

Design of Boost Converter With Mppt Controller for Solar Power Tracking System

Ch Kiran Kumar #1, S Supriya #2, N Srikanth #3, T Viswateja #4, M.Reshma #5, V Sai Manaswini #6

1 Asst, Professor, Department of EEE, QIS College of Engineering and Technology, Ongole.

2,3,4,5,6 B.Tech Scholars, Department of EEE, QIS College of Engineering and Technology, Ongole.

ABSTRACT :- In modern time electricity demand is increasing day by day, renewable energy sources are best alternative solution to challenge fossil fuels for energy consumption. The increase in use of renewable energy sources lead to use of more photovoltaic system which has higher advantages. In this paper we will discuss how to extract the Maximum power point from solar array and to get controlled photovoltaic power. We will use Incremental conductance method for MPPT & is used to get maximum power point from solar Array and feed it to boost converter which steps up the voltage to the required level. The algorithms utilized for MPPT are generalized algorithms and are easy to model or use as a code. The algorithms are written in m files of MATLAB and utilized in simulation. Both the boost converter and solar cell are model using Sim Power System blocks.

KEYWORDS:- Maximum Power Point (MPPT), Photovoltaic (PV), PV Array, Sims cape, Boost converter.

1.INTRODUCTION

One of the major concerns in the power sector is the day-to-day increasing power demand but the unavailability of enough resources to meet the power demand using the conventional energy sources. Demand has increased for renewable sources of energy to be utilized along with conventional systems to meet the energy demand. Renewable sources like wind energy and solar energy are the prime energy sources which are being utilized in this regard. The continuous use of fossil fuels has caused the fossil fuel deposit to be reduced and has drastically affected the environment depleting the biosphere and cumulatively adding to global warming.

Solar energy is abundantly available that has made it possible to harvest it and utilize it properly. Solar energy can be a standalone generating unit or can be a grid connected generating unit depending on the availability of a grid nearby. Thus it can be used to power rural areas where the availability of grids is very low. Another advantage of using solar energy is the portable operation whenever where necessary.

In order to tackle the present energy crisis one has to develop an efficient manner in which power has to be extracted from the incoming solar radiation. The power conversion mechanisms have been greatly reduced in size in the past few years. The development in power electronics and material science has helped engineers to come up very small but powerful systems to withstand the high power demand. But the disadvantage of these systems is the increased power density. Trend has set in for the use of multi-input converter units that can effectively handle the voltage fluctuations. But due to high production cost and the low efficiency of these systems they can hardly compete in the competitive markets as a prime power generation source.

The constant increase in the development of the solar cells manufacturing technology would definitely make the use of these technologies possible on a wider basis than what the scenario is presently. The use of the newest power control mechanisms called the Maximum Power Point Tracking (MPPT) algorithms has led to the increase in the efficiency of operation of the solar modules and thus is effective in the field of utilization of renewable sources of energy [3], [8].

2. LITERATURE SURVEY

The topic of solar energy utilization has been looked upon by many researchers all around the globe. It has been known that solar cell operates at very low efficiency and thus a better control mechanism is required to increase the efficiency of the solar cell. In this field researchers have developed what are now called the Maximum Power Point Tracking (MPPT) algorithms.

Mummadi Veerachary has given a detailed report on the use of a SEPIC converter in the field of photovoltaic power control. In his report he utilized a two-input converter for accomplishing the maximum power extraction from the solar cell [3].

M. G. Villalva in his both reports has presented a comprehensive method to model a solar cell using Simulink or by writing a code. His results are quite similar to the nature of the solar cell output plots [1]-[2].

P. S. Revankar has even included the variation of sun's inclination to track down the maximum possible power from the incoming solar radiations. The control mechanism alters the position of the panel such that the incoming solar radiations are always perpendicular to the panels [9].

M. Berrera has compared seven different algorithms for maximum power point tracking using two different solar irradiation functions to depict the variation of the output power in both cases using the MPPT algorithms and optimized MPPT algorithms [8].

Ramos Hernanz has successfully depicted the modeling of a solar cell and the variation of the current-voltage curve and the power-voltage curve due the solar irradiation changes and the change in ambient temperature [10].

3. METHODOLOGY

Incremental Conductance method

This method uses the PV array's incremental conductance $\frac{dI}{dV}$ to compute the sign of. When $\frac{dI}{dV} = -\frac{I}{V}$ is equal and opposite to the value of I/V (where $\frac{dP}{dV} = 0$) the algorithm knows that the $\frac{dP}{dV}$ maximum power point is reached and thus it terminates and returns the corresponding value of operating voltage for MPP. This method tracks rapidly changing irradiation conditions more accurately than P&O method. One complexity in this method is that it requires many sensors to operate and hence is economically less effective [5] and [6].

$$P = V * I$$

Differentiating w.r.t voltage yields;

$$\frac{dP}{dV} = \frac{d(V * I)}{dV} \quad (5)$$

$$\frac{d}{dV} \quad dV$$

$$\frac{d}{dV} = \frac{d(V * I)}{dV} = I + V * \frac{dI}{dV} \quad (6)$$

$$\frac{d}{dV} \quad \frac{d}{dV} \quad dV$$

$$\frac{dP}{dV} = I + V \frac{dI}{dV} \quad (7)$$

$$\frac{d}{dV}$$

When the maximum power point is reached the slope $\frac{dP}{dV} = 0$. Thus the condition would be;

$$\frac{dP}{dV} = 0 \quad (8)$$

$$I + V \frac{dI}{dV} = 0 \quad (9)$$

$$\frac{dI}{dV} = -\frac{I}{V} \quad (10)$$

Parasitic Capacitance method

This method is an improved version of the incremental conductance method, with the improvement being that the effect of the PV cell's parasitic union capacitance is included into the voltage calculation [5] and [6].

Constant Voltage method

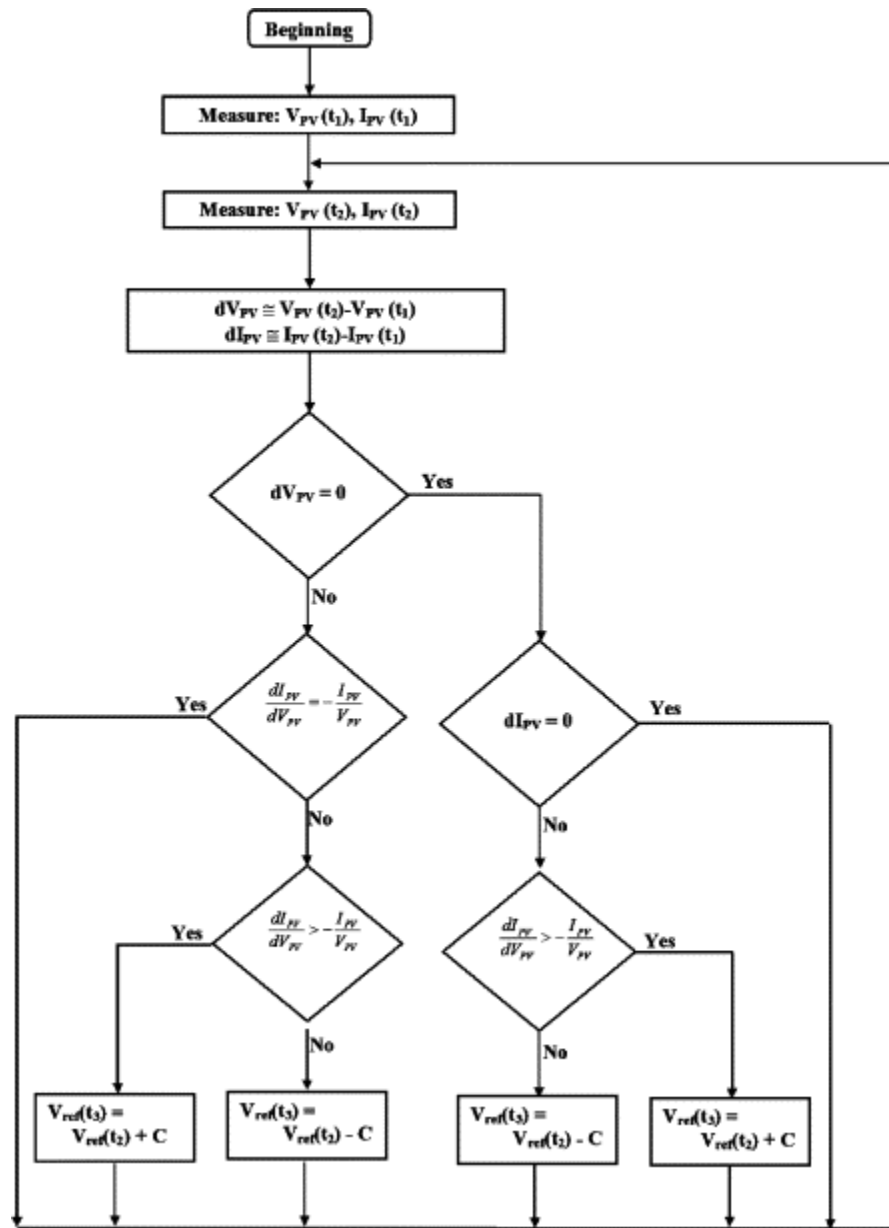
This method which is a not so widely used method because of the losses during operation is dependent on the relation between the open circuit voltage and the maximum power point voltage. The ratio of these two voltages is generally constant for a solar cell, roughly around

0.76. Thus the open circuit voltage is obtained experimentally and the operating voltage is adjusted to 76% of this value [8].

Constant Current method

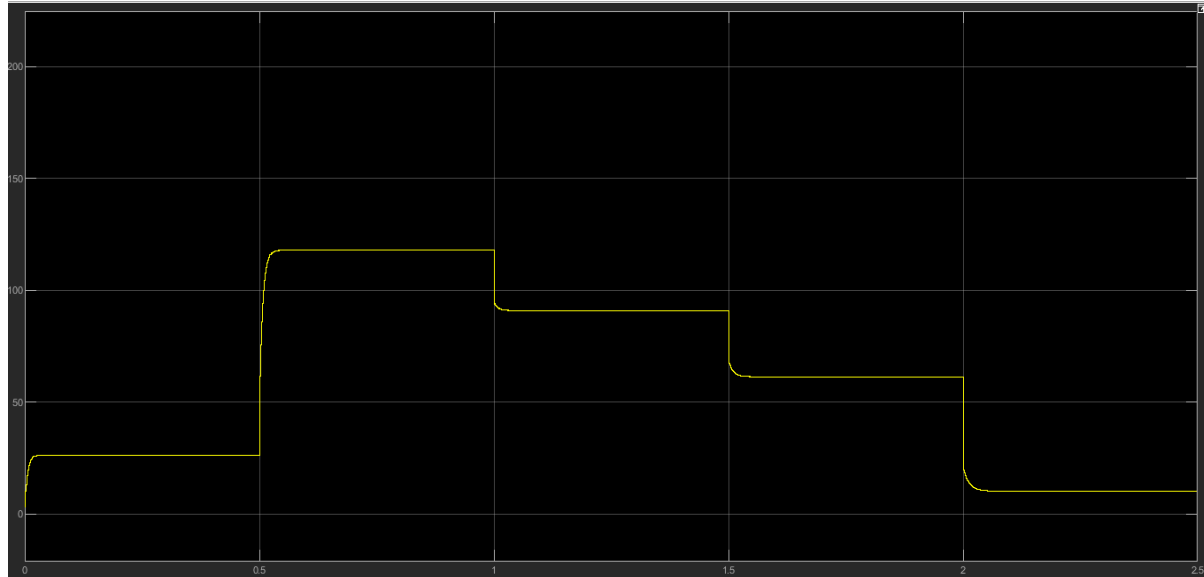
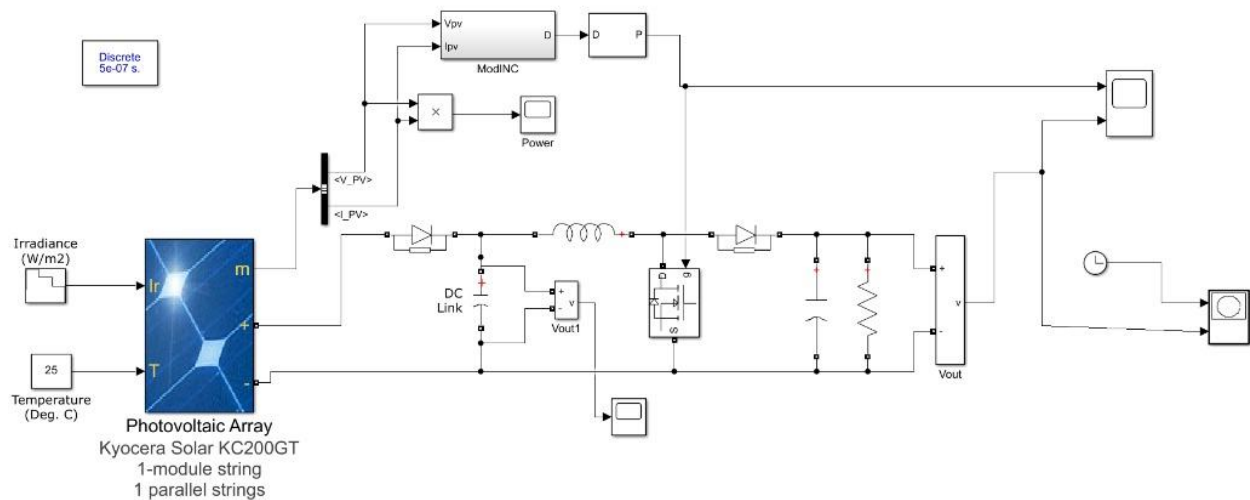
Similar to the constant voltage method, this method is dependent on the relation between the open circuit current and the maximum power point current. The ratio of these two currents is generally constant for a solar cell, roughly around 0.95. Thus the short circuit current is obtained experimentally and the operating current is adjusted to 95% of this value [8].

The methods have certain advantages and certain disadvantages. Choice is to be made regarding which algorithm to be utilized looking at the need of the algorithm and the operating conditions. For example, if the required algorithm is to be simple and not much effort is given on the reduction of the voltage ripple then P&O is suitable. But if the algorithm is to give a definite operating point and the voltage fluctuation near the MPP is to be reduced then the IC method is suitable, but this would make the operation complex and more costly.

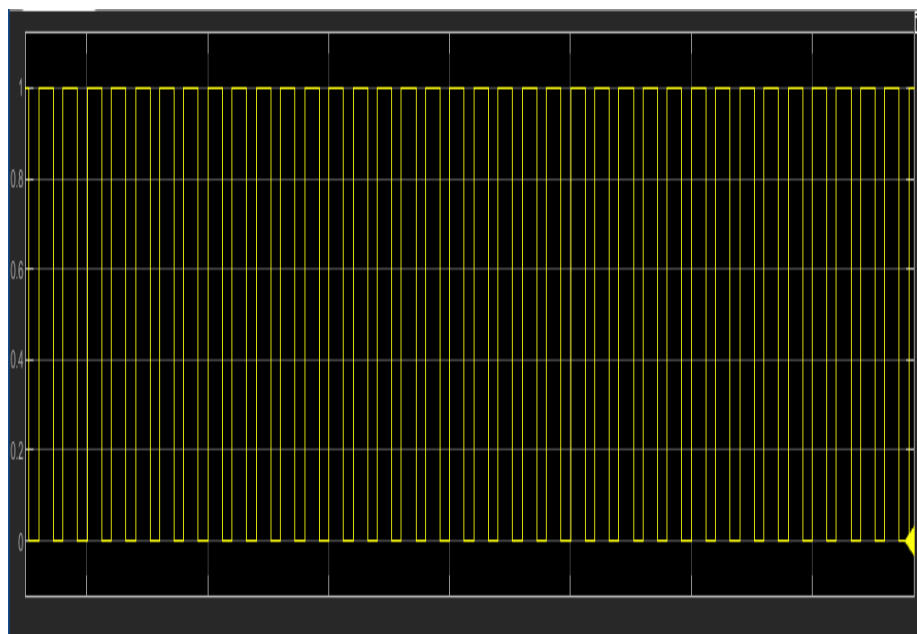
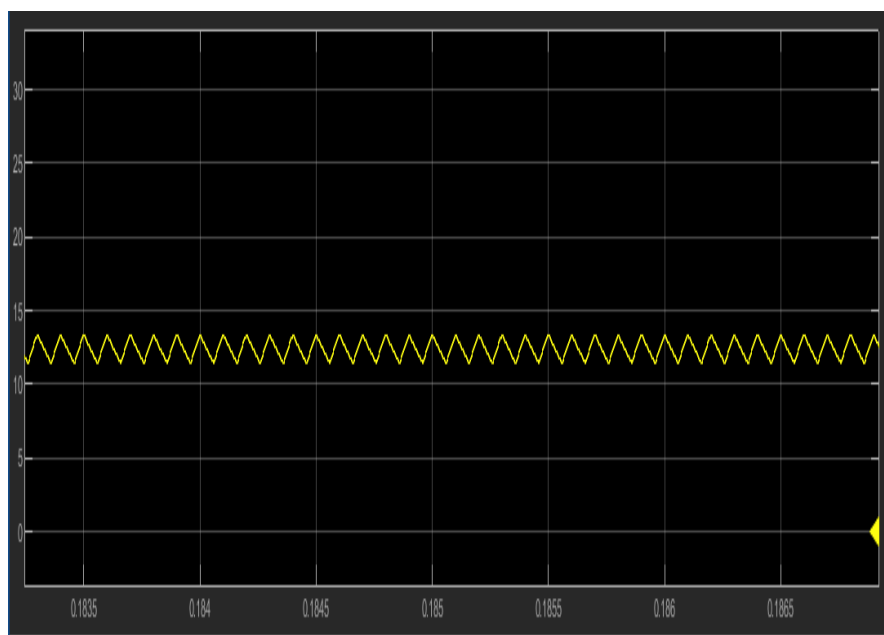


This algorithm is implemented using the Embedded MATLAB function of Simulink, where the code written inside the function block are utilized to vary certain signals with respect to the input signals.

4. SIMULATION&RESULT



Input wave form

**MAXIMUM POWER OUTPUT WAVE FORM****BOOST CONVERTER OUTPUT WAVE FORM**

5. CONCLUSION & FUTURE WORK

A resistive load of 10 ohms was used with the boost converter thereby making the output current and voltage similar. The frequency of operation was 10 KHz which was set by using a repeating sequence

generator. This generator was utilized for generating the pulse signal that was compared with the signal generated from the MPPT unit to give out the gating signal to the switch.

When MPPT is used there is no need to input the duty cycle, the algorithm iterates and decides the duty cycle by itself. But if MPPT had not been used, then the user would have had to input the duty cycle to the system. When there is change in the solar irradiation the maximum power point changes and thus the required duty cycle for the operation of the model also changes. But if constant duty cycle is used then maximum power point cannot be tracked and thus the system is less efficient.

The various waveforms were obtained by using the plot mechanism in MATLAB. There is a small loss of power from the solar panel side to the boost converter output side. This can be attributed to the switching losses and the losses in the inductor and capacitor of the boost converter. This can be seen from the plots of the respective power curves.

Improvement to this project can be made by tracking the maximum power point in changing environmental conditions. Environmental change can be change in solar irradiation or change in ambient temperature or even both. This can be done by using Simulink models to carry out MPPT instead of writing its code in Embedded MATLAB functions. In the Simulink models the solar irradiation and the temperature can be given as variable inputs instead of constant values as done here.

REFERENCES

1. M. G. Villalva, J. R. Gazoli, E. Ruppert F, "Comprehensive approach to modeling and simulation of photovoltaic arrays", *IEEE Transactions on Power Electronics*, 2009 vol. 25, no. 5, pp. 1198--1208, ISSN 0885-8993.
2. M. G. Villalva, J. R. Gazoli, E. Ruppert F, "Modeling and circuit-based simulation of photovoltaic arrays", *Brazilian Journal of Power Electronics*, 2009 vol. 14, no. 1, pp. 35--45, ISSN 1414-8862.
3. Mummadi Veerachary, "Control of TI-SEPIC Converter for Optimal Utilization of PV Power", *IICPE*, 2010 New Delhi.
4. R. Sridhar, Dr. Jeevananathan, N. Thamizh Selvan, Saikat Banerjee, "Modeling of PV Array and Performance Enhancement by MPPT Algorithm", *International Journal of Computer Applications* (0975 – 8887) Volume 7– No.5, September 2010.
5. Hairul Nissah Zainudin, Saad Mekhilef, "Comparison Study of Maximum Power Point Tracker Techniques for PV Systems", *Cairo University, Egypt, December 19-21, 2010, Paper ID 278*.