Journal of Electronic Materials

Volume 48, Issue 9, 2019, Pages 1-10

Modeling and Fuzzy MPPT Controller Design for Photovoltaic Module Equipped with a Closed-Loop Cooling System

M. BECHOUAT, M. Sedraoui, C-E. Feraga, M. Aidoud, S. Kahla

Abstract: Electrical energy generated by a photovoltaic (PV) panel depends heavily on two climatic conditions: total solar irradiance and absolute temperature. If high intensity of the solar illumination contributes positively to increasing electrical power, a high degree of absolute temperature has, by contrast, a negative effect on its electrical characteristic. In this paper, the electrical efficiency provided by a conventional PV panel is enhanced using the proposed photovoltaic thermal (PVT) panel. The latter contains serpentines fed by a water tank, which allows cooling its PV cells at high temperature. Accordingly, the desired enhancement needs two main requirements: an efficient PVT panel model that accurately describes the actual PVT panel behavior and an efficient controller that correctly tracks the maximum power point tracking (MPPT). For this reason, a number of experimental test data is firstly recorded from an actual ISOFOTON I-50-PVT module under different climatic conditions. Afterward, the recorded data are fitted by the Curve Fitting Toolbox (CF-Tool), creating therefore a 2-dimensional lookup table, used in the following step. Next, the fuzzy logic control (FLC) strategy is employed to synthesize the proposed MPPT-FLC controller, which should ensure a good extraction of the maximal electrical power. To validate the effectiveness of the proposed MPPT-FLC controller based on a 2-dimensional lookup table, the obtained performance is compared, in terms of electrical power and duty cycle, to those provided by an MPPT-FLC controller for a conventional PV panel in various climatic conditions.

Keywords : Photovoltaic thermal system, 2-Dimensional lookup table, fuzzy logic control, Maximum Power Point Tracking