European Association for the Development of Renewable Energies, Environment and Power Quality (EA4EPQ)

International Conference on Renewable Energies and Power Quality (ICREPQ'10)
Granada (Spain), 23rd to 25th March, 2010

Improvement of a MPPT Algorithm for PV Systems and Its Experimental Validation

A.J. Mahdi, W.H. Tang and Q.H. Wu
Department of Electrical Engineering and Electronics
The University of Liverpool, Liverpool, L69 3GJ, U.K.
E-mail: whtang@liv.ac.uk

Abstract. The amount of power generated from a photovoltaic (PV) system mainly depends on the following factors, such as temperatures and solar irradiances. According to the high cost and low efficiency of a PV system, it should be operated at the maximum power point (MPP) which changes with solar irradiances or load variations. A number of maximum power point tracking (MPPT) techniques have been developed for PV systems, and the main problem is how to obtain optimal operating points (voltage and current) automatically at maximum PV output power under variable atmospheric conditions. The majority of MPPT control strategies depend on characteristics of PV panels in real time, such as the duty cycle ratio control and using a look-up table.

Figure 1 illustrates a real-time implementation of a PV system using a fast dSPACE DSP controller. This system consists of two PV panels connected in series (the rated power of each panel is 162 W at a solar irradiance of 1000 W/m^2 and a temperature of 25°C), a boost converter to control the load voltage, a dSPACE controller to implement the proposed MPPT algorithm, sensors to measure the PV voltage, PV current and load voltage which are input signals to the MPPT controller, and a stand-alone resistive load.

The proposed MPPT algorithm is based on the perturbation and observation (P&O) strategy and the variable step method that control the load voltage to ensure optimal operating points of a PV system. The principle of the proposed MPPT algorithm is summarised by calculating the optimal reference output voltage that ensures the PV system is operated at its MPP. It is worth noting that the fixed perturbation step in the P&O algorithm is changed in this work to a variable perturbation step in order to improve the MPPT efficiency. The proposed MPPT algorithm is implemented by a dSPACE DSP controller and tested under real climatic conditions. The purposes of tests are to investigate the dynamic characteristics of a PV system and to calculate the amount of power increase using the proposed MPPT controller.

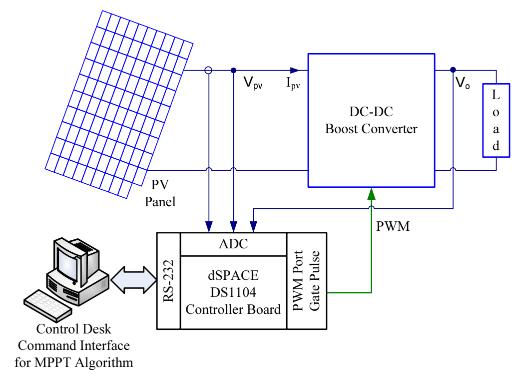

Fig. 1. Configuration of a PV power control system

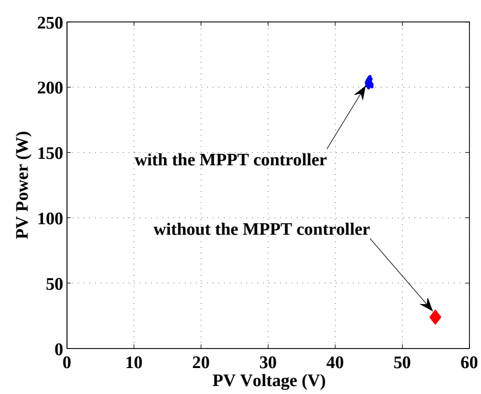

Fig. 2. Comparison of the experimental results obtained with and without using MPPT controller

The experimental results show that the PV power system, using the proposed MPPT algorithm, is able to accurately track maximum power points (with minimum steady-state power oscillations) under rapid irradiance variations. The experimental PV characteristics for both with and without a MPPT controller are simultaneously obtained as shown in Fig. 2. It shows that the PV output power is increased as much as 8.59 times of that without using the MPPT controller.