IJournals: International Journal of Software & Hardware Research in Engineering
ISSN-2347-4890
Volume 3 Issue 4 April, 2015

STUDY OF MAXIMUM POWER POINT TRACKING USING PERTURB AND OBSERVE METHOD FOR BOOST CONVERTER

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Abstract— **This paper presents the analysis of maximum power point tracking (MPPT) algorithms in a Solar photovoltaic system. A model of photovoltaic system is designed with MPPT along with Boost converter using Matlab/Simulink. This system is developed by combination of Solar PV module, MPPT and DC-DC boost converter with the algorithms of Perturb and Observe (P&O). From the simulation results, it is observed that the proposed photovoltaic simulation system can track the maximum power accurately using the P&O method with a better efficiency in association with the Boost Converter.**

Keywords— Maximum power point tracker (MPPT), Perturb and Observe (P&O), PhotoVoltaic (PV) , Boost Converter

I. INTRODUCTION

The Sun is a direct source of energy. Using renewable energy technologies, we can convert the solar energy into electricity. Two primary types of PV technologies available commercially are crystalline silicon and thin film. In crystalline-silicon technologies, individual PV cells are cut from large single crystals or from ingots of crystalline silicon. In thin film PV technologies, the PV material is deposited on glass or thin metal that mechanically supports the cell or module. Thin-film-based modules are produced in sheets that are sized for specified electrical outputs .In addition to PV modules, the components needed to complete a PV system may include a battery charge controller, batteries, an inverter or power control unit (for alternating-current loads), safety disconnects and fuses, a grounding circuit, and wiring. The application of photovoltaic (PV) has achieved a remarkable growth for past two decades from off-grid to grid connected PV systems. The best way to utilize the electric energy produced by the PV array is delivered to the utility grid directly, without using storage system (battery banks). The performance analysis of newly developed systems requires mathematical functional models for PV module research. These developed systems could not be readily adopted by the field professionals to reduce the failure rate. Hence it requires the simplified Simulink modeling of PV module for analysis purpose.

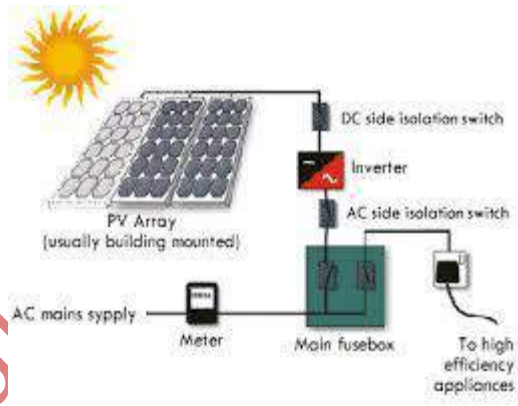

Fig. 1.1: solar PV generation procces

II. MAXIMUM POWER POINT TRACKER

There are commericially available MPPTs which are typically used for home solutions and buildings. These are not designed to withstand the harsh, fast-changing environmental conditions of solar car racing. Design of the customized MPPT will ensure that the system operates as closely to the Maximum Power Point (MPP) while being subjected to the varying lighting and temperature.

An MPPT(Maximum Power Point Tracker) is a high-efficiency DC-DC converter, which functions as an optimal electrical load for PV cell, most commonly used for a solar panel or array and converts the power to a voltage or current level which is more suitable to whatever load the system is design to drive.

OVERVIEW OF DC-DC CONVERTER:

DC-DC conversion technology is a major area of interest in the field of power system,power electronics. The technology have application in industries like automotive, renewable energy, R&D sectors etc and have gone under series of developmental stages for more than decades. This conversion technique is widely adopted in industrial application and computer hardware circuits. The ideas of DC-DC conversion technique and development have been on for over 80 years. All new topology and presently existing DC-DC converters were design to meet some sort of industrial or commercial applications. For example Buck converter, boost converter, buck-boost converter and ZCS(zero-switching) and ZVS(zer The application of photovoltaic (PV) has achieved a remarkable growth for past two decades from off-grid to grid connected PV systems. The best way to utilize the electric energy produced by the PV array is delivered to the utility grid directly, without using storage system (battery banks) [1]. The performance analysis of newly developed systems requires mathematical functional models for PV module research. These developed systems could not be readily adopted by the field professionals to reduce the failure rate. Hence it requires the simplified Simulink modeling of PV module for analysis purpose voltage switching) converters which are used to reduce, increase voltage respectively.

DC-DC converters such as boost convertes are also implemented with other devices as maximum power point trackers (MPPT) for PV module, to achieve high efficiency and current and power output.

III. PROPOSED METHOD

Now a days, PV power generation has become more important due its many benefits such as needs a few maintenance and environmental advantages and fuel free. However, there are two major barriers for the use of PV systems, low energy conversion efficiency and high initial cost.

To improve the energy efficiency, it is important to work PV system always at its maximum power point.

There are different types of maximum power point tracker methods developed over the years and they are listed below as follows

(1) Perturb and Observe method,

(2)Incremental conductance method,

(3) Artificial neutral network method,

(4)Fuzzy logic method,

(5) Peak power point method,

(6) Open circuit voltage method, and

(7)Temperature method etc.

IV. PERTURB AND OBSERVE METHOD

In this method a slight perturbation is introduce system. This perturbation causes the power of the solar module changes. If the power increases due to the perturbation then the perturbation is continued in that direction. After the peak power is reached the power at the next instant decreases and hence after that the perturbation reverses. When the steady state is reached the method oscillates around the peak point. In order to keep the power variation small the perturbation size is kept very small. The method is developed in such a manner that it sets a reference voltage of the module corresponding to the peak voltage of the module. A PI controller then acts moving the operating point of the module to that particular voltage level. It is observed that there some power loss due to this perturbation also the fails to track the power under fast varying atmospheric conditions. But still this method is very popular and simple

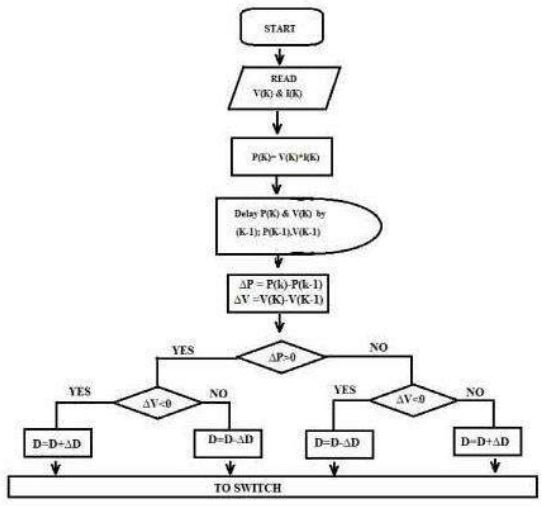

Fig. 1.2 Flowchart for P & O Algorithm

BOOST CONVERTER

A boost converter (step-up converter) is a DC-to-DC power converter with an output voltage greater than its input voltage. It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element, a capacitor, inductor, or the two in combination.

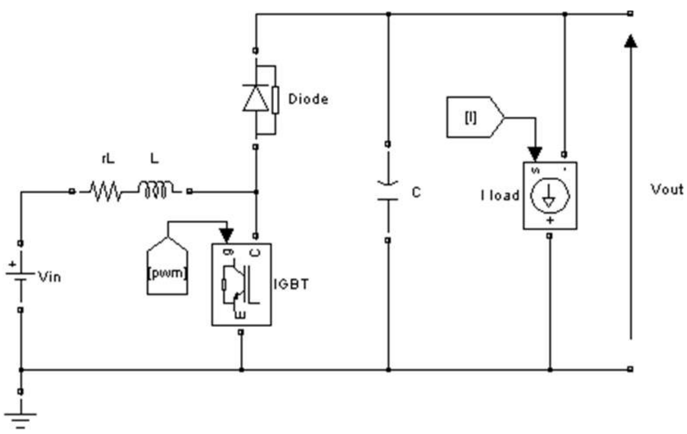

Fig.1.3 Boost Converter

Battery power systems often stack cells in series to achieve higher voltage. However, sufficient stacking of cells is not possible in many high voltage applications due to lack of space. Boost converters can increase the voltage and reduce the number of cells. Two battery-powered applications that use boost converters are hybrid electric vehicles (HEV) and lighting systems.

V. SIMULINK MODEL:

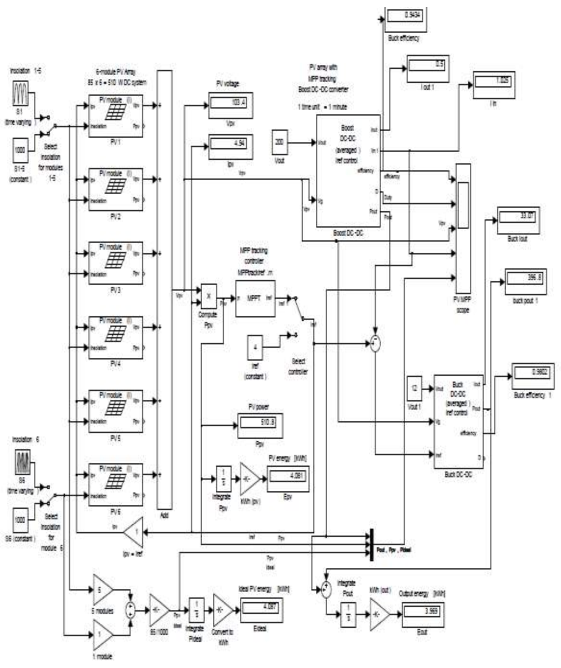

Fig. 1.4 Simulink model for P&O MMPT using boost converter

VI. SIMULATION RESULT

P & O Mppt With Perturb and Observe Method using Boost Converter

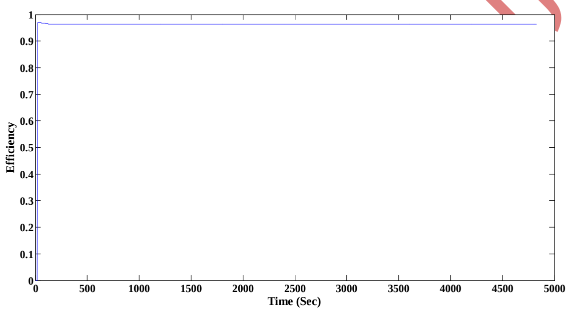

Fig. 1.6 Efficiency for P&O MPPT for Boost converter

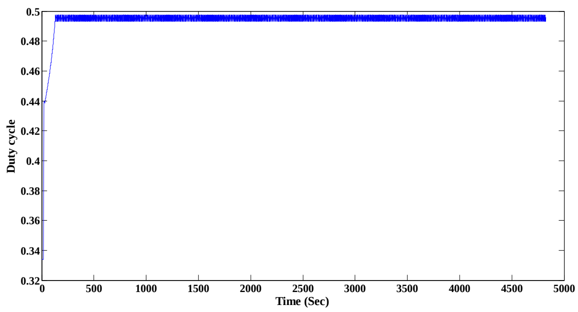

Fig. 1.7 Duty cycle for P&O MPPT for Boost converter

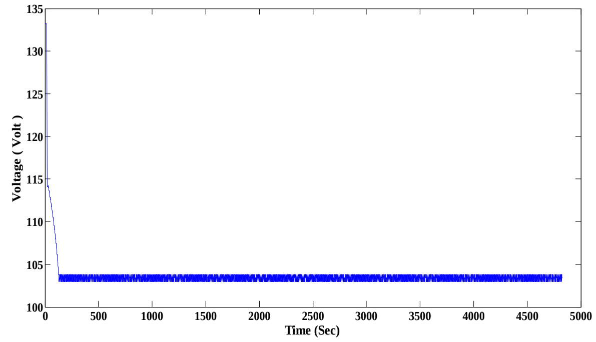

Fig. 1.6 Voltage for P&O MPPT for Boost converter

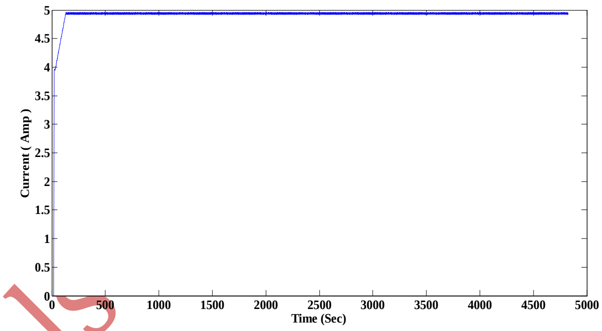

Fig. 1.6 Current for P&O MPPT for Boost converter

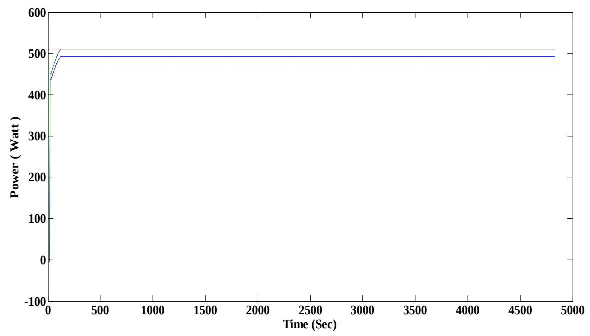

Fig. 1.6 Power for P&O MPPT for Boost converter

TABLE. 1.1 features of proposed method

PROPOSED METHOD	MPPT WITH BOOST CONVERTER (P&O Method)
Efficiency	0.9644
Current Output	2.46
Power Output	492.6
Output Energy KWh	3.936

CONCLUSION

Maximum Power Point Tracking Using Perturb and Observe Method is implemented with MATLAB-SIMULINK Environment.
In this paper we have successfully implemented boost converter and it is found to be more efficient in terms of efficiency, current output using Perturb and Observe Method technique.

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