Enhanced Power Emittance of Reconfigured Solar Cells Through Predetermined Shading Patterns

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Abstract:

There is a drastic increase in the usage of the Photovoltaic (PV) based power source for powering homes, commercial buildings, automobiles, satellite, and many more applications. In addition to pushing towards the redution of fossil energy and renewable energy awareness, the improvement in the PV Cell's efficiency and the decrease in the cost per cell over the years are significant factors in the increase in demand for PV based power sources.

However, during deployment, PV modules suffer from many power loss issues such as mismatch loss, partial shading, complete shading, grounding error, hot-spot, short and open circuit of PV cells. To some extent, the effect of mismatch and partial or complete shading can be reduced by the usage of the bypass diode. Additionally, different topologies for connecting PV cells in an array such as Total Cross-Tied (TCT), and Bridge Link (BL) have shown better capability in dealing with partial shading compared to the regular series-parallel configuration. Recently, the integration of silicon switches with PV cells enables in creating a reconfigurable PV panel. These PV panels have shown their adaptability by changing the configuration of the PV panel in case of partial or complete shading to maximize the power generation.

The capability of reconfigurable PV modules to autonomously detect the partial or complete shading and reconfigure to optimal configuration for maximizing the power is due to the integration of the PV module with an embedded computing device. This embedded computing device not only controls the functioning of the reconfigurable PV module but also applies various

fault and shading detection algorithms on the PV module to reduce the power loss that results from these anomalies.

This research mainly focuses on improving the algorithm to detect partial or complete shading in a reconfigurable PV module. Until now, most of the algorithms that are proposed use a column and row search to detect the partial shaded or failed PV cells in a given module. After detection of shaded or failed PV cells, an optimal configuration for the PV module is computed and deployed. However, this increases the partial shade detection and mitigation time. In this work, we are showing an algorithm that first looks for the best configurations in case of partial shading or faulty conditions by using the optimization technique. Therefore, while applying various optimized configurations, the power loss due damaged or shaded PV cells are alleviated.