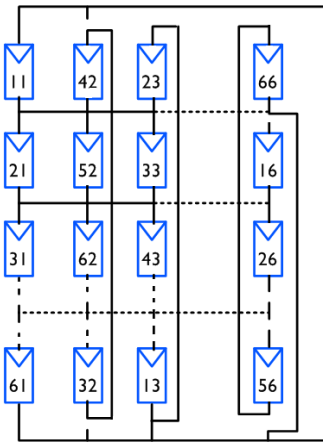
ALGORITHM FOR SKYSCRAPPER PUZZLE



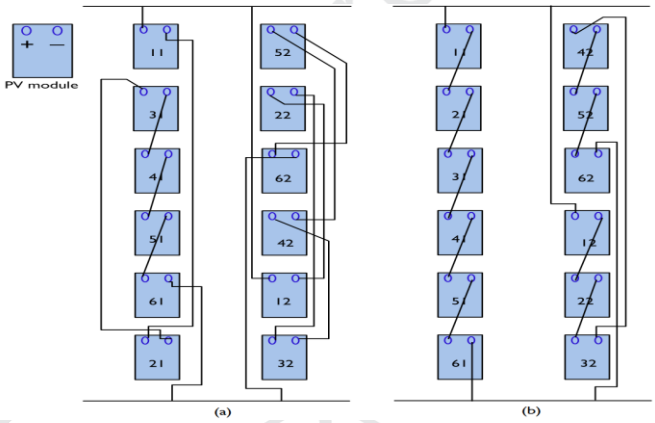
ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, 2021

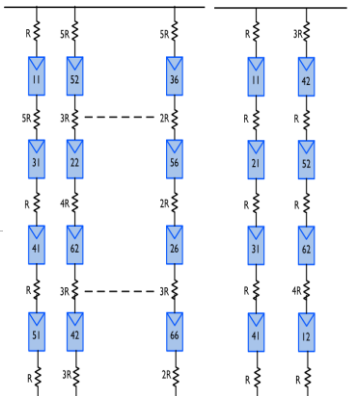
PHYSICAL RELOCATION OF THE MODULES USING SKYSCRAPER TECHNIQUE



typical array electrical connection:(a)Arrow-SuDoKu technique, (b) Skyscraper technique



wiring connection: (a)Arrow-SuDoKu technique, (b) Skyscraper technique



ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, 2021

CONCLUSION

(i) A novel skyscraper reconfiguration technique is suggested to lessen the effects of partial s hade and increase power output in the 66 TCT array.

(ii) According to the suggested method, moving the PV modules in the array can increase po wer production.

(iii) In order to evaluate the effectiveness of the suggested method using Matlab-Simulink, various significant shading effects, such as row-wise, column-wise, center, and corner, are discussed in this work.

The efficiency, fill factor, shading loss, potential local peaks, and GMPP and VGMP P for ea ch shading situation are calculated.

(iv) In addition to shading analyses, the power loss resulting from the wire configuration is al so computed for the suggested method.

(v) The study's findings show that, when compared to ARR, SP, TCT, BL, and HC interconn ections, the proposed method increases average power generation by 2.2%, 18.2%, 13.5%, 16 .8%, and 16.6% in row shading, 1.6%, 9.8%, 7.5%, and 7.2% in column shading, and 1.1%, 1 6.8%, 9.5%, 12.6%, and 15.4% in center shading.

(vi)According to the experiments, the skyscraper arrangement, as opposed to current array co nnections, enhances the global maximum power and reduces losses in all shading circumstan ces. Additionally, the suggested approach has less wire loss than the Arrow-SuDoKu.

REFERENCES

[1] Ali Al-Dousari, Waleed Al-Nassar, Ali Al-Hemoud, Abeer Alsaleh, Ashraf Ramadan, Noor Al- Dousari, and Modi Ahmed. Solar and wind energy: Challenges and solutions in desert regions. *Energy*, 176:184–194, 2019.

[2] Sobhan Badakhshan, Neda Hajibandeh, Miadreza Shafie-khah, and João PS Catalão. Impact of solar energy on the integrated operation of electricity-gas grids. *Energy*, 2019.

[3] Suneel Raju Pendem and Suresh Mikkili. Modeling, simulation and performance analysis of solar pv array configurations (series, series–parallel and honey-comb) to extract maximum power under partial shading conditions. *Energy Reports*, 4:274–287, 2018.

[4] Suneel Raju Pendem and Suresh Mikkili. Modelling and performance assessment of pv

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, 2021

array topologies under partial shading conditions to mitigate the mismatching power losses. *Solar Energy*, 160:303–321, 2018.

[5]G Sai Krishna and Tukaram Moger. Reconfiguration strategies for reducing partial shading effects in photovoltaic arrays: State of the art. *Solar Energy*, 182:429–452, 2019.

[6]Venugopal Reddy Barry Manjunath Matam and Avinash Reddy Govind. Optimized reconfigurable pv array based photovoltaic water-pumping system. *Solar Energy*, 170:1063–1073, 2018.

[7]Guillermo Velasco-Quesada, Francisco Guinjoan-Gispert, Robert Piqué-López, Manuel Román- Lumbreras, and Alfonso Conesa-Roca. Electrical pv array reconfiguration strategy for energy extraction improvement in grid-connected pv systems. *IEEE Transactions on Industrial Elec-tronics*, 56(11):4319–4331, 2009.

[8]MZ Shams El-Dein, Mehrdad Kazerani, and MMA Salama. Optimal photovoltaic array re- configuration to

uce partial shading losses. *IEEE Transactions on Sustainable Energy*, 4(1):145–153, 2013.

[9] Pietro Romano, Romano Candela, Marzia Cardinale, Vincenzo Li Vigni, Domenico Musso, and Eleonora Riva Sanseverino. Optimization of photovoltaic energy production through an efficient switching matrix. *Journal of Sustainable Development of Energy, Water and Environment Systems*, 1(3):227–236, 2013.

[10]Koray Şener Parlak. Pv array reconfiguration method under partial shading conditions. *In- ternational Journal of Electrical Power & Energy Systems*, 63:713–721, 2014.

[11]Dzung Nguyen and Brad Lehman. An adaptive solar photovoltaic array using model-based re- configuration algorithm. *IEEE Transactions on Industrial Electronics*, 55(7):2644–2654, 2008.