IMPLEMENTATION OF BUCK-BOOST CONERTER FOR EXTRACTING MAXIMUM POWER FROM PV SYSYTEM USING PERTURB AND OBSERVE METHOD

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Abstract :

Currently, one of the most efficient and cleanest forms of renewable energy source for effective power generation is photovoltaic (PV) source. It is because of its cheapness, most free maintenance cost, friendliness to the environment etc. Hence tracking these energy is very important. PV system output power increases with the rise in solar irradiation and in lower cell temperature. The characteristics curve (I-V& P-V) of PV Module is non-linear and it has only one maximum power point (MPP) under full exposure to light. The MPP varies with the changing insolation and temperature. Because of non-linear behavior of the PV module, MPPT is essential for an efficient PV system. Therefore an organized set of rules is required to operate the system at MPP. These set of rules are commonly referred to as MPP tracking (MPPT) methods. There are many MPPT methods, In this project, perturb and observe MPPT method is to obtain required duty cycle to operate buck-boost converter to extract maximum power from solar PV system.

Keywords- ***Maximum power point tracking, perturb and observe method, dc-dc converters, photovoltaic system***

I. Introduction :

The usage of modern efficient photovoltaic solar cells(PV) has featured as an masterminding alternative of energy conservation, renewable power and demand- side management. A maximum power point tracker is used for obtaining the maximum power from the solar PV module and conversion to the load. A DC-DC converter acts as a interface between the load and module. By varying the ratio of

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duty cycle the impedance of load as it appears by the source is varied and matched at the peak power point with the source so as to conversion the maximum power.

Therefore, maximum power point tracker methods are required to maintain the PV array's working at its MPP. The Perturb and Observe method MPPT technique will be implemented by using Matlab tool simulink, considering the variant of circuit combination. PV module and buck-boost converter with P and O MPPT.

II. Solar PV Cell:

A solar PV cell essential is a p-n semiconductor junction. When exposed to light, a current is generated. The generated current change linearly with the solar irradiance.

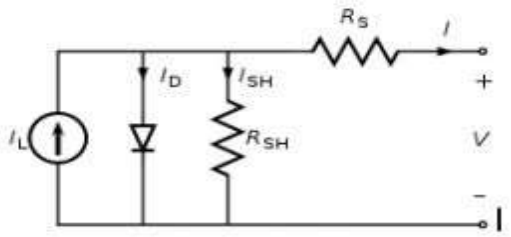

Figure 1.1: equivalent circuit of a solar cell

The I-V characteristics of the solar cell circuit can be sets by the following equations

The current through diode is given by:

$I_D=I_O[\exp(q(V+I\,R_S)/KT))-1]$

While, the solar cell output current: $I = I_L-I_D-I_{sh}$

$I= I_L-I_O[\exp(q(V+I\,R_S)/KT))-1]-(V+I_{RS})/R_{sh}$

III. Perturb and Observe Method:

P &O method is used for tracking the MPP. In this the module voltage is periodically given a perturbation and the corresponding output power is compared with that at the previous perturbing cycle. This perturbation causes the power of the solar module. If the power increases due to perturbation then the perturbation is continued in the same direction . After the peak power is reached the power at the MPP is zero and next instant decreases and hence after that the perturbation reverses.

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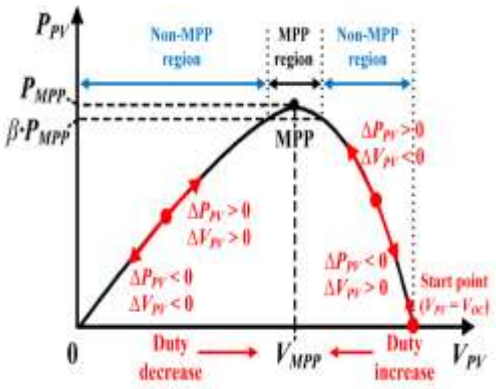

Fig: 4.1: Power Vs Voltage Graph

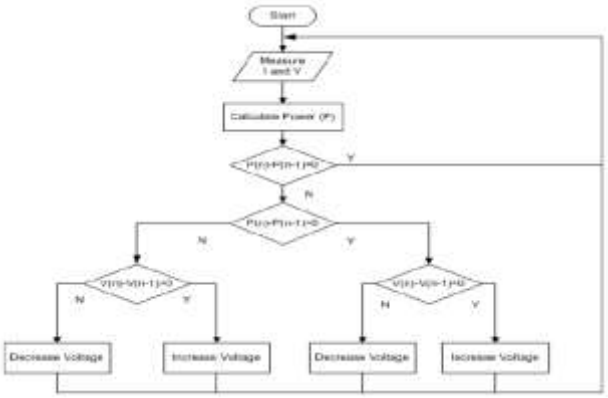

Fig:4.2: Flow Chart of P&O Method

IV. Buck Boost Converter :

A Buck boost converter produces a DC output voltage that can be either bigger or smaller in magnitude than its DC input voltage. The operation of the buck-boost converter is the inductor in the input resistance has the unexpected variation in the input current. If the switch is ON then the inductor feed the energy from the input and it stores the energy of magnetic energy. If the switch is closed it discharges the energy the output circuit of the capacitor is assumed as high sufficient than the time constant of an RC circuit is high on the output stage.

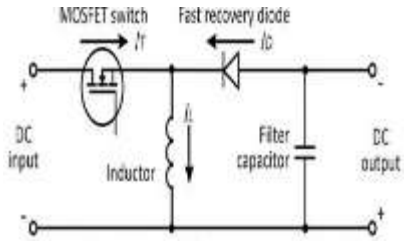

Fig 5.1: circuit of buck-boost converter

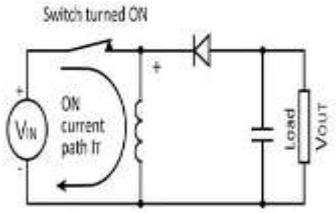

Fig 5.2 ON state of converter

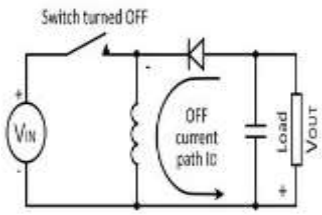

Fig 5.3: OFF state of converter

V. Simulation diagram:

It represents the block diagram of solar pv panel connected to load through a DC-DC converter with P&O MPPT

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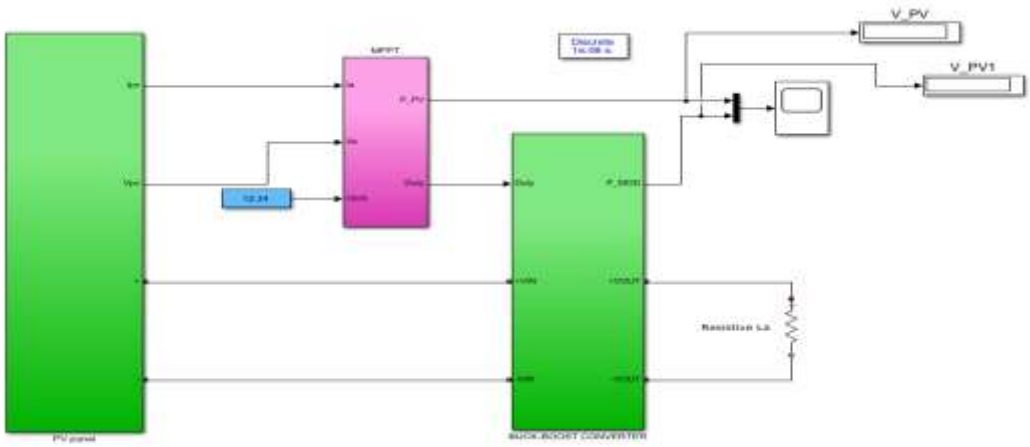

Fig 5.1: simulation design of solar MPPT

5.2 Solar PV panel and MPPT circuit model:

The solar pv panel has three inputs namely : irradiance (G), temperature(T), voltage

Fig 5.2.2 represents the simulation model of P&O MPPT. It has given input from solar PV panel and by using the P &O method calculate the required duty cycle to operate the buck-boost converter.

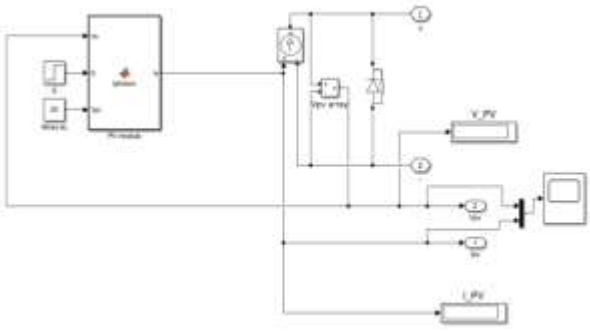

Fig 5.2.1: model of solar PV panel

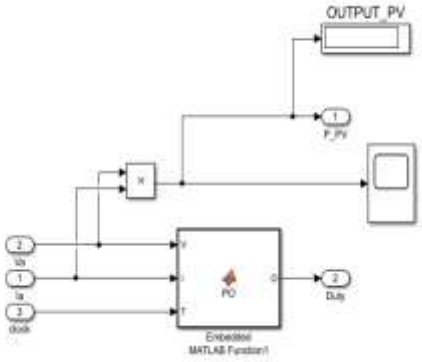

fig 5.2.2: model of P&O MPPT

5.3 Buck-Boost converter:

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Fig 6.3.1 represents the model of buck-boost converter. It has given input source from solar PV panel and required duty cycle from P&O MPPT. The power output is represented as P_mod.

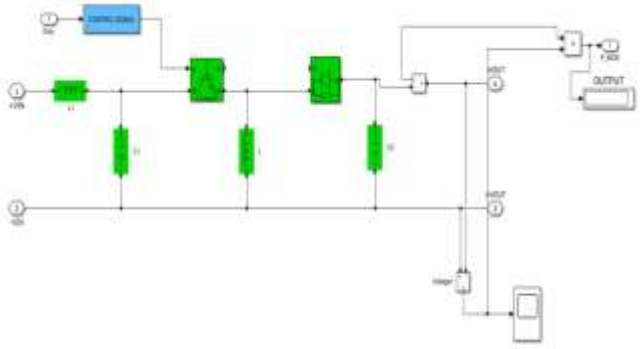

Fig 5.3.1: model of buck-boost converter

VI. Results and simulation:

1. The simulation result at temperature (T=25 degree) with irradiance (G=1000w/m^2)

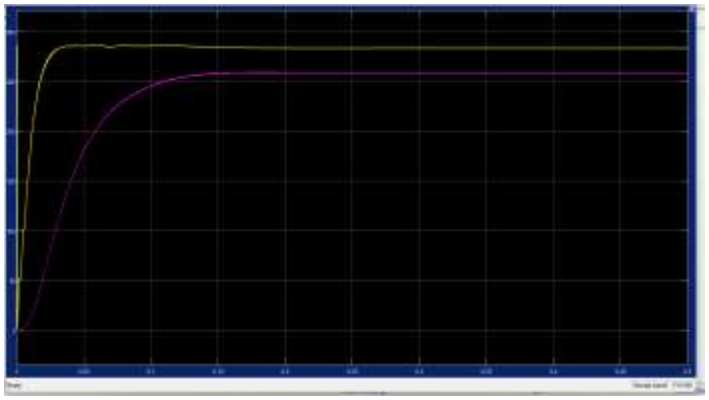

Fig 6.1: simulation output of MPPT and buck-boost converter

s.no	system	Current(A)	Voltage(V)	Power(W)
1.	Solar PV panel	I_pv= 8.613	V_pv= 32.88	P_pv=283.2
2.	Buck-boost converter	I_mod= 2.937	V_mod=88.1	P_mod=258.7

Fig 6.1: output current, voltage, power of P&O MPPT and converter

2. The simulation result at temperature (T=50 degree) with irradiance(G=1000w/m^2)

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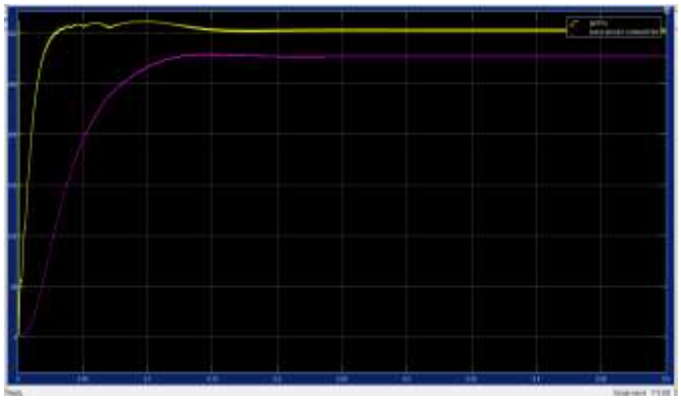

Fig 6.2 simulation output of MPPT and buck-boost converter

s.no	system	Current (A)	Voltage(V)	Power(W)
1.	Solar PV panel	I_pv=8.915	V_pv=34	P_pv=303.1
2.	Buck-boost coverter	I_mod=3.04	V_mod=91.21	P_mod=277.3

Fig 6.2: output current, voltage, power of P&O MPPT and converter

3. The simulation result at temperature (T=75 Degree) with irradiance(G=1000w/m^2)

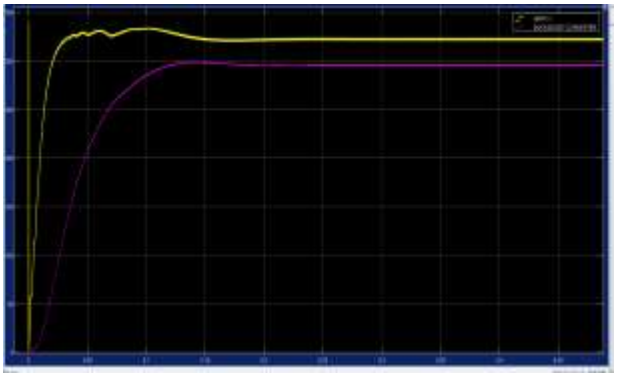

Fig 6.3: simulation output of MPPT and buck-boost converter

s.no	system	Current(A)	Voltage(V)	Power(w)
1.	**Solar PV panel**	**I_pv=9.204**	**V_pv=35.05**	**P_pv=322.6**
2.	**Buck-boost converter**	**I_mod=3.139**	**V_mod=94.18**	**P_mod=295.7**

Fig 6.3: output current, voltage, power of P&O MPPT and converter

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VII. Conclusion:

The MPPT method simulated is able to improve the dynamic and steady state performance of the PV system simultaneously. By varying the temperature input to the solar PV system we can vary the output power**.** P&O MPPT method is implemented with matlab simulink for simulation. Buck-Boost converters have succeeded to track the MPP. By observing and comparing the results and simulation at different temperatures and constant irradiance ,we can conclude that by using Buck- Boost converter along with Perturb and Observe MPPT, we can extract maximum power from PV system.

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