

A Comparison Study: Direct and Indirect Mode Control of Perturb and Observe-MPPT Algorithms for Photovoltaic System

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Abstract: The Perturb and Observe P&O algorithm has been widely used in most real-world applications due to its simplicity of implementation in the control loops. Its main idea is to adjust the operating point of photovoltaic PV panels to ensure a good tracking behavior of a desired Maximum Power Point (MPP). The P&O algorithm is one of the most used MPPT algorithms to extract the electrical energy of PV panels under different weather conditions. This can be done via the direct control mode of the DC-DC boost converter which is commonly linked by an external resistive load. However, the given electrical power of the P&O-MPPT algorithm becomes fluctuating in the small time range, especially when the current MPP is gradually approaching the desired one. It provides unfortunately a steady-state power oscillation problem and a loss of electrical energy at a sudden change of climatic conditions. The indirect control mode of the DC-DC boost converter via P&O-MPPT algorithm is adopted as an alternative key to avoid the above mentioned drawbacks where electrical performances are well enhanced in terms of transient and steady-states of the given output power response, the MPP tracking accuracy, the given electrical energy ratio and so on. This goal can be reached through the following steps. The desired reference voltage perturbation is firstly computed by the standard P&O algorithm using the MPP measurements recorded through the actual PV panel at the standard test condition (STC) (i.e., nominal absolute temperature and nominal solar irradiance). It is then compared by the actual voltage perturbation generated by the closed loop P&O-MPPT scheme, providing thus the discrepancy voltage perturbation. Finally, a Proportional-Integral-Derivative (PID) controller given in the P&O-MPPT inner loop scheme is used to mitigate as much as possible the previous voltage error perturbation. This yields a desired duty cycle perturbation of the DC-DC boost converter which allows reaching a good trade-off between both transient state speed and steady-state stationary of the output power response. Simulation results confirm the effectiveness of the indirect control mode of the P&O-MPPT algorithm over the direct control mode of the same algorithm for several sudden changes in weather conditions and wide variations of the resistive load.

Keywords : PV system, Boost converter, P&O algorithm, Direct and indirect control modes