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A Comparison Study: Direct and Indirect ModeControl of Perturb and Observe-MPPT Algorithmsfor Photovoltaic System

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Abstract: The Perturb and Observe P&O algorithm hasbeen widely used in most real-world applications due to itssimplicity of implementation in the control loops. Its main idea isto adjust the operating point of photovoltaic PV panels to ensurea good tracking behavior of a desired Maximum Power PointMPP. The P&O algorithm is one of the most used MPPTalgorithms to extract the electrical energy of PV panels underdifferent weather conditions. This can be done via the directcontrol mode of the DC-DC boost converter which commonlylinked by an external resistive load. However, the given electricalpower of the P&O-MPPT algorithm becomes fluctuating in thesmall time range, especially when the current MPP is graduallyapproaching the desired one. It provides unfortunately a steadystatepower oscillation problem and a loss of electrical energy at asudden change of climatic conditions. The indirect control modeof the DC-DC boost converter via P&O-MPPT algorithm isadopted as an alternative key to avoid the above mentioneddrawbacks where electrical performances are well enhanced interm of transient and steady-states of the given output powerresponse, the MPP tracking accuracy, the given electrical energyratio and so on. This goal can be reached through the followingsteps. The desired reference voltage perturbation is firstlycomputed by the standard P&O algorithm using the MPPmeasurements recorded through the actual PV panel at thestandard test condition STC (i.e., nominal absolute temperatureand nominal solar irradiance). It then compared by the actualvoltage perturbation generated by the closed loop P&O-MPPTscheme, providing thus the discrepancy voltage perturbation.Finally, a Proportional-Integral-Derivative PID controller givenin the P&O-MPPT inner loop scheme is used to mitigate as muchas possible the previous voltage error perturbation. This yields adesired duty cycle perturbation of the DC-DC boost converterwhich allowing reaching a good trade-off between both transientstatespeed and steady-state stationary of the output powerresponse. Simulation results confirm the effectiveness of theindirect control mode of the P&O –MPPT algorithm over thedirect control mode of same algorithm for several suddenchanges in weather conditions and wide variations of the resistiveload.

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