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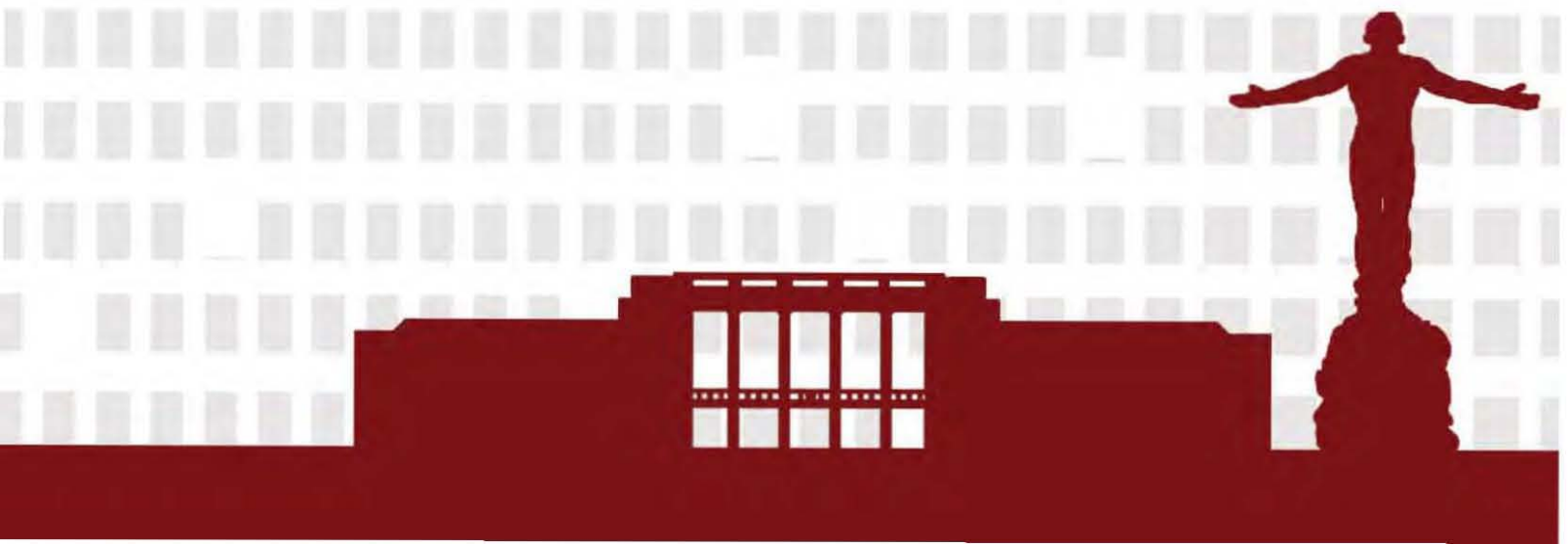
Metro Manila, Philippines



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CONVERSION EFFICIENCY OF MAXIMUM POWER POINT TRACKING FOR PHOTO-VOLTAIC STRING UNDER PARTIAL SHADING

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ABSTRACT

This paper aims to study the characteristics of string configuration of photo-voltaic (PV) panels. Its degradation of conversion efficiency will be investigated to confirm the effect of partial shading. The configuration is modified to improve its performance and an intelligent control algorithm will be subsequently designed.

A PV panel is a module that converts sun light to electricity directly. Its characteristics has a maximum power generation at a maximal operating point. This characteristics depends on temperature and irradiation. To match a PV panel with a load, a DC/DC converter is inserted between them. A maximum power point tracking (MPPT) algorithm such as the perturb and observe (P&O) is implemented to iteratively find the duty ratio of the converter that enables the maximum power transfer from the panel to the load.

In a large or roof top solar plant, multiple PV panels are installed to generate significant power to a utility AC grid. They are usually divided in groups called PV strings within which a series connection among panels is used and terminated with a DC/DC running an MPPT alogorithm. This configuration makes all panels working at the same string current. If all panels receive the same irradiation, the converter will be able to transfer maximum power because the maximal string current is the same as the maximal current of each panel. Unfortunaetly, when partial shading occurs, the characteristics of all panels become different. Hence, the maximal string current obtained by the MPPT will not be the same as the panels as shown in Fig. 1 (left). Therefore, there is a loss of maximum power transfer which can be as much as 25%.

In this research, a modification of the PV string is introduced. Each panel must have it own converter before interfacing with the string as shown in Fig. 1 (right). Each distributed converter gives flexibilty to maximize its power transfer. Now the problem is to determine the duty ratio of all converters so that the true total maximum power is obtained. This is a multidimension optimization that is an ongoing research.

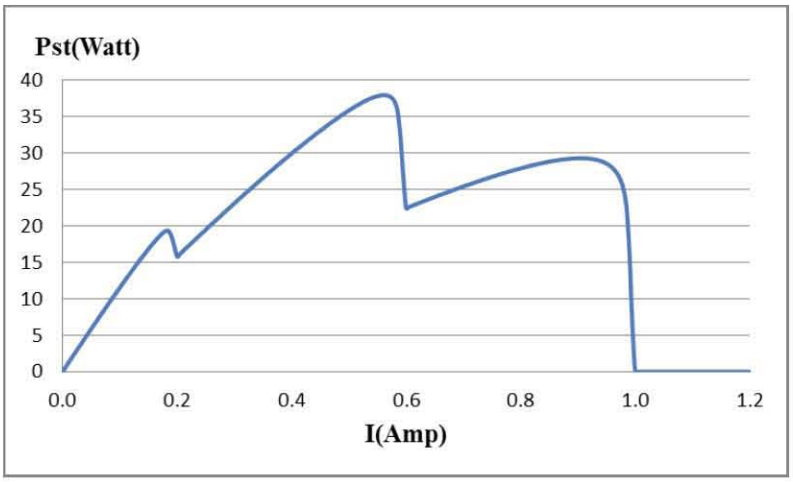

Figure 1. P-I curve of a string with 3 PV panels receiving 1000, 600 and 200W/m2 irradiations (left) and PV string with distributed DC/DC converter (right).

Keywords: DC/DC converter, energy conversion, grid-connect, maximum power point transfer (MPPT), partial shading, PV string.

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