Modelling Of Solar System Using PSO Technique

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ABSTRACT

In this paper a modified BOOST converter is presented for maximum power point tracking (MPPT) with PI controller to improve the performance of PV system. SEPI converter is proposed as interface between load and PV module array as DC-DC converter. Whichis more advantageous over boost converter for step up and step down operations. The P&O and PSO based BOOST converter proposed are main key factors for high efficiency output at foul weather conditions. The MATLAB/SIMULINK power system tool box will be used to stimulate the proposed system.

Keywords: Maximum power point tracking, photovoltaic (PV) system. Single ended primary inductor (BOOST) converter

INTRODUCTION

Solar energy is the one of the best renewable energy for future applications .So the use of photo voltaic (PV) systems increased with reduced costs and increased efficiency. But the generation of electricity from photo voltaic (PV) system is more expensive than the other non-renewable energy sources. We know that non-conventional sources which are also known as renewable energy resources are becoming more popular now a days as they are available nature free. Renewable energy sources are defined as the sources which can be reproduced from nature again and again once even they used.

There are many advantages with renewable energy resources comparing to non-renewable energy source. Some of the advantages are renewable energy sources are cost free and also pollution free compared to non-renewable resources. Some of the main examples for this renewable resources are solar, wind, tidal etc. Here in this project work we are considering solar as the source and obtaining maximum power from the sun by using maximum power point tracking algorithms (MPPT's). There are many algorithms are used for extracting maximum power such as perturb and observe, incremental conductance, fuzzy control etc. In our daily life, power electronic converters have been widely used, not only for industry applications but also in many electronic products, such as portable devices and consumer electronics. Actually, most electronic devices are not using energy directly from the power system or a battery set. To provide the required voltage or current level to a load, in general, a power electronic converter is interposed between the power source and the load to perform the conversion of the voltage or current level and in addition to regulate the power requirement.

A conventional power electronic converter is supplied from a single input source, but may provide multiple outputs. In the case that two or more voltage or current levels are required by the loads, a transformer with multiple output windings is employed [1], [2]. On the other hand, however, for some applications, the loads may not be powered from a single source but from two or more input sources specified by different voltage, current, and power ratings [3-13]. For example, a solar power based street lamp is mainly supplied from solar cells, but needs a subordinate battery power.

SOLAR PHOTOVOLATIC SYSTEM:

a. Photovoltaic Array Modeling:

In the PV network of electrical phenomenon, cell is the necessary part. For the raise in appropriate current, high power and potential difference, the sunlight dependent cells and their region unit joined in non-current or parallel fashion called as PV exhibit are used. In practical applications, each and every cell is similar to diode with the intersection designed by the semiconductor material. When the light weight is absorbed by the electrical marvel sway at the point of intersection, it gives the streams at once. The (current-voltage) and (Power-Voltage) attributes at absolutely unpredictable star intensities of the PV exhibit are represented in figure 3, whereas the often seen existence of most electrical outlet on each yield is shown in power diagram 2.

$$I = I_{ph} - I_D - I_{sh} \quad (1)$$

$$I = Iph - I_o [\exp (q V_D / nKT)] - (v_D / R_S) \quad (2)$$

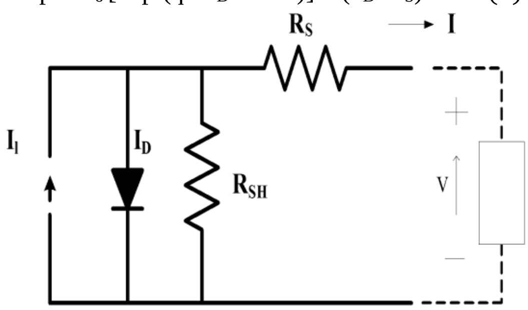

Figure 1: PV Electrical Equivalent circuit

Solar cell output power is given as the product of V and I

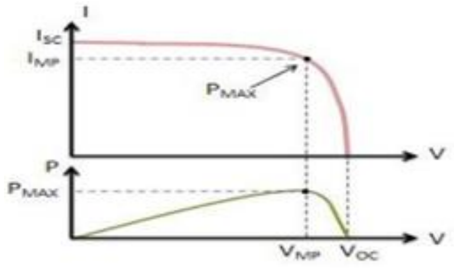

Figure 2: Response of output characteristics of PV Array

DC-DC CONVERTER SEPI CONVERTER:

SEPI stands for Single ended-primary inductor converter (BOOST) is a type of DC-DC converter which is more advantageous to the Boost, Buck and CUK converters. It also performs the same operation of Buck-Boost converter that is step up and step down of input. But it will give non-inverted output unlike Boost and Buck-Boost converters so there will be no need to have extra circuit for non inverted output. Comparatively there are more advantages over other converters.

SEPI Converter circuit diagram is shown in the below figure which looks similar to the boost converter but has more elements compared to Boost. It has two inductors and two capacitors for step up and step down operations. It has switch i.e. MOSFET, IGBT, or BJT can be used as switch. The duty cycle of the switch is controlled by MPPT algorithm so that the output of the converter increases. It operates under fixed frequency and there will be less amount of harmonics. And also it gives high transient performance.

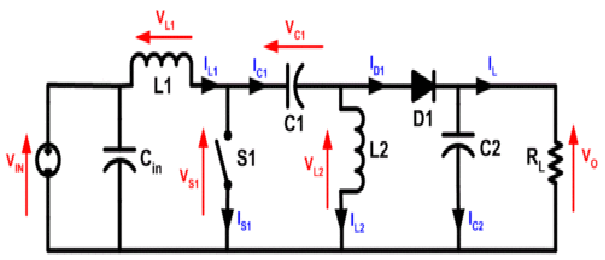

Fig: 3 Shows the circuit design of SEPI converter

The circuit diagram for a SEPI converter is shown in above Figure. S1 acts as switch that is it can be replaced by MOSFET or IGBT or BJT. There are 9347106288 two modes of operations of SEPI converter those are (a). When switch is closed. (b) When switch is open. When switch is closed the capacitor C1 stores the energy. When switch is opened capacitor C2 gives the output. So in this way the operation of SEPI converter occurs. The capacitor. C1 also acts as isolation capacitor between input and output. The main function of converter is controlled by duty cycle of the switch. So that duty cycle is controlled by MPPT algorithms which are given below.

MAXIMUM POWER POINT TRACKING ALGORITHMS

These are the mostly used MPPT algorithms in PV systems for maximum power point tracker to improve the performance of the system.

A. Perturb and Observe MPPT algorithm

B. Incremental ConductanceMPPT algorithm.

C. Particle swarm optimization MPPT algorithm.

PERTURB AND OBSERVE MPPT ALGORITHM:

In this type of MPPT algorithm requires external circuit to repeatedly perturb the array voltage and subsequently measure the resulting change in the output power. The main disadvantage of this algorithm is it forces the system to oscillate around MPP instead of continuously tracking it. This algorithm fails under rapidly changing environment. The major disadvantage of P&O algorithm is during rapid fluctuations of insolation the algorithm is likely to lose its direction while tracking true 7702335401 MPP. So that is this algorithm is not preferable under rapidly changing environmental conditions. The advanced version P&O is incremental conductance algorithm it is designed to overcome the drawbacks of P&O algorithm under rapidly changing environmental conditions in this algorithm the increase and decrease operations are performed continuously to achieve maximum power point in one direction. The output is continuously compared with previous to have better output.

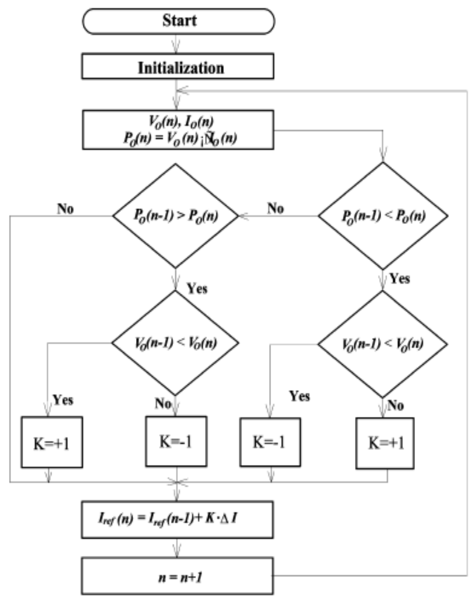

Figure 4: Flow Chart representation of P&O Technique

PARTICLE SWARM OPTIMIZATION TECHNIQUE:

It is a bio spurring processing apparatus. It is created dependent on the exercises of winged creatures, angle, and different creatures. Who are specialist and electrical designer? It is a vigorous stochastic showcasing system dependent on the development and knowledge of swarms

[15-16]. PSO applies the idea of social discussion for critical thinking.

Velocity function

$$V_{r(k+1)} = V_{r(k)} + t_{lr}(P_r - X_{r(k)})) + t_{2r}(G - X_{i(k)})$$

ANALYSIS OF PSO TECHNIQUE:

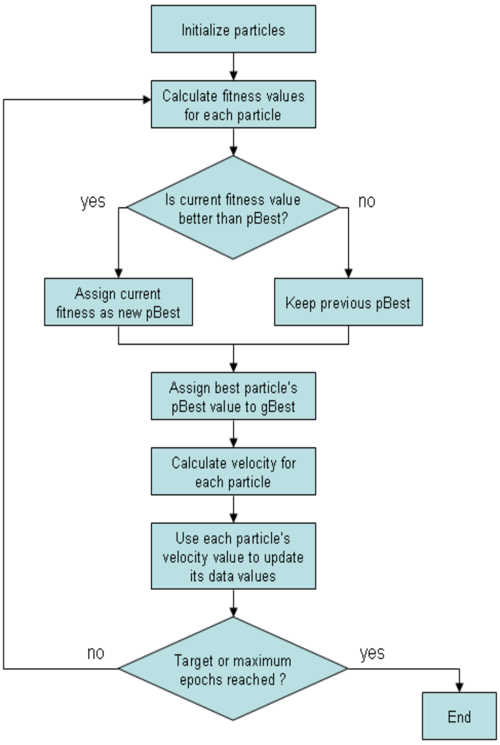

Figure 5: Algoritham for PSO MPPT

Mathematical Modelling of PV System:

PV cells are grouped in larger units called PV modules which are further interconnected in a parallel-series configuration to form PV arrays.

The photovoltaic panel can be modelled mathematically as given in equations

Modulo-Photo Current Can be expressed as:

$$I_{ph} = [I_{SCr} + K_i(T - 298)] * \lambda / 1000$$

Module reverse saturation current – Irs

$$I_{rs} = I_{SCr} / [\exp(qV_{OC} / N_S kAT) - 1]$$

The module saturation current I0 varies with the cell temperature, which is given by

$$I_0 = I_{rs} [\frac{T}{T_r}]^3 \exp[\frac{q * E_{g0}}{Bk} \left\{ \frac{1}{T_r} - \frac{1}{T} \right\}]$$

The PV output Current is given as,

$$I_{PV} = N_P * I_{ph} - N_P * I_0 [\exp\left\{ \frac{q * (V_{PV} + I_{PV} R_s)}{N_S AkT} \right\} - 1]$$

SIMULATION RESULTS

Here in this project work a real time organisation was taken for analysis and developed under DC-DC converter such as BOOST. A block diagram of the stage by stage model based upon the equations of PV model is represented in Simulink environment as given in Figures 5 to 10. These models are developed in moderate complexity to include the temperature dependence of the photo current source, the saturation current through the diode, and a series resistance is considered based upon the shackle diode equation as shown in above section.

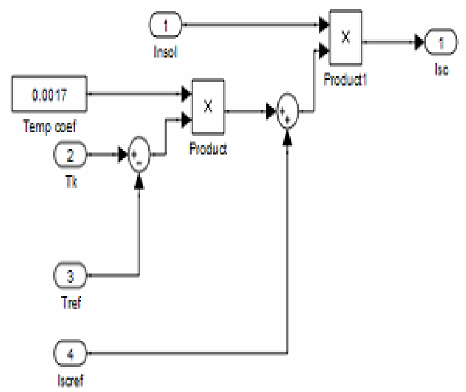

Figure 6: Model for I_{SC} at a given temprature

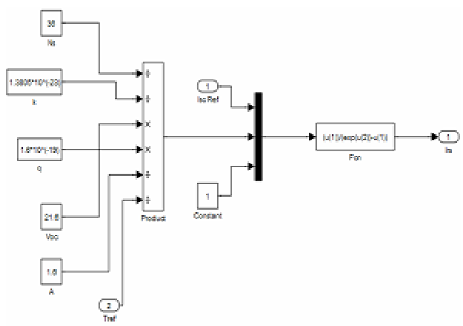

Figure 7: Model for reverse saturation current through the diode

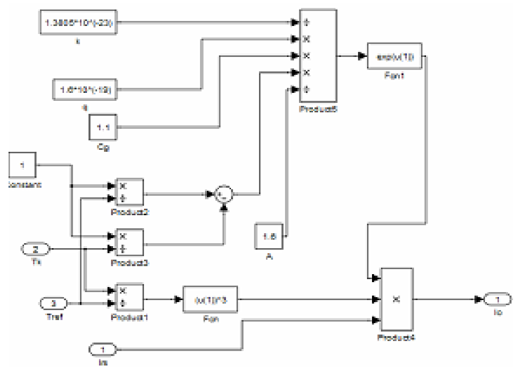

Figure 8: Model takes reverse saturation current, module reference temperature and the module operating temperature as input and calculates module saturation current

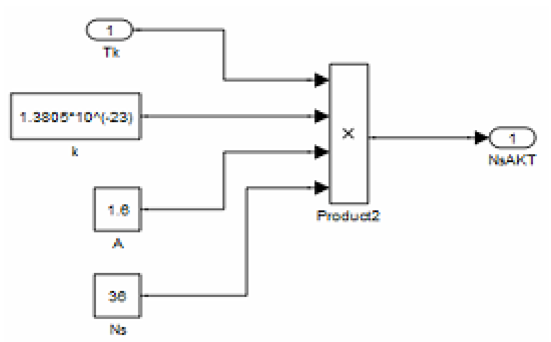

Figure 9: Model takes operating temperature in Kelvin and calculates the product NsAkT

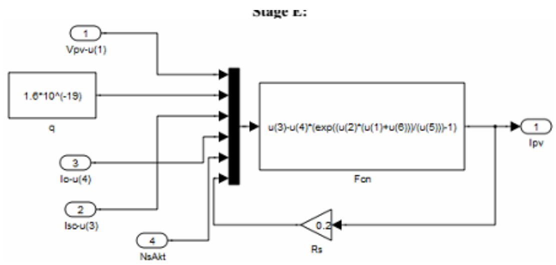

Figure 10: Model executes the function given by equation I_{PV}

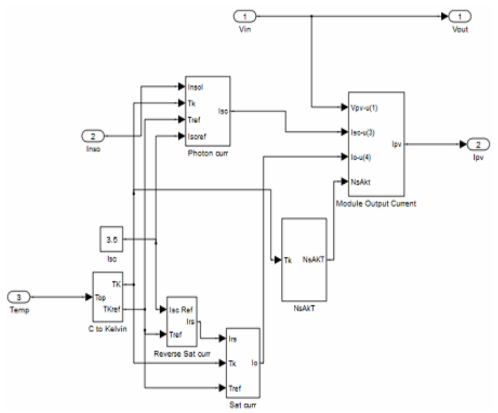

Figure 11: Model contains all the six model interconnected together

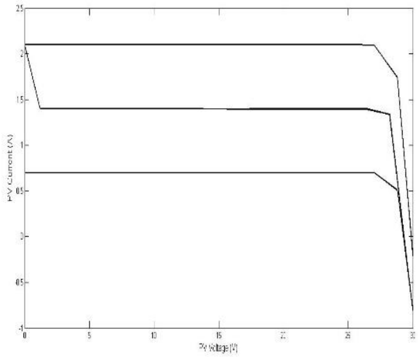

Figure 12: Simulation result for photovolatic I-V Cureve

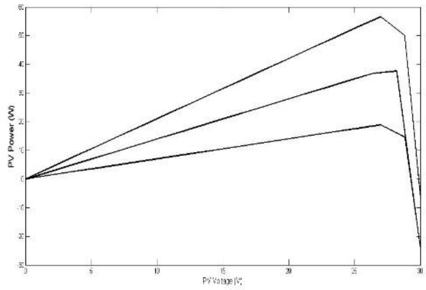

Figure 13: Simulation result for photovolatic P-V Cureve

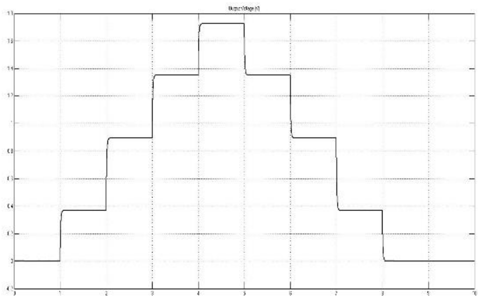

Figure 14: Simulation result for Output Voltage from BOOST Converter

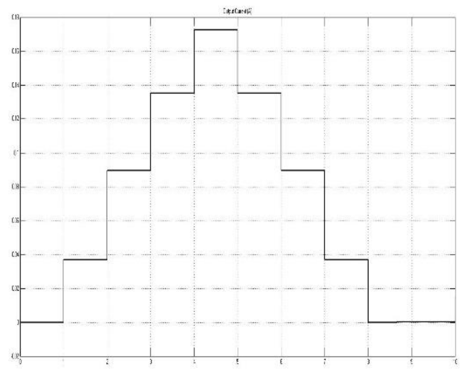

Figure 15: Simulation result for Output Current from BOOST Converter

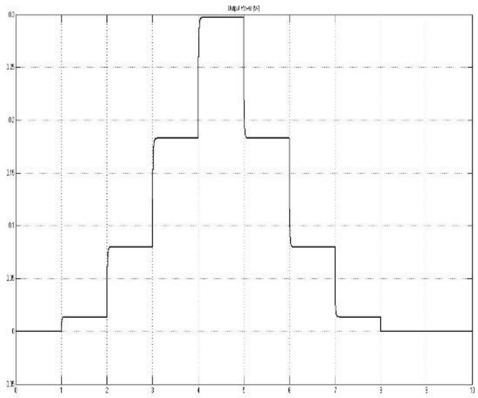

Figure 16: Simulation result for Output Power from BOOST Converter

CONCLUSION

In this paper the step-by-step procedure for modeling the PV module is presented. This mathematical modeling procedure serves as an aid to induce more people into photovoltaic research and gain a closer understanding of I-V and P-V characteristics of PV module. This paper has presented a P&O based MPPT scheme for BOOST converter and inverter system for PV power application. A standalone solar PV energy generation system with BOOST dc-dc converter has been designed and the performance analysis of the system has been presented under variation in solar radiation with the device current and voltage. It has been found that the performance of the proposed controller is better than that of the conventional based converters.

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