Simulation of Boost Converter Topology for PV System with Perturb and Observe MPPT Algorithm

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Abstract— In this paper utilization of boost converter for control of photovoltaic (PV) power using maximum power point tracking control technique is presented. First photovoltaic (PV) module is analyzed using MATLAB software. The mail aim the boost converter is to be used along with a maximum power point (MPPT) mechanism. The MPPT is responsible for extracting maximum possible power from the photovoltaic (PV) and feed it to the load via the boost converter which steps up the voltage to required magnitude. The main aim will be track maximum power point of the photovoltaic (PV) module so that the maximum possible power can be extracted from the photovoltaic. The algorithms and boost converter are modeled using MATLAB software.

Key words: Boost converter; MPPT; Solar cell; MATLAB

I. INTRODUCTION

Energy is fundamental to the quality of our lives. Nowadays, we are totally dependent on supply of energy for working and living. Energy use constantly at work, at home .Energy is important in everyone's life. Energy is important in many ways like. You wake up sound of your alarm clock. Energy heats our homes, and most houses have oil, gas or electric heaters. Nowadays energy has become more important for the collective than individual's need. Energy is required for a wide range of applications such as industrial application, office application, transportation, agricultural applications and household requirement. It can have many forms like electrical energy, nuclear energy, heat energy, light energy, chemical energy and so on. Electrical energy is most convenient form of energy which can be converted to all other forms of energy. It is one of the most versatile forms of energy, from the point of view of distribution, transmission and control. The use of energy plays very important role in our life.

Solar PV generation systems have two inherent major problems. The first is low conversion efficiency (10 to 15% efficiency foe commercially available amorphous silicon solar cells) and second problem is presence of highly nonlinear i-v characteristics. The extract the maximum amount of energy, the PV system must be capable of tracking the solar panel unique maximum power point that varies with irradiance and temperature. MPPT is a power electronics DC-DC converter between PV module and load to achieve optimum matching.

II. PRINCIPLE OF TRACKING THE MAXIMUM POWER POINT

When the literature is reviewed, one can find many maximum power point tracking techniques proposed by many researches. Nineteen recognized MPPT techniques are discussed. Figure shows the plot of module output power versus module voltage for a solar panel at an irradiation. The point marked as MPP is maximum power point, the theoretical maximum output obtained from PV panel. Consider A and B as two operating points, as shown fig. 1.The point A is on the left side of the MPP. Therefore, we can move towards the MPP by providing a positive perturbation to the voltage. The point B is on the right hand side of the MPP. When we give a positive perturbation, the value of P becomes negative, thus it is imperative to change the direction of perturbation to achieve MPP.

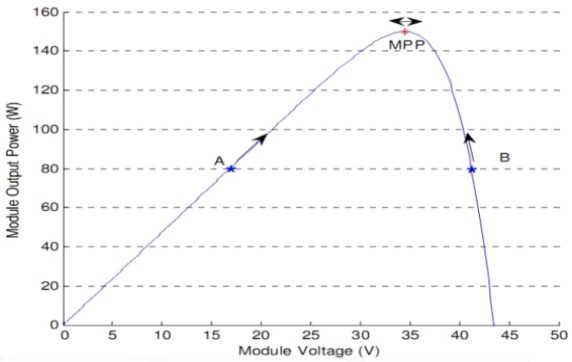

Fig. 1: Solar Panel Characteristics

III. SIMULATION

In this section discusses the simulations of MPPT and Boost converter. The simulations validate the design and verify the functionality of MPPT system with a resistive load. The overall block diagram of the system designed in this work is shown in fig. 2

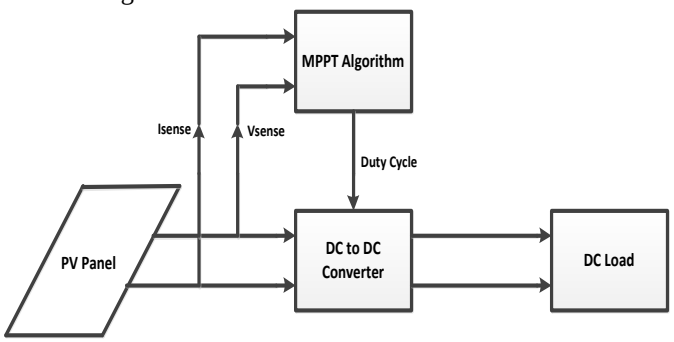

Fig. 2: Block Diagram of the System

A. PV Module Model:

The detailed model presented in [3] is utilized in this work and simulated with Matlab Simulink. The parameter of 1200W PV module, used in the Paper, at 25 ˚C and 1000 W/m2 are listed as:

Parameter	Value
Maximum power	1200W
Maximum power current	23.25A
Maximum power voltage	54.2V
Short circuit current	25.44A
Open circuit Voltage	66V

Table 1: PV Panel Parameter

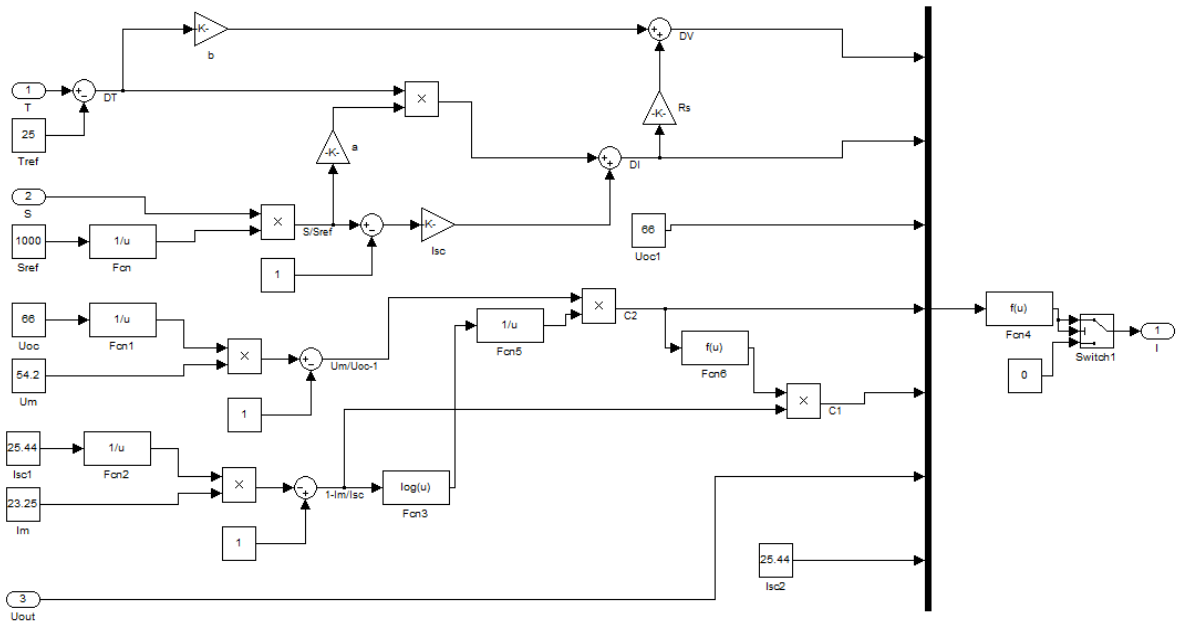

Fig. 3: PV Panel Simulation Model

This simulation of PV panel and show simulation power curve results in below.

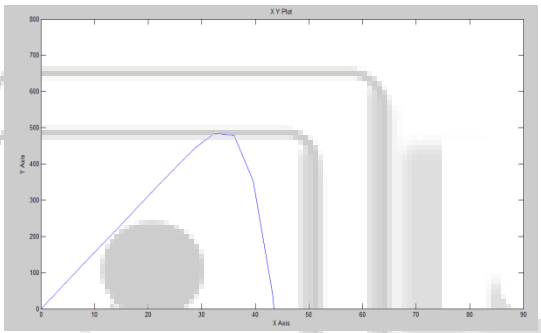

Fig .4: PV Panel Power Curve in MATLAB

B. DC-DC Boost Converter:

The DC-DC converter used in this paper is boost converter. Boost converter produce an output voltage higher than the input source voltage. Fig .5 shows open circuit of the Simulink model of this converter.

Parameters	Value
Inductor	0.028
Input capacitor	2e-3
Output capacitor	500e-6
Duty cycle	75%

Table 2: Boost Converter Parameter

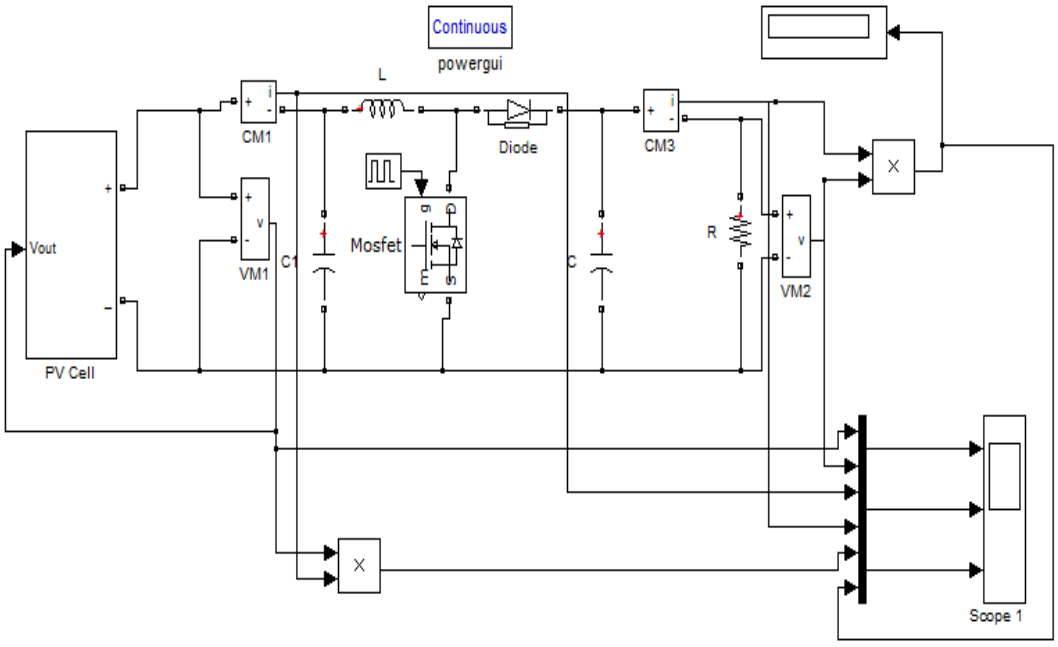

Fig. 5: Boost Converter in Open Loop Circuit

Boost converter is shown as per our discussion simulation circuit and waveforms are shown. Here no any control technique is used because this is open loop control.

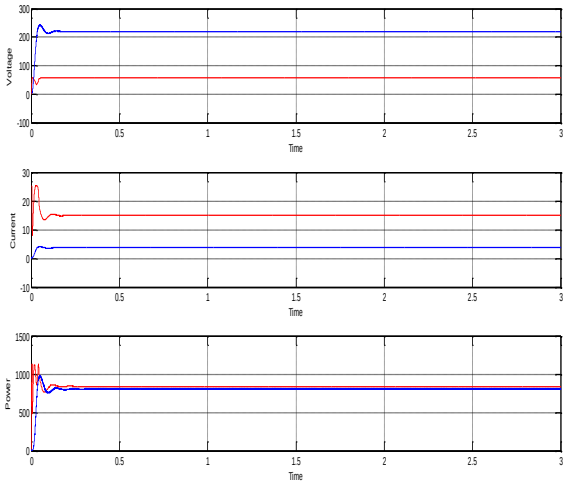

Fig. 6: Waveform of Boost Converter in Open Loop

In the scope given below input and output Voltage, Current and Power is shown in sequence. At 75% duty cycle solar panel terminal voltages are nearly 50V as we can see in results and also output voltage on the same axis we can see 230V.

C. MPPT Control:

Perturb and observe is the MPPT algorithm used in this project. The algorithms perturb the duty ratio of the power converter which leads to perturbing the voltage of PV panel. Fig. shows the Simulation model of the P&O algorithm.

D. Simulation Results:

In this section some simulation results and discussions are presented. Matlab Simulink was used to achieve these simulations. The overall simulation setup of the MPPT system is shown in Fig.

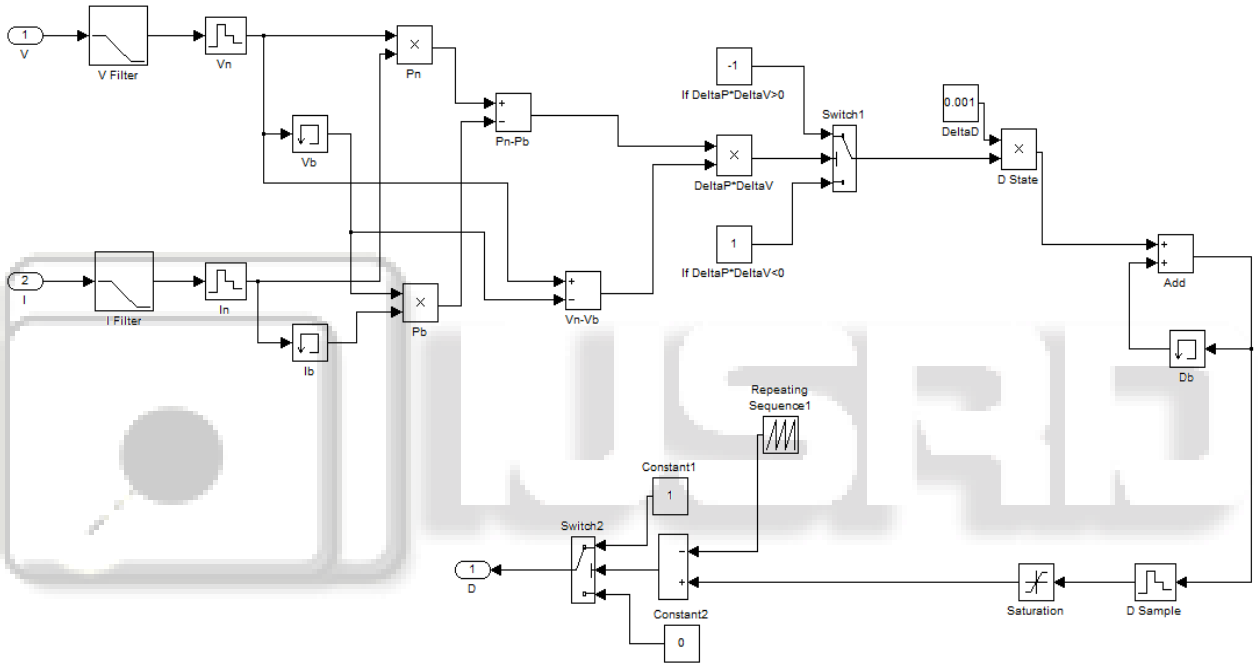

Fig. 7: Simulink Model of the P&O Algorithm.

This project is simulated and analysed on different parameter and different working conditions. Close-loop simulation shown and results of their input and output parameter variation are discussed in detail. This chapter is on the basis of simulation of all the system and individual analysis of the entire converter at different varying conditions.

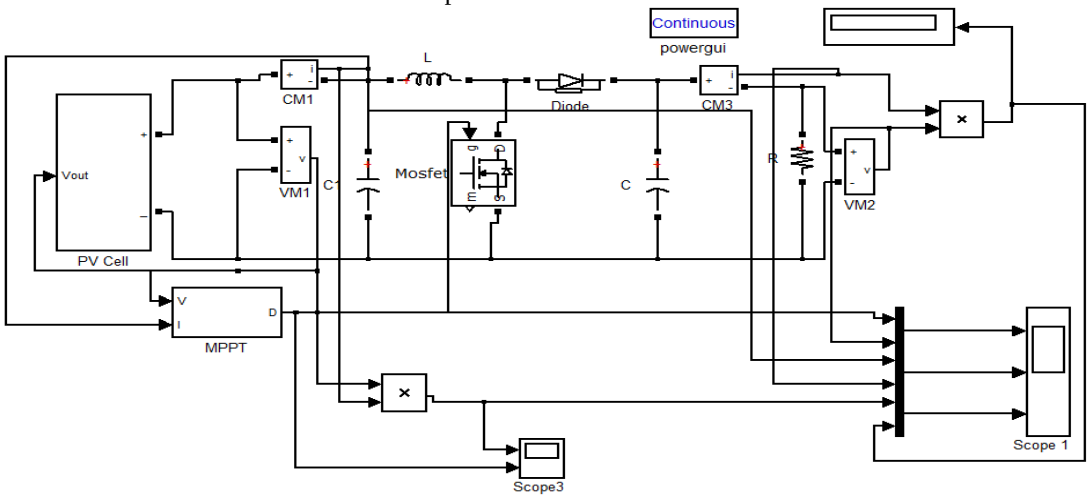

Fig. 8: Overall Simulink Setup of the MPPT System

In the scope given below input and output Voltage, Current and Power is shown in sequence. Solar panel terminal voltages are nearly 50V as we can see in results and also output voltage on the same axis we can see 240V.

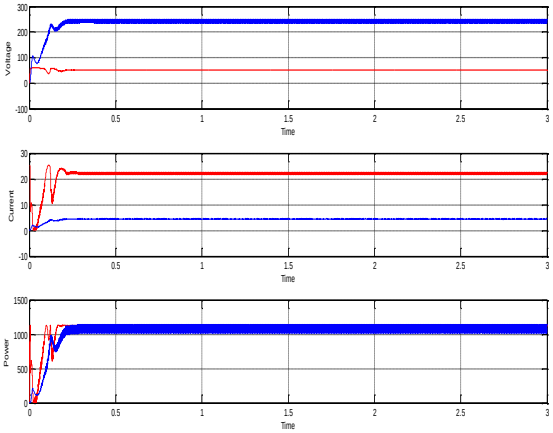

Fig. 9: Waveform of Overall Simulink Setup

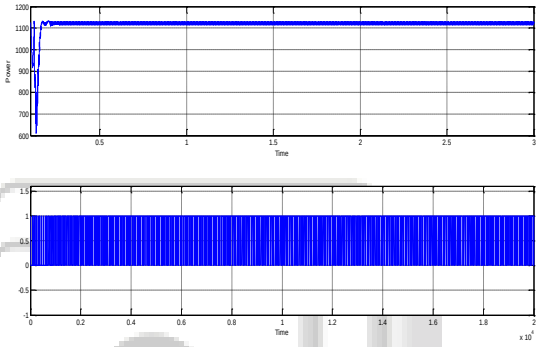

Fig. 10: Power and GATE Pulse Waveform of the MPPT

IV. CONCLUSION

The proposed model is established in Simulink software, and output characteristics of PV array is studied and analyzed. Mainly perturb and observe (P&O) MPPT algorithm is used to obtain the maximum operating point voltage.so by using MPPT algorithm and Boost converter solar array is operated at maximum power point irrespective of solar irradiance. Further we can also design inverter circuit which converts the DC power into AC power and this can be connected to grid with the help of inverter.

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