

Photovoltaic System Reconfiguration strategy for mismatch condition

1st Dafang Zhao

dept. name of organization (of Aff.)
name of organization (of Aff.)

2nd Given Name Surname

dept. name of organization (of Aff.)
name of organization (of Aff.)

3rd Given Name Surname

dept. name of organization (of Aff.)
name of organization (of Aff.)

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I. INTRODUCTION

As the world of fossil energy constantly exhausted and the increasingly serious environmental pollution, the research and utilization of renewable energy and green energy have become maintain necessary means of survival and development of the human. Photovoltaic (PV) energy received significant attention since it has unlimited energy and easy to be scaled up. Thanks to extensive technology and research on photovoltaic energy generation, large scale photovoltaic energy generation system have been deployed into many practical application. But due to PV arrays are sensitive to shading and PV cell's fault or aging. That means when interconnection of PV cells or modules do not have identical properties or experience different conditions from one another. PV arrays are in mismatch condition. In order to avoid mismatch condition damage PV cells, we proposed an algorithm that can re-configure photovoltaic arrays to minimize mismatch loss.

In this paper, we use non-uniform irradiance levels to represent mismatch condition and analyze the efficiency of a PV system under different shaded working condition is presented. When photovoltaic arrays operating in non-uniform irradiance levels may present multiple local maximum power points (MPPs) [1], which are generated by turning on bypass diodes. By changing electrical connection among the panels to prevent activate bypass diodes is a recent appealing solution [2].

The main difficulty facing the reconfiguration problem is that some or even all panels can be subjected to partial shading, so there may be more than one MPP for each panel. Reconfiguration strategy need also consider to group PV modules which provided high power separately [3] [4].

This procedure enables to detect panel's operating conditions, in more than two-strings, receiving different irradiance levels. The reconfiguration algorithm will analyze panels' working conditions and reorganizes panels into different strings by different irradiance levels. However, in sparse of

mismatching conditions, distribution of panels among different irradiance levels are not significant. For that, by increasing number of strings in the PV array and using exhaustive search can be a solution [3]. Another approach to optimize photovoltaic arrays is using genetic algorithm [5]. However, computing cost is too significant, and this algorithm can't detect best configuration precisely.

II. ASSUMPTION OF A PV ARRAY

In this paper, we use following definitions of PV arrays, modules, strings and panels. A PV array formed by several parallel connected PV strings, and string is several series connected PV panels. For a PV panel, formed by two or three PV modules connected in series with bypass diodes. An equivalent connection as shown in Fig. 1.



Fig. 1. Definition of PV array and internal components.

The algorithm we proposed based on following assumptions.

- The current versus voltage (I - V) curve of each panel calculated by algorithm presented in [6]. This algorithm will analyze panel's I - V curve sample and coordinate to maximum or minimum power point in P - V curve.
- All the panels in PV array have same number (N) of modules. For particular module, using (V_{mppn} , I_{mppn}) to identify MPP voltage and current by index n . Those parameter can be directly estimated by the process provided in [7].

Furthermore, it is also assumed that for each string it has same number of panels in PV array. Means every string in PV array have same length. String's length are identical based on when they connected in parallel, a string has more panels may cause current back flow into other strings which have less panels [8].



Fig. 2. Flowchart of reconfiguration algorithm.

III. RECONFIGURATION ALGORITHM

The general steps of reconfiguration algorithm are presented in Fig.2. The first step is determine each PV modul's V_{mpp} and I_{mpp} by using algorithm provided in [7] [9], and calculate MPP current and voltage candidates of PV array. Afterward, determine real number of working modules per string by applying method in [10].

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Fig. 3. Example of a figure caption.

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ACKNOWLEDGMENT

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Unless there are six authors or more give all authors’ names; do not use “et al.”. Papers that have not been published, even if they have been submitted for publication, should be cited as “unpublished” [4]. Papers that have been accepted for publication should be cited as “in press” [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

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