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Comparative Study of Perturb & Observe Method and Incremental Conductance Method for Maximum Power Point Tracking System

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***Abstract*— Due to the mounting demand of electricity, inadequate reserve of fossil fuel and rising expenses of traditional sources, photo-voltaic (PV) electricity turns into a promising substitute. It is a accepted potential of producing clean and renewable energy and due to this reason, the demand of PV technology structures will increase and there is a need to extract most electricity from them.So there is need of most strength point tracking (MPPT) in a PV system. It is a technique that can operate photo voltaic PV structures in such a way that they produce most electricity that can be generated. MPPT tracking machine works based on a tracking algorithm which is furnished through a manipulate system. In this dissertation, a contrast is made between perturb and look at MPPT method and incremental conductance MPPT approach to make clear understanding about their conduct for monitoring maximum electricity factor (MPPT) of PV module. For this purpose, a simple and correct model of photo-voltaic module is proposed and simulated. The mathematical model and MPPT with H-BRIDGE two are mentioned with MATLAB/Simulink and analyze the distinction between P&O and InC approach.**

Keywords*— MPPT Maximum Power Point Tracking; H Bridge; perturb and observation (P&O), Incremental conductance (InC)

INTRODUCTION

In the power part the request of vitality isn't sufficient to satisfy the everyday necessity this need of vitality offer ascent to utilization of customary vitality asset. Used along the side with regular frameworks to take care of the vitality demand. The Mathematical Model of Simple PV System.

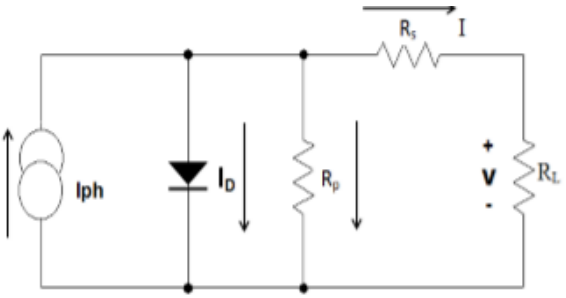

Fig -1: PV single diode model

Fig 1 demonstrates the single diode model of the PV cell that is properly built with a parallel current source to the diode, a shunt resistor Rp, an arrangement resistor Rs and a heap resistor RL. The fundamental conditions [2,3] from the hypothesis of semiconductors that numerically depicts the I-V qualities of the perfect photovoltaic are given as takes after.

$I = I_{ph} - I_D$
Where

$$I_D = I_o \exp((qV/akT)-1) \quad (2)$$

$$I = I_{ph} - I_o \exp((qV/akT)-1) \quad (3)$$

In the above conditions, Iph speaks to the current produced by the episode light, ID is the diode current and Io is the invert immersion current of the diode, q is the electrical charge, k is the Boltzmann steady, T is the temperature of the p-n intersection, and 'a' is the diode ideality factor (consistent).

The expression for the photovoltaic current is given by:

$$I = I_{ph} - I_o[\exp(V + IR_s / V_T) - 1] - (V + IR_s / R_p) \quad (4)$$

And expression for voltage is given by

$$V = I_{ph}R_p - IR_p + I_o[\exp(V + IR_s / V_T) - 1] - IR_s \quad (5)$$

MPPT TECHNIQUES

1. Perturbation and Observation Method

The Perturbation and Observation Method (P&O) is one of the most famous MPPT techniques due to the fact of its simplicity. The P&O technique operates with the aid of making small incremental changes in voltage and measuring the resulting trade in power. Two by comparing the modern-day power measurement to the previous energy measurement, the P&O technique selects the direction for the subsequent perturbation. The path the subsequent perturbation will take is described in table

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Perturbation	Change in Power	Next Perturbation
Positive	Positive	Positive
Positive	Negative	Negative
Negative	Positive	Negative
Negative	Negative	Positive

Table 1: Table of operation for the P&O MPPT method.

Furthermore, P&O strategies can fail under rapidly altering atmospheric stipulations (see Fig. 2). Starting from an operating factor A, if atmospheric prerequisites remain approximately constant, a perturbation ΔV the voltage V will bring the working factor to B and the perturbation will be reversed due to a decrease in power. However, if the irradiance will increase and shifts the electricity curve from P1 to P2 within one sampling period, the running factor will go from A to C. This represents an extend in power and the perturbation is kept the same. Consequently, the running point diverges from the MPP and will hold diverging if the irradiance step by step increases

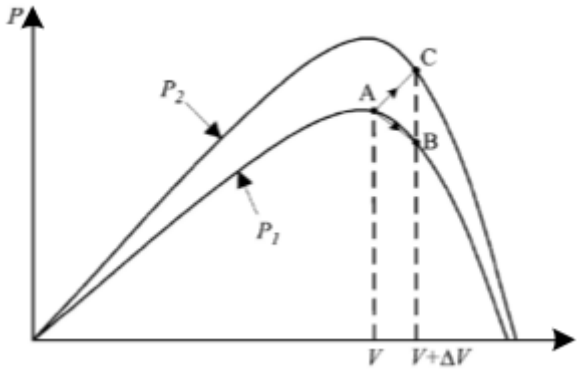

Fig 2. Divergence of P&O from MPP

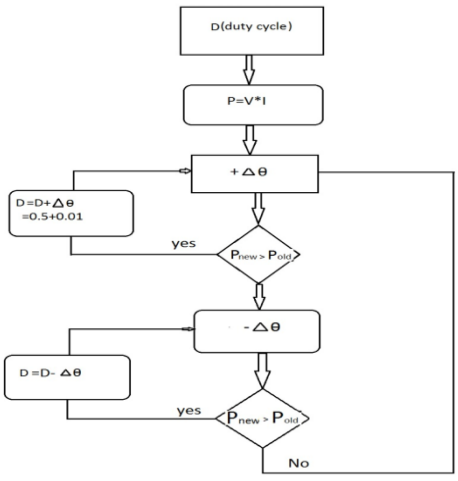

Fig 3. Flow diagram of P&O method

ADVANTAGES

- Reliable result.
- It is not dependent on the panel properties and on characteristics.

DISADVANTAGES

- The accuracy of the system and its time requirement are depending on the size of perturbation.
- The P&O method is not suited in fast changing environmental conditions.
- At the steady state condition the output voltage and current signals of PV panel oscillates which causes losses.

2. Incremental Conductance Method:

The theory at the back of the incremental conductance method (IC) is to determine the terminal voltage of the PV module with the aid of measuring and comparing the incremental and instantaneous conductance of the PV module. If it is located that the incremental conductance is equal to the instant conductance, it shows that the maximum electricity factor is found. It has been found that within operating limits, output power will increase with growing terminal voltage of the PV module (slope of the energy curve is positive, dP/dV>0). On the contrary, at working factors previous MPP there is a decrease in the output power with an increase in terminal voltage of the PV modules (the slope of the energy curve is negative, dP/dV<0). When the working factor is exactly at the MPP, the slope of the curve as anticipated is zero. These observations are graphically represented in below Fig 4

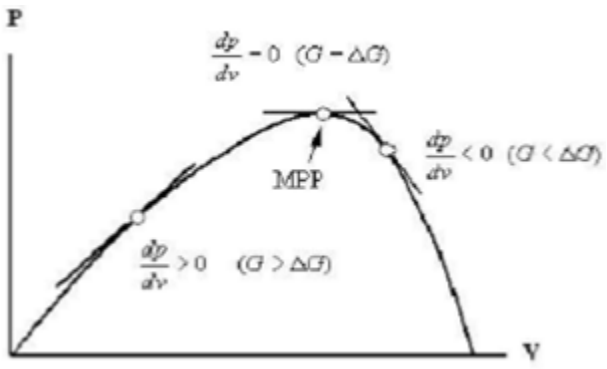

Fig 4. A schematic representation of the power curve and the slope at the maximum power point.

From the flow design it can be determined that if dV=0 however dI>0, the photo voltaic irradiance has extended and voltage at the most electricity factor rises. Thus, the operating voltage of the PV module has to be multiplied in order to tune the maximum power point. On the other side, if the solar irradiation decreases, voltage at the maximum energy factor falls. The operating voltage at this point desires to be decreased

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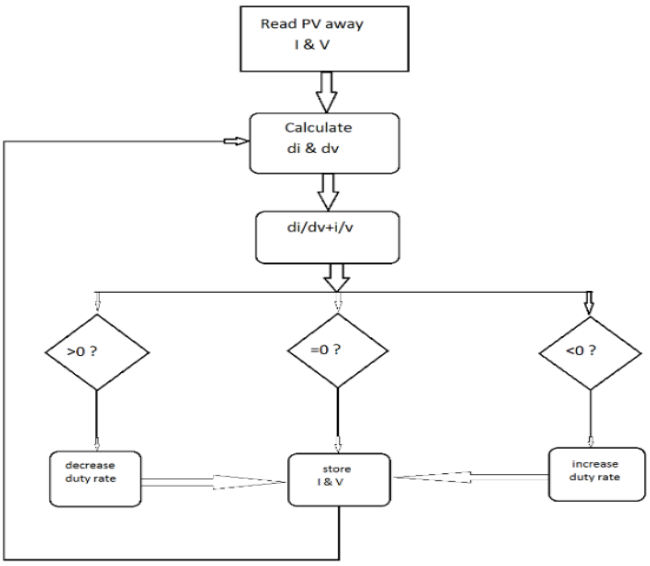

Fig. 5 The flow diagram of incremental conductance method

- ADVANTAGES
- Good yield under rapidly changing atmospheric condition.
- DISADVANTAGES
- Efficiency is somewhat less then P&O method
- Requires complex and costly control circuit.
- Needs four sensors to accomplish its MPPT action.
- Output voltage and current signals of PV panel oscillates even at steady state.

The Proposed Model:-

In the proposed model the PV array consists of 86 parallel strings. Each string has 7 SunPower SPR-415E solar cell two modules related in series. The converter is modeled the usage of a 3-level IGBT bridge with PWM-control. The inverter choke RL and a small harmonics filter C are used to filter the harmonics generated by using the IGBT bridge. A 250-kVA 250V/25kV three-phase transformer is used to join the inverter to the utility distribution system. The Maximum Power Point Tracking (MPPT) controller is based on the 'Perturb and Observe' technique. This MPPT system mechanically varies the VDC reference signal of the inverter VDC regulator in order to gain a DC voltage which will extract maximum energy from the PV array.

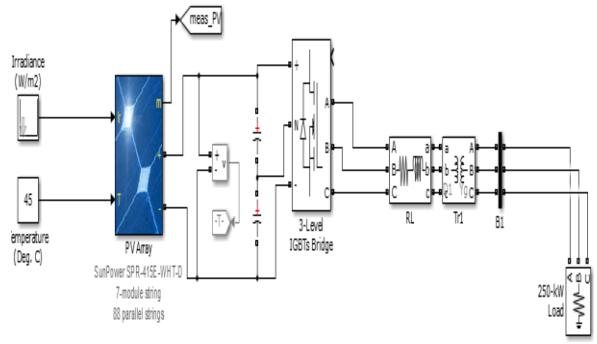

Fig 5 Proposed Array Model

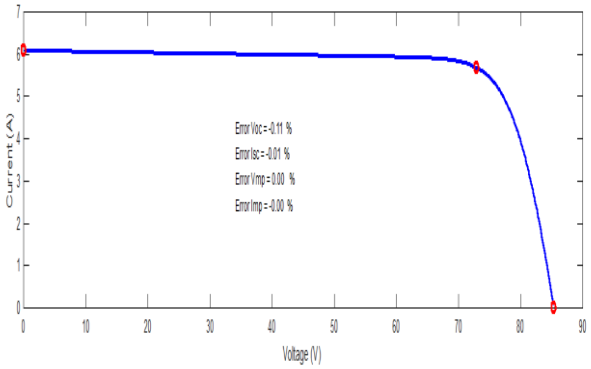

Fig 6. I-V &P-V Curves of Pv Array

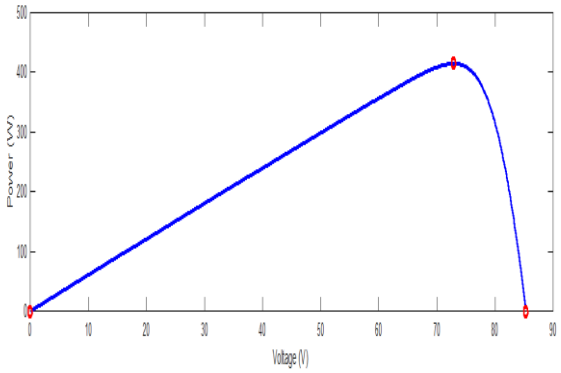

Fig 7. P-V Characteristics of Pv Module

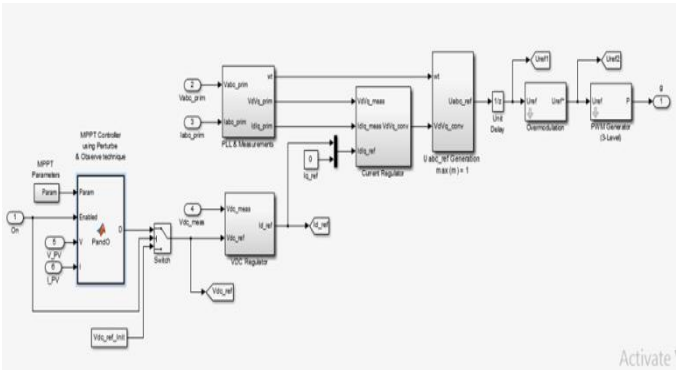

Fig 8 P&O model in Mat lab/Simulink

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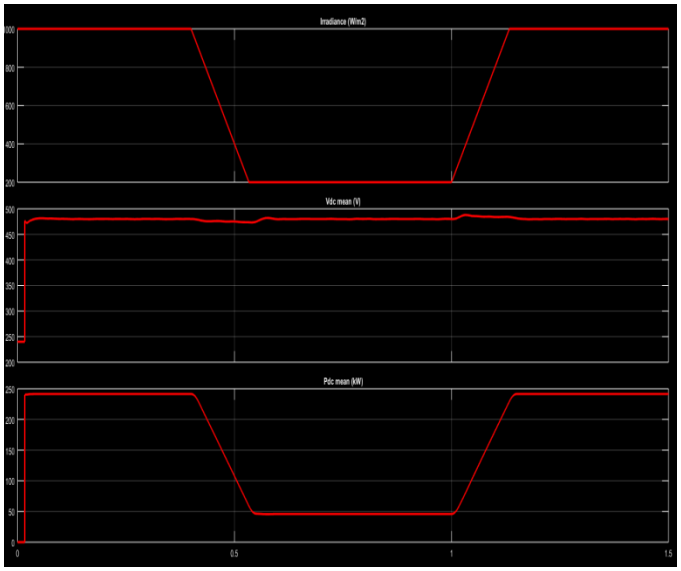

Fig 9 Voltage and current waveforms without MPPT techniques.(DC Parameters)

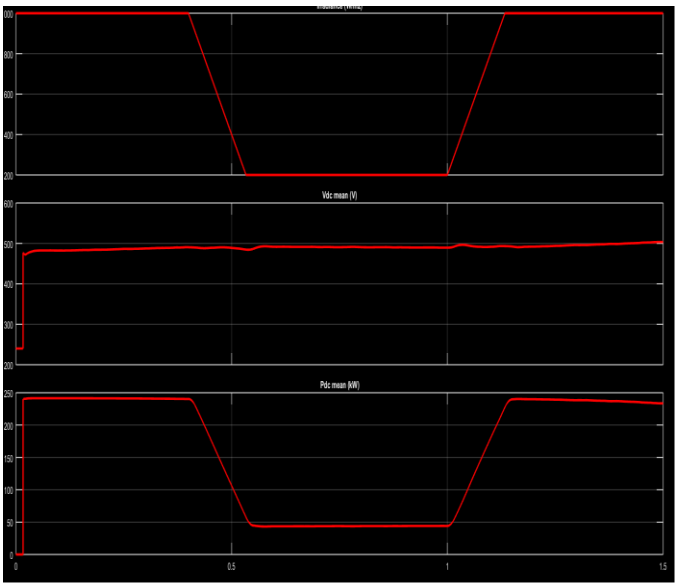

Fig 10 Voltage and current waveforms with MPPT techniques (DC Parameters) with P&O algorithm

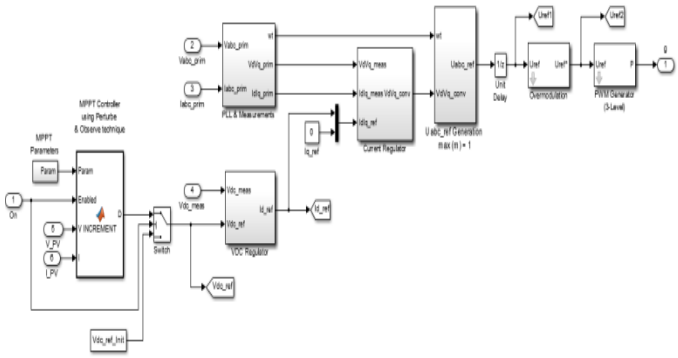

Fig 11 Incremental conductance model in Matlab/Simulink

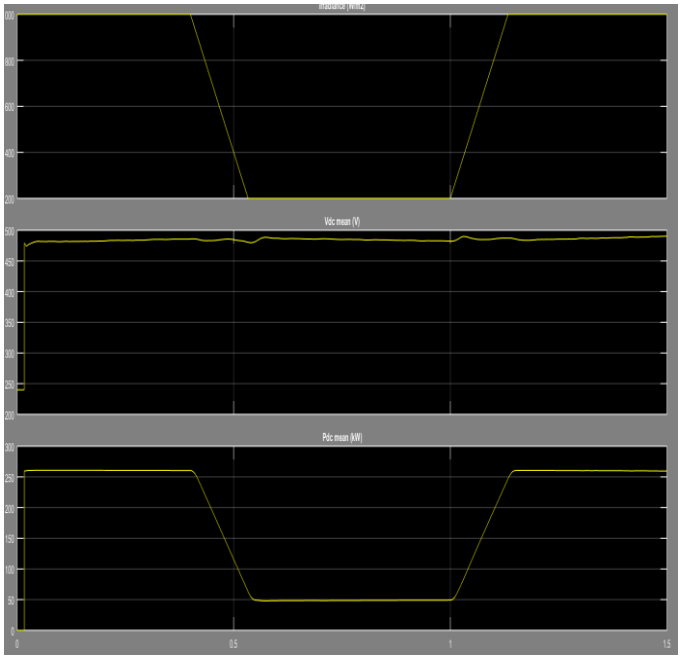

Fig 12 Voltage and current waveforms with MPPT techniques (DC Parameters) with InC method

S.No	Time	Technique	Voc	Pdc	Isc
1	1 sec	P&O	481	244	0.51
2	1.5sec	P&O	475	52	0.11
3	1 sec	IC	481	248	0.52
4	1.5sec	IC	478	52	0.11

Table 2: Comparison of P&O and IC methods

CONCLUSION

MPPT methods plays very essential position while designing PV array module/system .Without MPPT strategies there located much fluctuations and low effectivity in energy output however with MPPT methods expanded efficiency and energy output has been obtained. The P & O and InC MPPT algorithms are simulated and in contrast using the equal conditions. When atmospheric stipulations are regular or change slowly, the P&O MPPT oscillates close to MPP however InC finds the MPP precisely at changing atmospheric conditions also.

. It is proved that Incremental conductance technique has higher performance than P&O algorithm

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