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# Maximum Power Tracking & Harmonic Reduction on grid PV System Using Different Algorithm Based MPPT Controller

Ritisha G. Ankushe<sup>1</sup>, Prof. Walmik Gavhane<sup>2</sup>

PG Student, Dept. of Electrical Engineering, Govt. College of Engg. Aurangabad (MH), India<sup>1</sup>

Asst. Professor, Dept. of Electrical Engineering, Govt. College of Engg. Aurangabad (MH), India<sup>2</sup>

**ABSTRACT:** Electricity generated by photovoltaic (PV) arrays is rapidly being viewed as a viable alternative to fossil fuels. The ability to track the PV array's maximum power point (MPP) is an essential element of a PV system. The most important maximum power point tracking (MPPT) approaches utilized in solar systems are reviewed and compared in this research. There are numerous methods for increasing the efficiency of photovoltaic systems. Digital or analogue implementation, design simplicity, sensor requirements, convergence speed, stability, range of efficacy, and costs are the key differences between these techniques. Thus, selecting an appropriate algorithm is critical since it influences the PV system's electrical efficiency and lowers costs by reducing the number of solar panels required to achieve the target output.

**KEYWORDS:** Photovoltaic (PV) Arrays, Maximum Power Point (MPP), Solar Systems.

## I. INTRODUCTION

In the coming years, the globe is expected to face a number of issues relating to the depletion of certain energy sources, particularly fossil fuels. It is also well known that various components of the rise in oil prices as a result of economic and political issues have contributed to economic crises in recent decades [1]. Photovoltaic (PV) solar energy is an appealing possibility to supplementing the generation of electricity among the clean and green power sources [2]. The photovoltaic effect is a direct conversion of light into electricity that can be used to generate electricity. Solar energy is also free to utilize, abundant in nature, and nonpolluting, and it plays a critical role in the survival of all primary energy sources on Earth [3,4]. Maximum Electricity Point Tracking (MPPT) is a method of operating solar PV modules in such a way that they can produce all of the power that they are capable of. MPPT is not a mechanical tracking system; instead, it is based on a control system that uses a specific tracking algorithm. Although MPPT can be used in conjunction with a mechanical tracking system, the two are not the same. Based on variations in irradiance and temperature, MPPT algorithms are utilized to extract the greatest power from the solar array. The maximum power point of a PV module is the voltage at which it can produce the most power (or peak power voltage). Solar radiation, ambient temperature, and solar cell temperature all affect maximum power [5].

### 1. Need of maximum power point tracking (MPPT)

- A single solar cell's I-V characteristic and power vs voltage curve. It means that solar PV can only provide maximum power at a particular location. The operating voltage or current should correspond to the maximum power point (P<sub>max</sub>) of the cell, i.e. V<sub>m</sub> and I<sub>m</sub>, respectively, at a particular temperature and insolation, in order to extract the maximum power from the cell. [6] Has a considerable impact on the properties of solar cells.
- The Effects of Isolation: Variations in characteristic as a function of insolation. The solar cell's short circuit current (I<sub>sc</sub>) is a function of insolation and decreases proportionally as insolation decreases. Insolation reflects the fact that the point of greatest power fluctuates with changes in insolation.
- Temperature: Another component that has a significant impact on solar cell characteristics is temperature. The open circuit voltage grows proportionally as the temperature rises, but the short circuit current falls logarithmically.
- Partial shade condition: In addition to temperature and insolation, partial shading has a significant impact on solar cell performance. When more than one PV module is connected to each other and one of them is partially shaded, the insolation received by both modules varies. Consider two series linked Q6LMXP3-G3 solar cells with terminal voltages V<sub>1</sub> and V<sub>2</sub>, total power P, and total voltage V to describe this mismatch scenario.



**2. The Maximum Power Point (MPP) Methods**

The maximum power point (MPP) of a solar array is an important milestone in the development of a PV system [7]. As a result, multiple MPPT approaches have been developed, with numerous versions of each method proposed to address distinct drawbacks. The great number of solutions provided can make deciding on the best technique to use while installing a PV system challenging. The most widely used MPPT approaches are summarized in this publication. Following that, two promising strategies are highlighted for consideration for developing a system that must cope well with a wide range of irradiance conditions.

**A. Perturbation and Observation (P & O) Method**

The P & O method, as depicted in Figure 1, works by periodically increasing or reducing the array terminal voltage, or current, and comparing the PV output power to that of the previous sample point. The control system adjusts the PV array operating point in that direction if the PV array operating voltage changes and power increases ( $dP/dV_{PV} > 0$ ); otherwise, the operating point is moved in the opposite way [8]. The algorithm continues to work in the same way at each perturbation point. The simplicity of the methodology is the key benefit of this method.

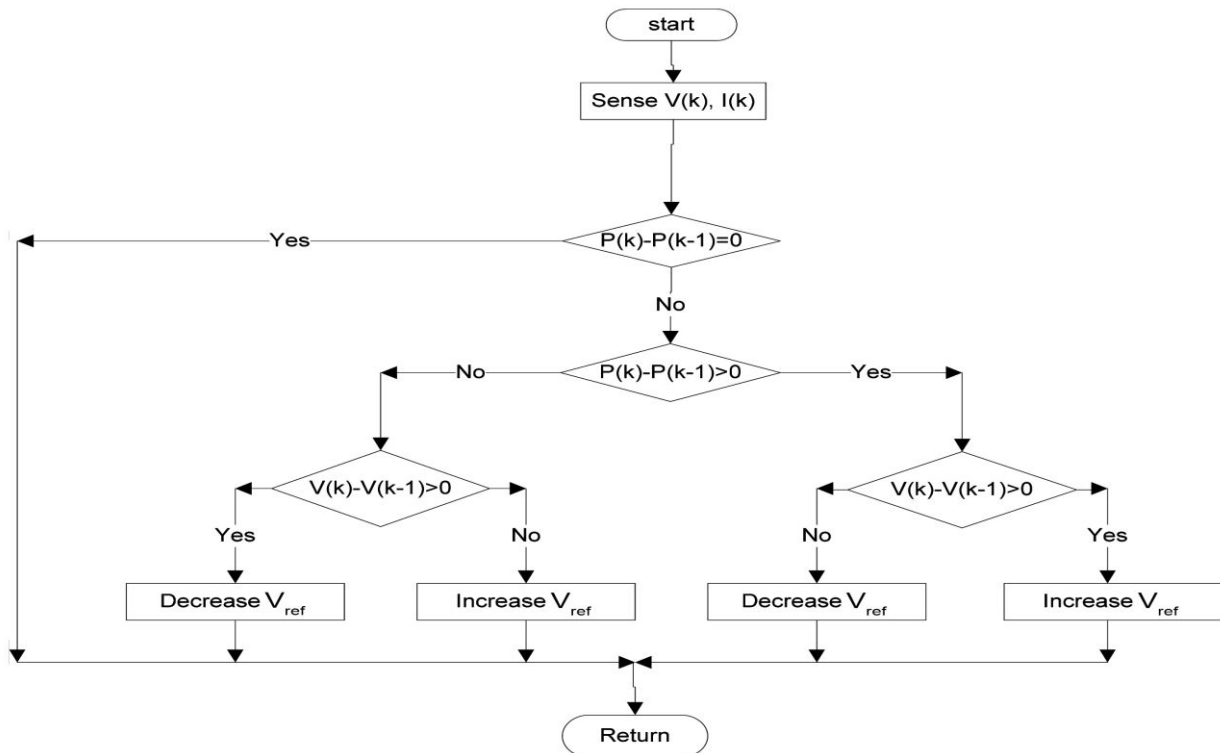


Figure 1 Flowchart of the P & O method.

**B. Incremental Conductance (IC) Method**

The incremental conductance (IC) algorithm, displayed in Figure 2, uses the photovoltaic's incremental conductance to overcome the restrictions of the perturbation and observation algorithms. The voltage operating point at which the conductance equals the incremental conductance is found using this approach. The system then stops interfering with the operating point. This algorithm has the advantage of being able to compute the relative "distance" to the maximum power point (MPP), allowing it to detect when the MPP has been achieved. In addition, compared to the P & O technique, it is capable of monitoring the MPP more precisely in highly fluctuating weather conditions [9], and exhibits less oscillating behavior around the MPP [10]

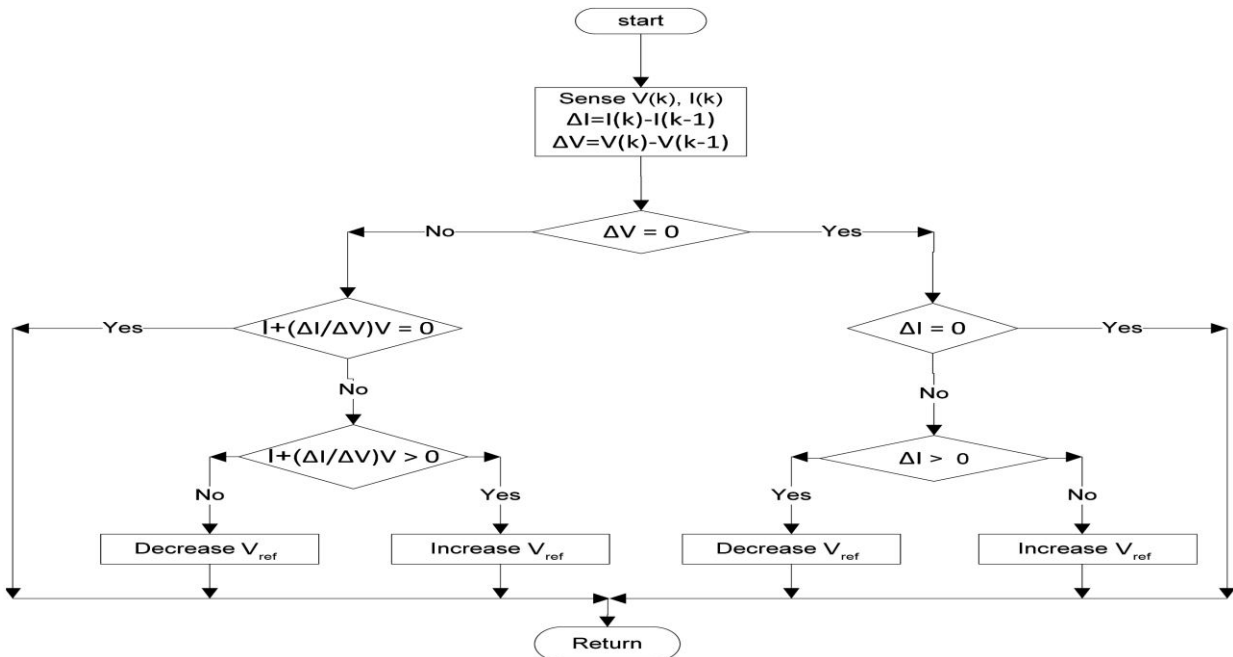


Figure 5 Flowchart of the IC method.

**C. Constant Voltage (CV) Method**

One of the most basic MPPT algorithms is the constant voltage (CV) algorithm. By adjusting the solar output voltage to meet an immovable reference voltage  $V_{ref}$ , the operating point of the photovoltaic array is kept near the maximum power point (MPP). The voltage at the maximum power point ( $V_{mpp}$ ) of the typical photovoltaic array is used as the reference voltage. The method assumes that PV panel fluctuations such as temperature and irradiance are minor, and that a steady reference voltage is sufficient to provide MPP-like performance. As a result, the CV algorithm may never be able to precisely pinpoint the MPP in practice.

**D. Temperature (T) Method**

In articles by R. Faranda and S. Leva [11], a temperature MPPT algorithm is introduced. When looking at the V-I characteristics, it can be seen that the solar array's short-circuit current ( $I_{sc}$ ) is proportional to the irradiance (G) level and remains relatively constant as the cell temperature changes, whereas the solar panel's open circuit voltage ( $V_{ov}$ ) is directly proportional to the PV array temperature (T). Temperature sensors mounted on the PV array's rear surface, as well as voltage sensors, are used in this algorithm.

**E. Open Voltage (OV) Method**

R. Faranda and S. Leva [11] proposed the algorithm, which is based on the observation that the MPP voltage is always close to a constant proportion of the open circuit voltage. Temperature and insolation level adjust the location of the maximum power point within a 2-percent tolerance band. The open-voltage algorithm method chooses 76 percent of the open circuit voltage ( $V_{ov}$ ) as the optimum operating voltage ( $V_{op}$ ) for obtaining maximum output power.

**F. Feedback Voltage (Current) Method**

To keep the bus voltage constant, a feedback voltage (or current) is used. It works by comparing the PV voltage to the constant voltage and modifying the duty cycle (D) of the converter to operate the PV array near the MPP, as shown in Figure 3. The approach is low-cost, computationally straightforward, and only employs one feedback control loop. It does not, however, take into account the impact of temperature and irradiation fluctuations [10].

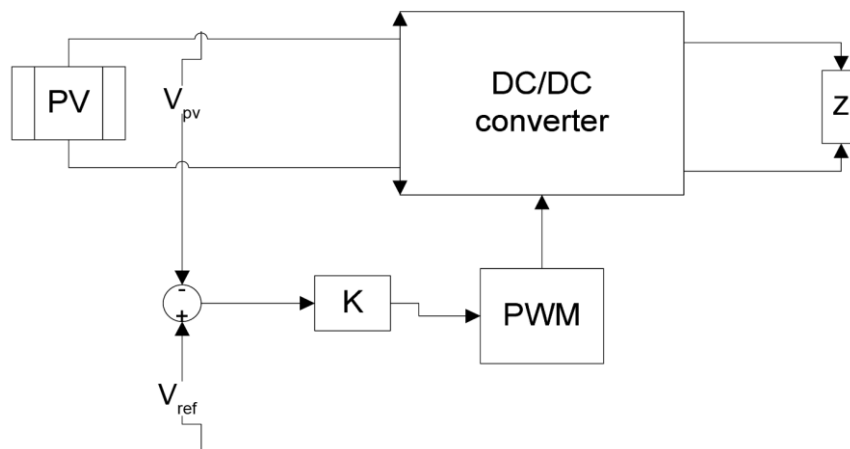


Figure 3 Voltage-feedback with PWM modulation.

### G. Fuzzy Logic Control

As microcontroller processing power has improved and costs have decreased, fuzzy logic control in MPP applications has grown more common. Fuzzification, rule basis table lookup, and defuzzification are the three steps of fuzzy logic controllers. Fuzzification is the process of converting numerical input variables into language variables using a set of membership functions. The higher the number of membership functions used, the more precise the controller will work [12].

### H. Neural Network

T. Hiyama [13] and L. Zhang [14] describe a neural network technique. To ensure precise MPPT operation, the neural network must be trained to cooperate with the PV array and compensate for the system's time-varying features. The neural network does not require detailed information about the PV system once it has been trained; it functions as a black box model.

## II. CONCLUSION

This study provides an overview of MPPT approaches and discusses their applicability in systems that operate under a variety of situations. As a result, each MPPT method has its own set of benefits and drawbacks, and the choice is very application-dependent. The goal of installing solar panels in residential areas is to shorten the payback period. To do so, the maximum power point must be tracked continuously and fast. In addition, the MPPT should be able to reduce the ripple around the MPP. As a result, the two steps of the technique—incremental conductance (IC) and perturbation and observation (P & O) algorithms—are appropriate. Simulating a standalone PV system with a DC-DC boost converter to connect the PV panel to the load was used to test these two ways. The performance of each approach has been evaluated under a variety of various irradiation settings.

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