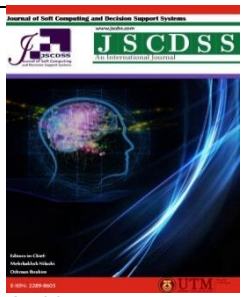
An International Journal
JSCDSS
http://www.jscdss.com
Vol.8 No.2 April 2021: 14-18
Article history:
Accepted 24 April 2021
Published online 26 April 2021

Journal of Soft Computing and Decision Support Systems



E-ISSN: 2289-8603

Implementation and comparison of Perturb and Observe, and Fuzzy Logic Control on Maximum Power Point Tracking (MPPT) for a Small Satellite

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Abstract

In a small satellite, with the restriction of the size of solar arrays, variation of the sun radiation, and low efficiency of solar cells, there is a huge demand for Maximum Power Point Tracking (MPPT). However, the main issue with using solar cells is to reach its maximum power point because of the change in the temperature and sun radiation. There are some basic and hybrid MPPT methods, which in this paper, the Perturb and Observe (P&O) method, has been designed which is a fast method with high reliability. But, because of power oscillation around the operating point in P&O method, a fuzzy method is used for maximum power point tracking so that without the need for temperature and light sensors, reduction of output power oscillations can be achieved. Simulation results indicate that by using the fuzzy method, the output power is less fluctuated and therefore more power can be driven from the same solar panel.

Keywords: Maximum Power Point Tracking (MPPT), Research Satellite, P&O Method, Fuzzy Logic Control

1. Introduction

The power subsystem of a satellite is providing power throughout its entire mission and solar arrays are the only source of energy for most satellites. In addition, maximum solar energy allows to use a satellite for a long period of time, which is crucial for small satellites with all the costs for fulfilling such projects. In a small satellite, the voltage and current characteristics of the solar arrays are nonlinear and affected by sun radiation and temperature. So, maximum power point tracking is inevitable in order to extract maximum power from solar arrays (Taherbaneh & Menhaj, 2007). By using MPPT techniques need sensors for measuring voltage and current, a DC-DC converter for converting the solar output voltage to the required voltage of the satellite subsystem, and a proper controller.

This paper is organized as follows. Section 2 gives the characteristic of solar arrays. In section 3, dc-dc buck boost converter is shown. In section 4, maximum power point tracking is described, P&O and fuzzy techniques has been designed. In section 5 results are shown and compared with Perturb and Observe algorithm the output power is more in the same solar panel.

2. 2.Current - voltage characteristic of Solar Arrays

Fig. 1 represents a one-diode equivalent circuit of a solar cell. It is obvious that solar arrays are comprised of a series and parallel combination of these cells (Femia, Petrone, Spagnuolo, & Vitelli, 2005).

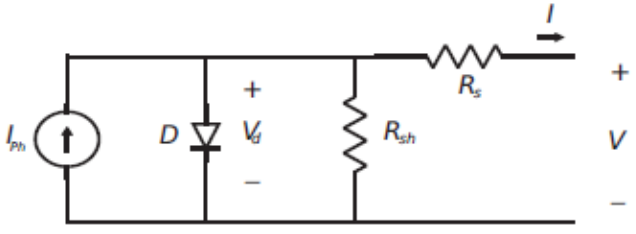

Fig. 1. An equivalent circuit of a one diode solar cell