

COMPARATIVE STUDY OF P&O AND MODIFIED INCREMENTAL CONDUCTANCE ALGORITHM IN SOLAR MAXIMUM POWER POINT TRACKING

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Abstract

Photovoltaic (PV) system has been widely used as one of the renewable energy resources. Due to the non-linear I-V characteristic and changes of the external environment and load, the output power of the PV array varies according to different situation. Hence, the maximum power point (MPP) tracking technology is necessary to be implemented in order to track for the only MPP on the P-V curve to increase the energy harness from the PV array. In this study, two commonly used MPPT algorithm, perturb and observe and incremental conductance were developed in Matlab Simulink with a boost DC-DC converter to study the accuracy, speed and tracking efficiency under STC, slow changing irradiance condition and step changing irradiance condition. Comparative studies shows that modified incremental conductance is able to track MPP faster and more efficiently under fast changing of irradiance.

1 Introduction

Solar energy is considered as one of the most important source of energy in future. It is an inexhaustible source of energy as well as it emits zero carbon during operation of the photovoltaic (PV) system. Due to the high initial cost of PV system, it is essential to capture the available solar energy. One of the most efficient and economical way to increase energy yield by the PV system is to ensure that the system is operating at maximum power point (MPP). In order to achieve this, MPP tracker (MPPT) is necessary to be employed in the system.

Due to the non-linear relation between the power and voltage/current in PV cell, thus posing a challenge for the MPPT algorithm in performing MPP tracking. With the same objective of tracking MPP, the performance of different MPPT techniques differ by the convergence speed, steady state oscillation and its cost effectiveness. Among them, perturb and observe (P&O), Hill climbing (HC) and incremental conductance (INC) are most popular.

In this paper, perturb and observe and modified incremental conductance with direct control strategy [1] are proposed to study the performance of both method. The proposed work will demonstrate on direct duty cycle control for MPPT controller by the tracking algorithm. The proposed system is investigated with a PV module with a dc-dc boost converter configured as MPPT.

2 Maximum Power Point Tracker (MPPT)

Solar cell has been known which it operates at very low efficiency and its non-linear electrical behaviour, thus necessary control mechanism is required to increase the conversion efficiency of the cell. The non-linear photovoltaic power characteristic as shown in Figure 1, which varies with the solar irradiance and cell temperature causing the extraction of maximum power a complex task [2].

For a PV array under a uniform irradiance as shown in Figure 2, there is a unique point on the current-voltage (I-V) curve which the array will operate with maximum efficiency and produces maximum output power.

A MPPT is a device, employing a microprocessor, to constantly track the power output of the PV array and to maintain the optimal operating point, at which the PV array will produce maximum power [3]. The changing of irradiance and cell temperature will varies the optimal operating point of the array. Hence, the new optimal operating point of the PV array have to be located either through model calculation or by a search algorithm.

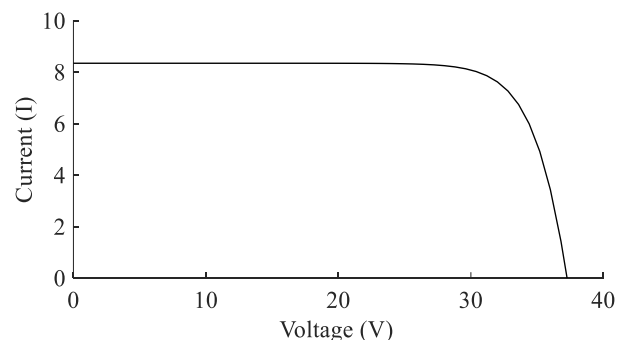


Figure 1. PV current versus voltage (I-V) characteristic