

Comparison of Solar PV MPPT by Incremental Conductance and Perturb and Observation Method.

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ABSTRACT

Due to high demand and scarcity of conventional energy sources and mainly due to their high polluting factor it is now worldwide accepted that renewable energy is the suitable alternative for the existing power generation method. Out of the several options available in renewable energy generation methods solar PV is the most common. Due to its modularity, nonmoving parts, portability and clean energy production capacity it's attracting more attention. In this paper different algorithms for MPPT such as Perturbation & Observation MPPT, Incremental Conductance MPPT have been analyzed to show which one is most efficient. In the paper all the algorithm methods are simulated and compared with each other to find the effective method.

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Introduction:

The reasonable and effective utilization of solar energy is an important path which can deal with the global energy crisis at present. In order to reduce the cost of solar power, study on improving the efficiency of solar power by tracking the maximum power is very necessary. Analysis showed that: to improve the efficiency of solar power, we can study in the technical aspects of the conversion efficiency of solar panels; in the solar energy application of automatic tracking system device; In the solar power control adopts maximum power point tracking technology and suitable for storage battery charging and discharging technology; additionally, the application of complex mechanism of photosynthesis, and the "condenser", which can strengthen the solar energy, will be the future research direction to improve the efficiency of solar power. [1][2]

This paper reports the tracking of maximum solar power out of the PV array. Out of different techniques Perturbation & Observation and Incremental Conductance methods are modeled and simulated with

different patterns of irradiance. Both the methods are carried out manually, controlled by a switch. The main objective is to obtain the maximum power of grid connected solar PV using different algorithms. Firstly, we have designed the model for the Incremental conductance method of MPPT and then the second i.e. the Perturbation and Observation method of MPPT are modeled with different irradiance and compared. It is found that by the application of incremental conductance to the MPPT, the power & efficiency holds good with the theoretical aspects.

Grid connected Solar PV array:

Solar PV array connected with the grid supplies power to the grid when sufficient radiation is captured by the panel. The DC voltage generated from the panel is highly intermittent depending on the insolation level. So this DC voltage is fed to the boost converter and then inverted to get the constant AC which is then supplied to the grid or to the load directly. But the power obtained is not the optimum one as maximum voltage and current are not trapped due to variable irradiation. The proposed

block diagram for the overall system is shown infig.1.The Cell parameters for the PV array are shown in table 1. The Load current supplied by the solar PV cell is shown below [4][5]:

$$I = I_L - I_0 \left[e^{\frac{q(v+IR)}{m\eta KT}} - 1 \right] \quad (1)$$

Where

- m= photovoltaic cells in each module
- q =electron charge
- k =Boltzmann constant
- Io =reverse saturated current
- T =connection temperature

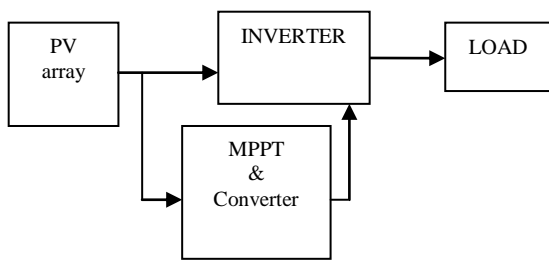


Fig. 1: Block diagram for MPPT controller

Table: 1.Cell Parameters

Parameters	Values
Temperature	298K
Cells in PV	36
Max. Irradiance1	1061.5W/m ²
Max. Irradiance2	760W/m ²
V _{o,c}	21.7V

Modelling of MPPT Techniques:

MPPT or “maximum power point tracking” technique is used to track the MPP at all environmental conditions and then direct the PV system to operate at that maximum Power point. MPPT is an inherent component of PV systems. There are different techniques of MPPT available such as curve fitting Technique, fractional short circuit current technique, fractional open circuit voltage technique, one cycle control technique, P&O technique, Inc –Cond technique. Out of which we have implemented P&O technique and Inc–Cond technique for our designed 100KW grid connected solar PV system.

1. MPPT using P&O Method:

In this method first the power generated (P_g) was calculated and then it was compared with the perturbed power (P_p) by taking a incremental change in voltage. If P_p is greater than P_g then it should go in the incremental direction, otherwise the voltage should be decremented by the amount of fixed step size. When the difference in

P_p and P_g becomes zero or remain in the defined region then MPPT will stop running the algorithm.[5]The flow chart and control model for the MPPT using P & O method in MATLab-Simulink is shown in fig.2 and Fig.3 respectively.

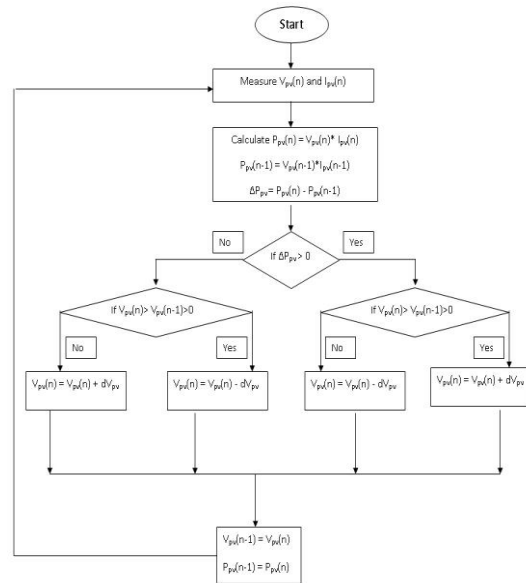


Fig. 2: Flow Chart for P&O Technique

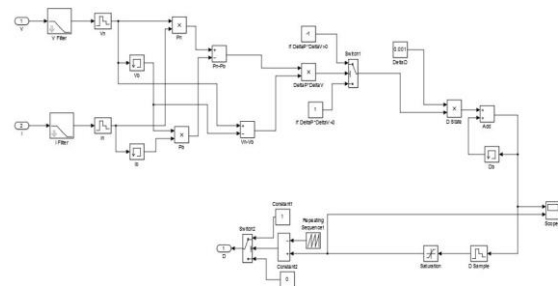


Fig.3: Control Model of MPPT using P&O

2. MPPT using Inc-Cond Method:

Due to limitation of P & O method such as step size & oscillation around the operating point, the Inc-Cond technique is widely used. This method uses reliable decision making capability for step size based on current status resulting response is faster & tracking result is good with small step size. For the PV system, the relationship between power, voltage & current is given by the equation-2 [6].

$$\frac{dP}{dV} = \frac{d(IV)}{dV} = I + V \frac{dI}{dV} = I + V \frac{\Delta I}{\Delta V} \quad (2)$$

Comparing incremental conductance with instantaneous conductance, the maximum power point can be tracked. The Flow chart of Inc-Cond method is shown in the Fig. 4 below.

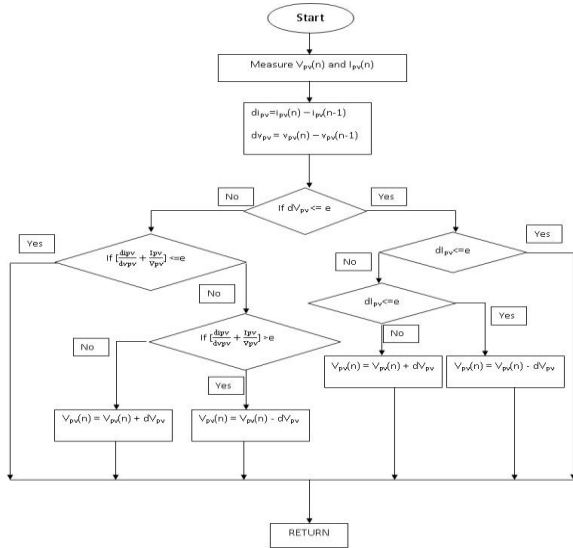


Fig.4: Flow Chart for Inc-Cond Method

The control model for the Inc-Cond method in Matlab Simulink environment is shown in the fig.5

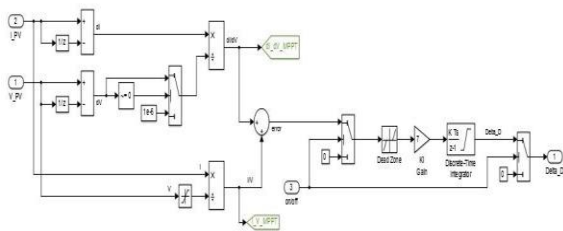


Fig.5: Control Model of MPPT using Inc-Cond

Simulation and Result:

The MPPT model shown in fig.6 is simulated in Matlab Simulink environment by taking two different virtual solar radiation i.e. 1061.5W/m² and 768 W/m² due to the irradiance level in Bhubaneswar region is in between 800W/m²& 1000 W/m². Then the result of both the techniques i.e. P&O and Inc-Cond methods are analyzed. Also the behavior of the system in terms of output power with respect to different irradiances is observed.

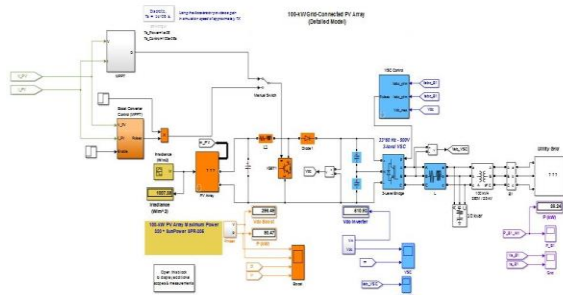


Fig. 6: Modelling of MPPT using PV array.

The model is simulated by taking irradiance of 1061.5 w/m² and the waveforms of irradiance and corresponding output power, voltage and current for Inc-Cond are shown in the fig. 7, fig.8 and fig.9 respectively.

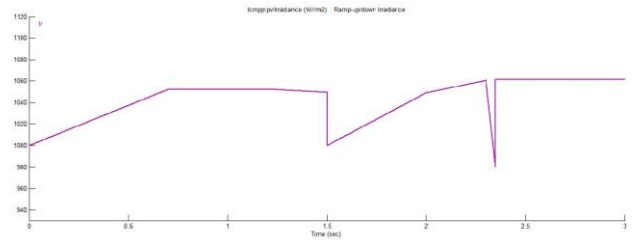


Fig. 7: Waveform for irradiance with max 1061.5W/m².

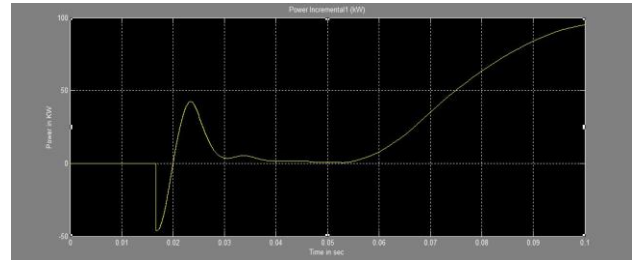


Fig.8: Output power waveform for Inc-Cond MPPT

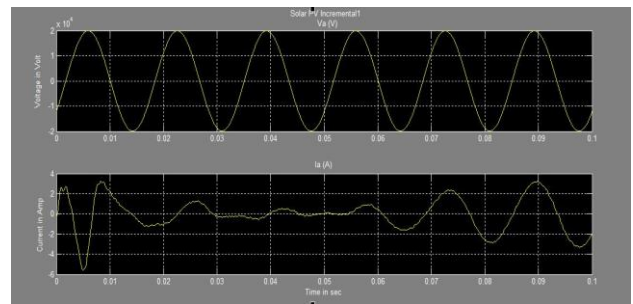


Fig. 9: Voltage and Current waveform for Inc-Cond MPPT

Also the model is simulated by using P&O technique with irradiance of 1061.5 w/m² and the waveforms of corresponding output power, voltage and current are shown in the fig. 10 and fig.11 respectively.

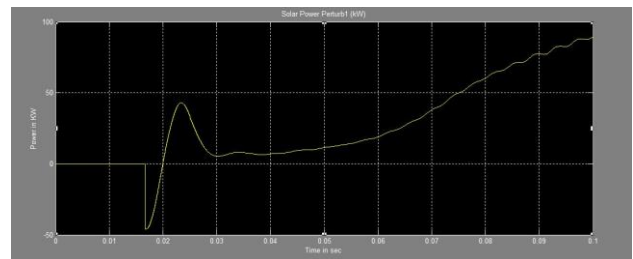


Fig.10:Output power waveform for P&O

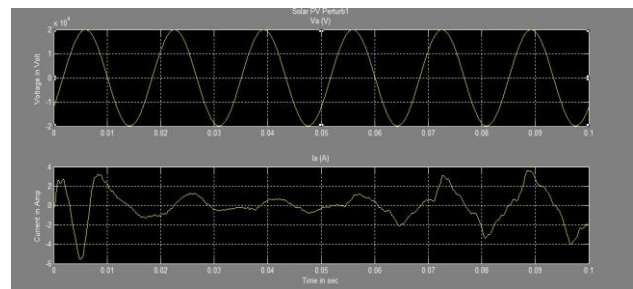


Fig. 11: Voltage and Current waveform for P&O

From the output power waveform shown in fig. 6 and 8, it is found that maximum power obtained with method Inc-Cond is 95 KW and with P&O is 90 KW. Similarly, for irradiance 768W/m^2 output waveform of power and voltage, current for Inc-Cond method are shown in fig. 12, fig. 13 and fig.14 respectively.

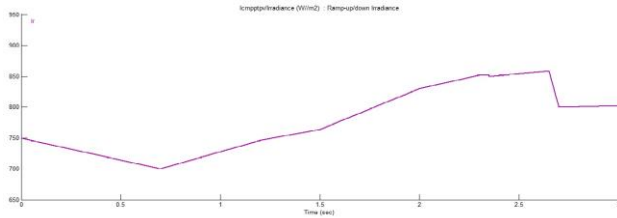


Fig. 12: Waveform for irradiance with max 768W/m^2

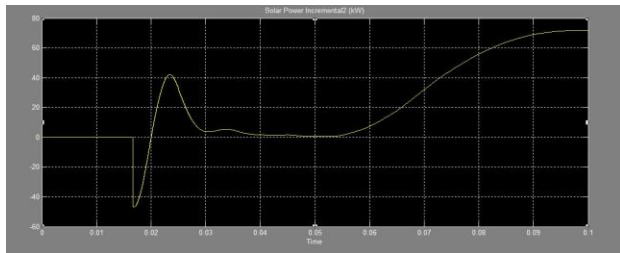


Fig.13:Output power waveform for Inc-Cond MPPT

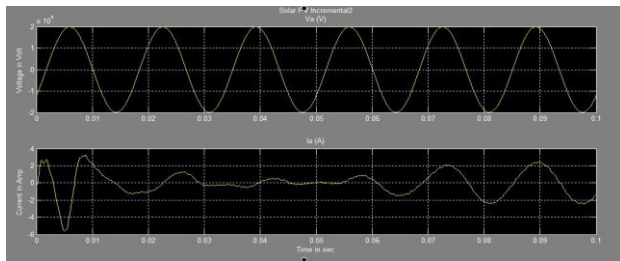


Fig. 14: Voltage and Current waveform for Inc-Cond

Conclusion and Future Work:

This paper takes a case study of MPPT based grid connected solar PV not only in different atmospheric conditions but also by taking two control strategies. It is found that Inc-Cond technique for MPPT provides higher value of output power in comparison to Perturbation and Observation technique.

In future we can improve the performance of controller by introducing fractional parameters as well as with fuzzy controller in addition to developed fractional controller.

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