# ANALYSIS OF VARIOUS MAXIMUM POWER POINT TRACKING TECHNIQUES FOR PHOTOVOLTAIC CELL

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*ABSTRACT*: This paper acknowledges about the maximum power point tracking for photovoltaic system. Many papers have been registered and published up to the date, but it‟s been mere to select a particular tracking technique for PVC. However, crisis arises because each tracking has its own merits and demerits. It‟s very vital to give a proper and detailed review of the technique. In previous decades power generation was done with the help of conventional sources like coal, water and wind. This paper emphasises on the various maximum power point tracking techniques, controlling strategies, features and types of different circuits used in PV system. The intention of this paper is to serve as a guideline for the future MPPT users.

## 1. INTRODUCTION:

There has been an exponential demand of electricity in the recent developing years which causes increase in prices of conventional sources too. Thus, PVC thereby becomes excellent and is pollution free too i.e. completely eco-friendly serving less maintenance and operational cost resulting in increasing demand of PVC generation system. An efficient maximum power point tracking (MPPT) technique should exhibit perfect MPP at all the environment conditions further forcing the MPP to operate at that particular point. Firstly, as we all know in the previous decades the depletion of fuels has been influenced at a major scale, this is because the demand of electricity is also gradually increasing. Sun, which is a never-ending resource of light and heat radiates both. According to Newton‟s corpuscular theory, the emitted light by the sun consist of small discrete particles travelling in a straight line with particular and finite velocity. These corpuscular consists of packets which holds photons. The family of photons possess energy in optical form. In semiconductor electronics we have a family which is the baseline and the backbone of modern electronics named *‘**diode**’*. To convert this optical energy in form of electrical energy a reverse biased photodiode is used.

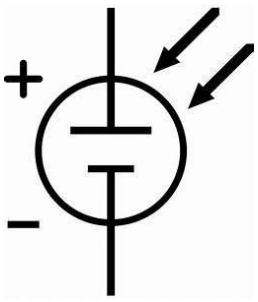


***Fig. (a) Symbol of PVC***

*SECTION 2. CONTAINS DESCRIPTION OF PVC*

## 2. PHOTOVOLTAIC SYSTEM

The principle of photodiode is that it consumes light energy to give electrical energy as the output in the form of voltage. This phenomenon is known as „***photovoltaic effect***". Photodiode mainly comprises of optical fibre, built-in lenses and also of variable surface areas. It is also known as photovoltaic cell or solar cell. Its electrical characteristics such as current, voltage and resistance vary when exposed to direct sunlight. Individual solar cell combines to form „***solar panels***" and when photodiodes collectively arranged in series or parallel forms „***grid***".

***Fig. (b) Solar Panel***

*Operation of PVC needs three basic attributes*

- Generating electron-hole pair by absorption of light
- Charge carrier separation of opposite types
- Separate carrier extraction to an external circuit

*Working of solar cell consist of following several steps:*

- The photons in sunlight incidents on solar panel and are absorbed by the semiconducting materials
- Electrons revolve in their current atomic state, once the electron gets excited it has two paths available to walkthrough i.e. dissipate the energy as heat and get back to its orbit or travel through the orbit till it hits the electrode
- Current flows through the material giving rise to the electric current
- The chemical bond is due to the boron and phosphorus being doped along with the silicon
- As these layers have different electrical charges both of them drive electric current
- A collection of photodiodes collectively assembled in form of array results into solar panels giving rise to DC current
- An inverter is used to convert the power into alternating current
- These arrays supply solar electricity in commercial as well as residential areas

Fig. (c) shows I-V curve of PVC

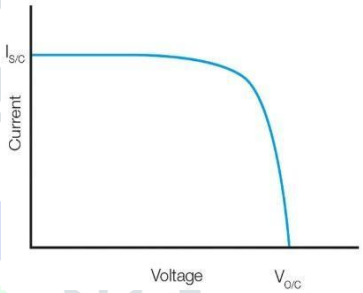


***Fig. (c) I-V Curve of PVC***

*SECTION 3. CONTAINS DESCRIPTION OF MAXIMUM POWER POINT TRACKING*

## 3. MAXIMUM POWER POINT TRACKING (MPPT)

MPPT is a control technique mainly used to extract the maximum capable power inhibited by the PV modules along with respective solar irradiance and temperature at a particular instant of time by the controller. Number of algorithms are being discovered, implemented and practised over wide range in order to achieve maximum power point efficiently. Many algorithms lack or suffer due to drawback of slow tracking thereby resulting in reducing the utilization efficiency. Following are some of the MPPT tracking techniques

such as, Artificial neutral network with back propagation technique, Fuzzy logical controller intelligent control, etc. in this paper we are going to study about the Hill Climbing technique followed by its types.

*SECTION 4. CONTAINS DESCRIPTION OF HILL CLIMBING TECHNIQUE*

## 4. HILL CLIMBING TECHNIQUE

The Hill Climb Technique is named so because of shape of the P-V curve.

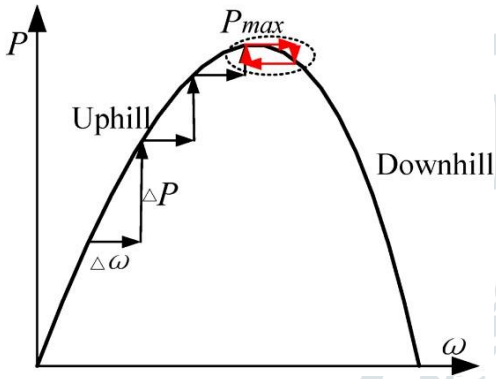


***Fig. (d) Hill Climb Technique***

Hill Climb Technique is further classified as:

- Perturb and observe algorithm
- Incremental Conductance Algorithm

### 4.1 PERTURB AND OBSERVE ALGORITHM

P&O technique is easy to implement and commonly used in battery charging applications. The operating voltage or current of PV is perturbed and then the power obtained is observed further deciding the direction of change in voltage or current. If in case the power is increased by the perturbation the REREvoltage or current keeps falling until the power begins to fall. The P&O algorithm measures the instant voltage and current to calculate the power and then compare it with the previous power or last calculated power. The algorithm continuously perturbs until the power is positive if not so then the direction of perturbation is changed to get the power variation as positive. Fig. (e) below represents algorithm of P&O technique.

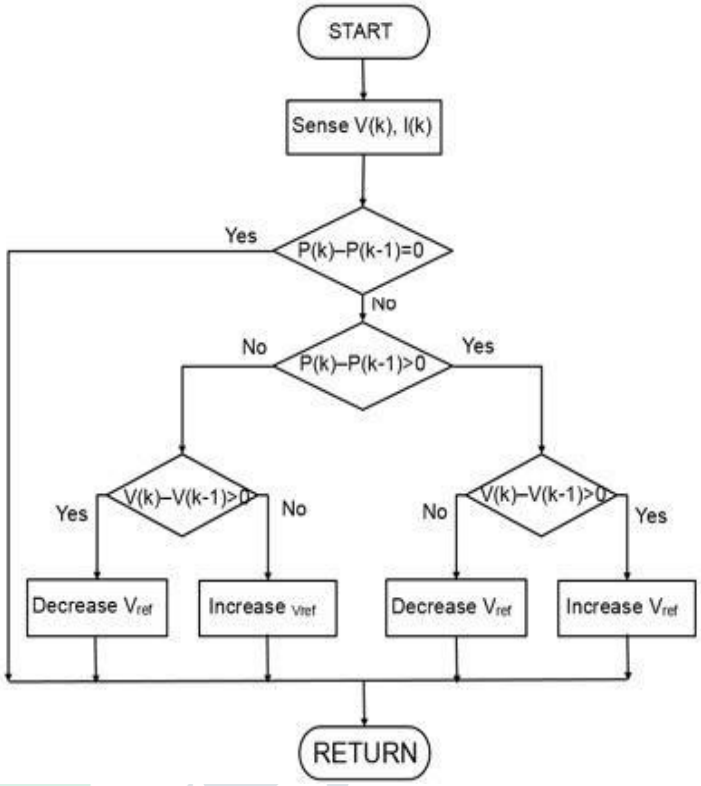


***Fig. (e) Algorithm of P&O Technique***

P&O technique is considered to be the best among all the tracking techniques. It can also be said that it uses instant measurement of tracking MPP as it uses current and voltage and is independent of varying operating conditions like radiation of sun, temperature and degradation of module. P&O is fast responding algorithm tracking with utilization efficiency of 97% for slow changing radiation.

### 4.2 INCREMENTAL CONDUCTANCE ALGORITHM

The Incremental Conductance Algorithm of MPP tracking was developed by K.H. Hussein, I. Muta, T. Hoshino and M. Osakada, however, the concept technique was later developed by O. Wasyneczuk. This technique make use of derivates of conductance i.e. voltage and current to determine the MPP. The tracking of MPP is done by comparing the instant conductance with the incremental conductance. This algorithm is better than P&O algorithm because it gives less oscillations as compared to previous technique. More accurate MPP point is obtained in rapidly varying solar changes or radiation. Adding variable step size gives impetus to speed and accuracy. If the MPP is far from operating point the step size is large and when the operating point is closer to MPP the step size is small and vice versa resulting in reduction of steady state oscillation. Fig. (f) represents the algorithm of INC tracking technique.

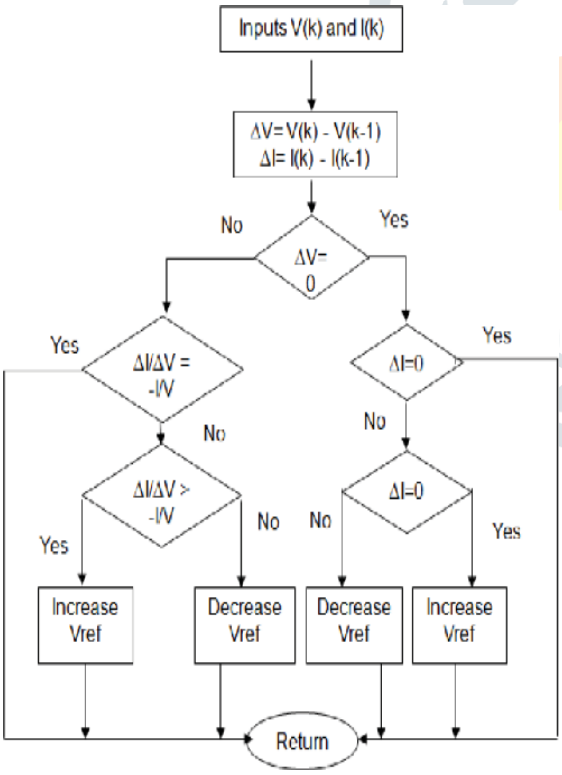


***Fig. (f) Flow chart of incremental Conductance Algorithm***

## 5. CONCLUSION

Hill climb technique of MPPT is discussed above along with its classification. Flow charts included provide the latest information and update on conventional and advancements in Hill Climb Technique. Both P&O and INC technique are most efficient method to track MPPT.

## 6. REFERENCES

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