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Case Study Of Perturb And Observe Method Under Climatic Disturbance For Solar Photovoltaic System

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***Abstract*-**The high demand for PV systems is because they generate electricity without harming the environment by transforming solar radiation straight into electricity. Solar radiation, on the other hand, is never continuous. Throughout the day, it fluctuates. The necessity of the hour is to provide a constant voltage to the stand-alone system of temperature and solar irradiance change. In this paper, performance of both MPPT algorithm Perturb & Observe (P&O) and Incremental Conductance method are discussed. The major goal of this paper is to use the perturb and observe method to efficiently extract the greatest power by varying irradiance and temperature. In this paper MATLAB based simulation results of Perturb & Observe method are obtained under various conditions such as constant solar radiation, constant temperature and varying both solar radiation and temperature.

Key-words: Photovoltaic (PV) System, Maximum Power Point Tracking (MPPT), Perturb and Observe (P&O) Algorithm, Incremental Conductance (INC) Algorithm

INTRODUCTION

1 An Overview

Solar power is fast-growing and one among the most crucial sources of renewable energy now a day. This energy can be utilized by method such as solar heating, photovoltaic etc. For requirement of our power demands, the alternative energy system is another name for it. The non-renewable energy resources are ending in future for example such as coal, oil product etc. Suppose we talk about solar energy, for example, is a renewable energy source available in large amounts in comparison to other renewable energy sources. The energy received from solar is clean, pollution-free, greenhouse gases or does not affect the human health after the installation. It also helps to reduce CO_2 emissions and lower our hindrances on the environment; i.e. it is eco-friendly to nature. India's worldwide energy consumption rate is increasing as a result of solar energy. The most difficult task is to efficiently harness solar energy.

The researchers' largest issue in PV generation is its low efficiency, which is caused by non-linearity in output characteristics when insolation levels vary. Even though theoretical efficiency is around 28%, it will only meet about 15% of the time in practice. So far, improving the efficiency of the photovoltaic system with cost-efficient strategies like MPPT algorithms has been important for effective PV-based generation usage.

The major application of solar energy is commercial power production, Road signage, Satellites, solar power radio, swimming pools, power at home, outdoor lights and irrigation. These can be implemented by making suitable arrangement as per as our requirement and necessity.

System Description using block diagrams with MPPT

The main aim of maximum power point tracking (MPPT) is to connect a converter between the load and the PV array, as shown in fig 1, to manage the array output voltage (or current) and extract the maximum amount of available power. When a PV module is connected directly to a load, the operating point is rarely at maximum power, or MPP. To modify the energy flow from the PV array to the load, a power converter is required. The power can be measured via voltage and current sensors. If a power value is available, it can be decided whether to move up or down the power curve. The power curve is an unregulated direct current power source that must be appropriately conditioned before being connected to the grid. The dc/dc converter is installed at the PV array output for MPPT purposes, that is, to extract the maximum available power for a given degree of insolation. The buck converter (step down dc/dc converter) is utilized as a dc transformer that can meet the optimum load of the PV array by altering its switching duty ratio (D).the operation of an ideal buck converter is given as below

$$V_{out}/V_{in} = I_{in}/I_{out} = D$$

Where Vin and Vout are the input voltage from PV array and output voltage at the load side. Iin and Iout are the Input current from PV array and output current at the load side. (i.e. Vin and In are the input of buck Converter and Vout and Iout are the output of the buck converter.) D is the duty ratio cycle

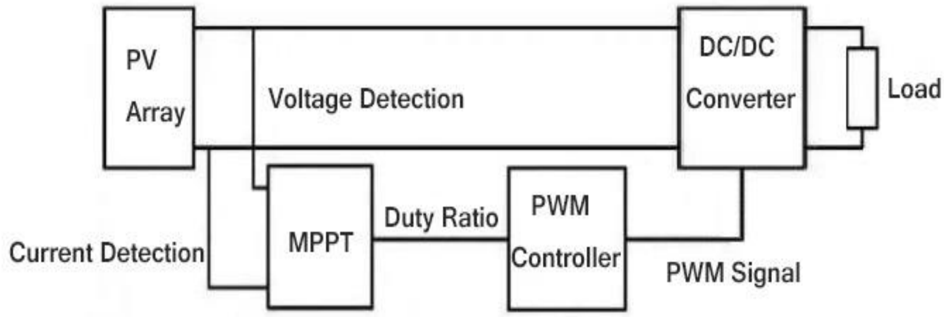


Fig.1 Block diagram of Photovoltaic system

2 Photovoltaic Cell

2.1 Working and Characteristics of PV Cell

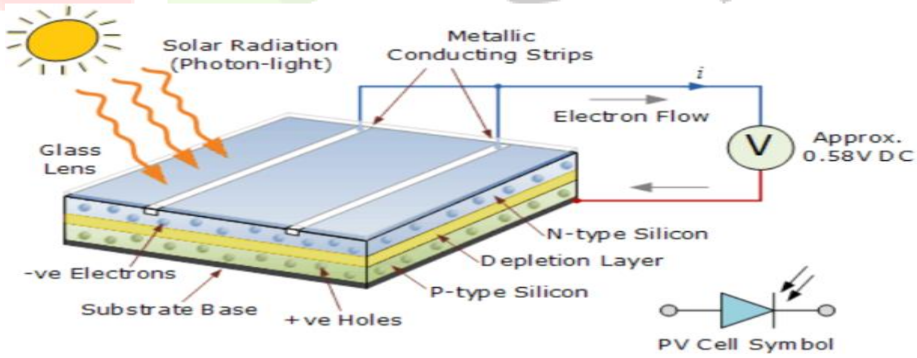


Fig. 2. Mechanism of a PV Panel

The principle of solar cell is that it accepts light energy and it transfer light energy to electrical energy. It’s type of battery. In a PN junction diode, basically, two types of layers are used, which are P-type &N-type layers. N-type layer whose faces are towards the sun should be kept thin and on another opposite side downward of the N-type layer should be kept thick. This thick layer is a P-type layer. When sunlight falls on the N-type semiconductor, then light goes to depletion layer. In depletion layer, there is a shortage of charges, i.e. it means there is no presence of any holes & charges carriers in it. Neutral atoms are present in the depletion layer.

Energy received from this depletion layer break the neutral atom. When a neutral atom breaks, an electron will move outside, and holes and electrons are created. When the light coming from the sun strikes the depletion layer, then the neutral atom will be a breakdown, and there is the possibility of occurrence of charge carrier, i.e. electrons and holes charge carrier is generated.

$$E = \frac{F}{q} \text{ or } F = Eq$$

Due to the existence of an electric field, a force will exist on the carrier. When force occurs on the charge carrier, then electrons is shifted to (+) positive side of the N type semiconductor and holes is shifted to (-) negative side of P type semiconductor. The electrons which go to the positive side (N-type semiconductor) are absorbed by the metal fingers. The space between the metal fingers is gapped it is due to light will reach up to the depletion layer. Now when a conductor is connected from N type semiconductor to P type semiconductor through a small load then at end of N-type semiconductor negative charge will occur, and towards P-type semiconductor end point Positive charge will exist then there is a production of potential occur due to such type of phenomenon $V = kq/r$ and such type of voltage is known as Photo voltage. It comes from a photo, meaning light. The electron will pass from the N type to P type layer, and the flow of current will take place from the P to N type layer. We can occur power will be $\text{Power} = \text{square of Current} \times \text{Resistance}$. The produced voltage of cell is 0.5 V to 0.6 V. The condition is the light energy (El) should be greater than the (Eg) band gap energy.

A simple equivalent circuit model for a PV cell consists of a real diode in parallel with an ideal current source. This equivalent circuit is composed of a current source-controlled models which the photovoltaic effect (the generated current is controlled by the Sun's rays). The led represents the effect of the junction semiconductor of the cell (model use two diodes in parallel for more precision). Two resistors (Rs, Rp) represent the mass and the effect of resistivity in the cell respectively

The current that flows when the terminals are shorted together (the short-circuit current, I_{sc}); the voltage across the terminals when the leads are left open (the open-circuit voltage, V_{oc}. I= I p v –Io [exp ((V+IRs) / Vt Ns) - 1]-{((V+IRs)/Rsh)} is the Characteristic equation.

A simple solar cell has little amount of power. The same power is used in storage battery watches, solar panels and calculators. When more numbers of panels are assembled together as per as our need then the system become are complex from which we can utilized to provide electricity to houses and power grids.

3 Maximum Power Point Tracking

3.1 Understanding MPPT & their Methods.

Maximum power point tracking maximizes the power production from photovoltaic systems for a given set of circumstances, such as irradiance and temperature, and hence maximizes the tracking efficiency. In the P-V or I-V curve of a solar panel, there is a peak operating point at which the solar panel delivered the maximum amount of power to the load. A solar panel's maximum power point (MPP) is its highest point. It is an algorithm that incorporates an electronic system that runs the PV modules in such a way that the module extracts the maximum amount of electricity possible from the PV Module. Maximum Power Point Tracking (MPPT) must function at their maximum power point (MPP) despite changes in environmental conditions in order to get the most power out of the solar module.

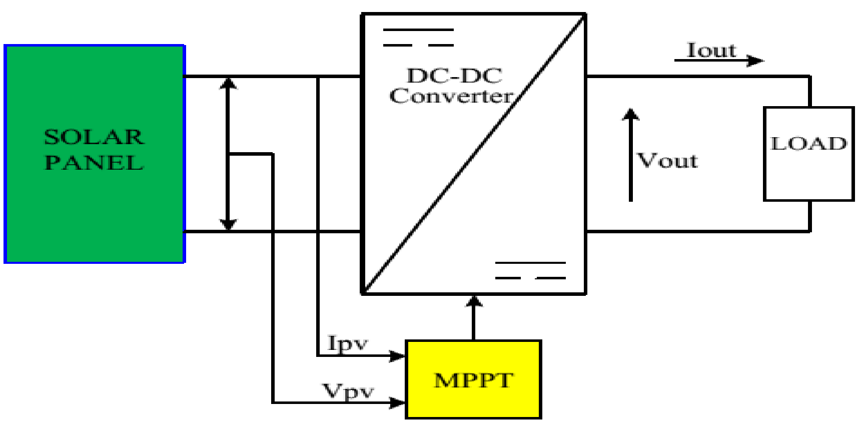


Fig. 3 Installation of MPPT in PV panel.

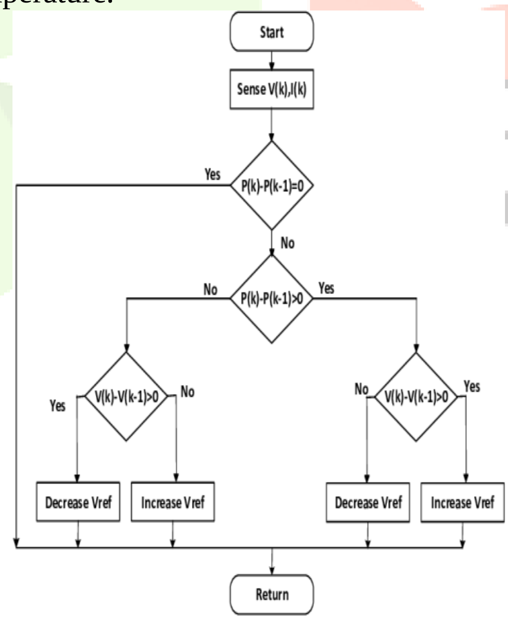
The Photovoltaic array has a non-linear voltage current characteristic due to which MPPT algorithm are required. The Photovoltaic System has a maximum operating point known as MPP.The operating point varies as per as change occur in condition of environment. These may change during the day or in cloudy weather. By implementation of MPPT, the power production from solar panel is increased which is almost 25 % current characteristic. The power produced by these voltage-current characteristics reaches a peak at a specific point. This stage varies depending on the surrounding conditions. These variables alter during the day and vary according to the seasons. MPPT can double the amount of electricity produced by 25% Between the PV system and the load, MPPT is inserted. The output voltage and current is modified in order to achieve MPPT.It is most effective under cloudy or hazy day and cold weather. In Photovoltaic generation system there are mainly two existing problems; the efficiency is almost low (9 % to 16 %) during low irradiation condition and power generated is continuous changes with temperature.

There are numerous strategies for obtaining the greatest electricity from a solar system. fews of them are listed here. Some important techniques are given as Constant Voltage method, Open Circuit Voltage method, Short Circuit Current method, Perturb and Observe method, Incremental Conductance method, Sliding Mode method, etc Algorithms of Perturb and observe method and Incremental Conductance method are studies below:

3.2 Perturb and Observe method

In this perturb and observe method the array terminal voltage is periodically perturbing (i.e. incrementing or reducing) and compare with the out power of photovoltaic system of previous perturbation cycle. This method states that a small change in the value of voltage of photovoltaic module then it causes the following effects. If power is found positive during corresponding variations, then power start to reach at the maximum points on the track and follow the same until it does not reach MPP.

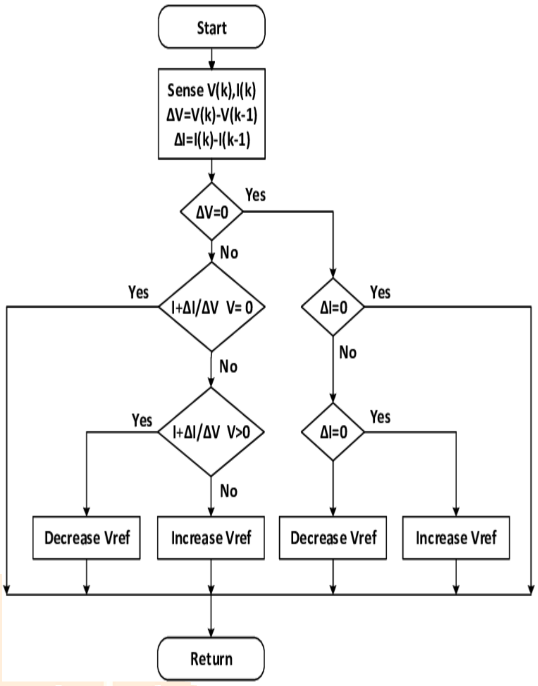
If power is found negative during corresponding variations, then power start to far away from the maximum points on the track so in that case the change of direction of perturbation is required, until it does not reach MPP. The advantages of this method are It is a basic algorithm, It implementation cost is low, It’s simple to put into action, It is more accurate method, I does not consist complex circuit and It gives better efficiency under constant irradiance and Temperature.



The method’s drawbacks are follows It has no way of knowing when it has arrived at the MPP. The output power oscillates about the MPP in steady-state operation, If the voltage is far from MPP, this method takes a long time to discover it and Power is also lost as a result of disturbance, and it fails to track power under changing atmospheric conditions.

3.3 Incremental Conductance Method

"Implementing the perturbation and observation method is simple because it only increases or decreases reference voltage. However, this method cannot readily track any immediate and rapid change in the environment. One alternative is the incremental conductance method. The Perturb occur oscillation around the peak power point when tracking point reach peak power point. It is overcome by INC method and this method also helps to track the peak power under fast varying atmospheric conditions The Incremental Conductance can tell when the MPPT has reached the MPP and when it's time to quit perturbing the maximum point (operating point). If this condition is not match, The MPP can be calculated with the help of the relation between (Rate of change of conductance) dI/dV and (negative of the conductance)-I/V.



The incremental conductance method is based on the fact that the slope of the PV array of the power curve is positive on the left region side of the MPP and negative on the right region side on the MPP and is zero at the MPP.If the MPP is on the right side of the region, di/dv -i/v and the PV voltage must be decreased to reach the MPP. To determine the best MPP INC method to apply, we must first determine how to improve PV efficiency, reduce power loss, and lower system costs but its circuit is so complicated.

It's advantages are follows It is capable of detecting variations in irradiation and shifting its MPP value by altering the duty cycle, It tracking efficiency is best under rapid temperature and rapid irradiance perturbations, This approach aids in the reduction of oscillation at the MPP point, The system power loss is reduced.

Its disadvantages are the computational time is longer due to the slower sampling frequency, the algorithm's higher complexity when compared to the P&O approach, it tracking efficiency is low under constant temperature and constant irradiance perturbations and under high result of power output minimum oscillation will take place

4 Simulation

4.1 Design of Perturb & Observe Method

In this paper only, the design of Perturb & Observe method has been discussed. This modelling and simulation of this method has been introduced and carryout in the MATLAB/ SIMULINK. For a resistive load R=10, the MPPT of a solar photovoltaic system was simulated using the P & O algorithm with a buck dc-dc converter. The property of a buck converter is that it produces a lower output voltage based on the duty cycle (D) provided to its gate input of an IGBT in the buck converter, so that the duty cycle of the converter may be changed to obtain maximum power at load whenever the temperature or irradiance varies. MATLAB simulation model is of photovoltaic system with MPPT controller is shown in fig.4.The simulation was carried out for a movement change in solar irradiance (w/m2) from 1000w/m2, 800w/m2, 600w/m2, 400w/m2, 200w/m2 for different temperature values such as 45 ℃, 40 ℃, 30 ℃, 35 ℃, 25 ℃ under varied conditions.

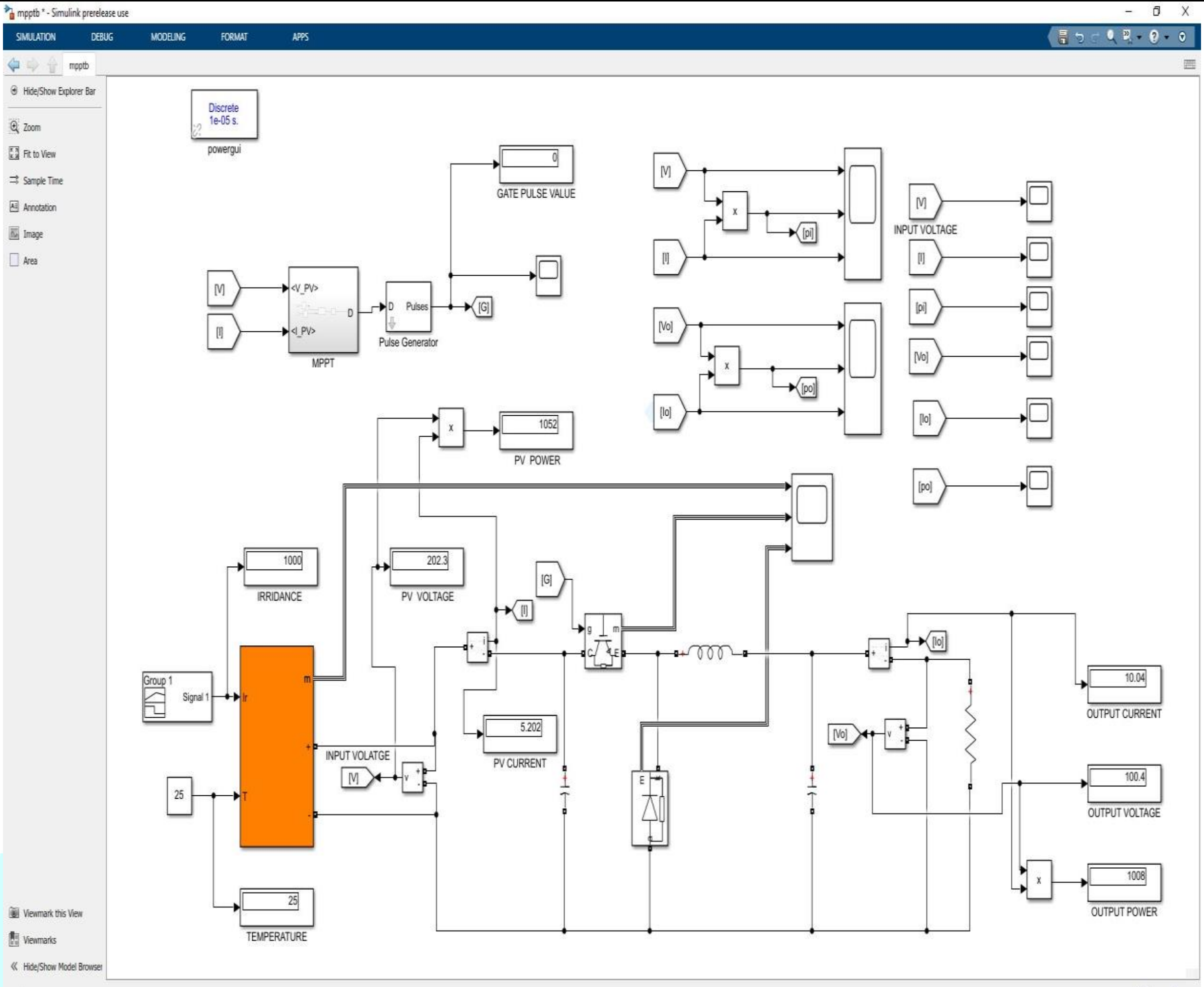


Fig. 4 SIMULINK model of MPPT System using Perturb & Observe Method Algorithm

5 Result

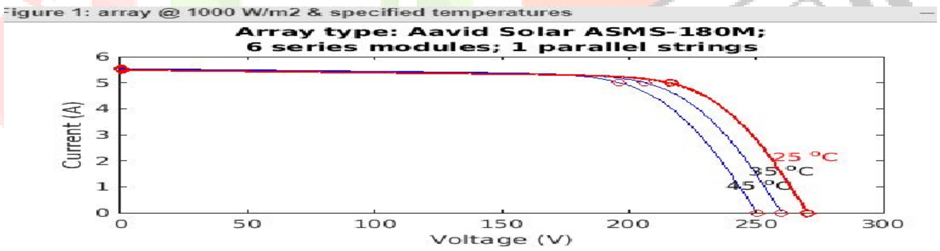


Fig. 5 Variation of Voc with temperature at constant irradiance

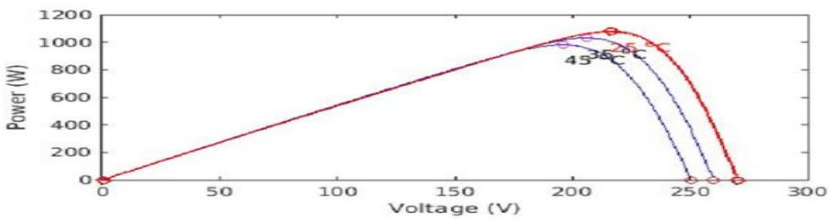


Fig. 6 Variation of MPP with the temperature at constant irradiance

It is concluded from the fig 5 & 6 above is when we are keeping our irradiance constant and increases temperature from 25℃ to 45℃, Isc is almost constant, and voc from 270 to 250V and increase in temperature will also result in a decrease of maximum power output, it shows that the solar panel efficiency decreases with increase in temperature.

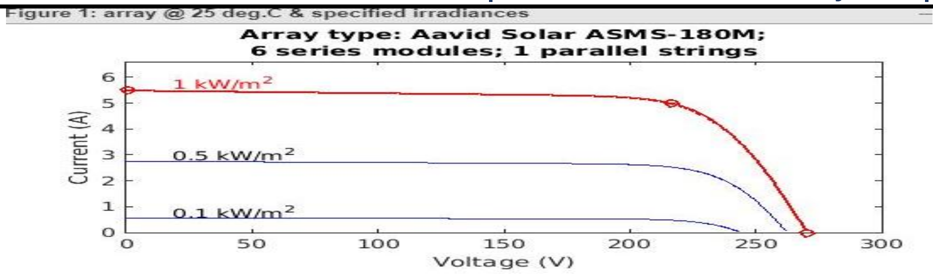


Fig. 7 Variations of Isc at with Solar Irradiances at Constant Temperature

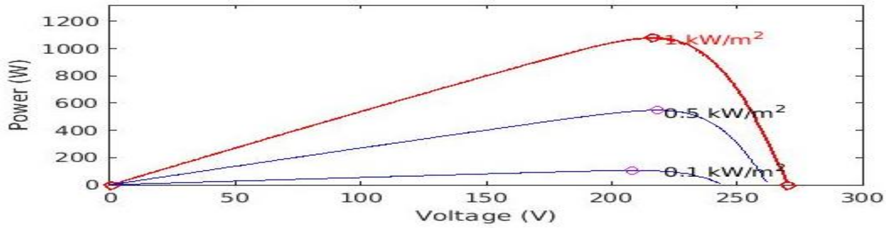


Fig. 8 Variations of Voc at with solar irradiance at Constant Temperature

It is concluded from Fig 7&8 when we are increasing the value of irradiance, keeping the temperature constant. It can be concluded from the graph that with an increase in irradiance Voc, Isc both are increasing and also maximum power output also increases with an increase in irradiance.

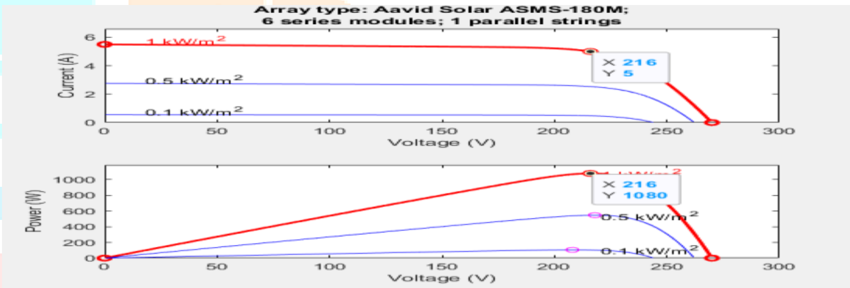


Fig. 9 Solar panel p-v and i-v curve

It is Concluded from the graph, the max power can be obtained from our PV array ASMS-180 M is 1.08kw, and that can be obtained at 216V, which corresponds to the value of current of 5 amp.

Case I When Solar Irradiance=1000 w/m2 and Temperature=25 °C

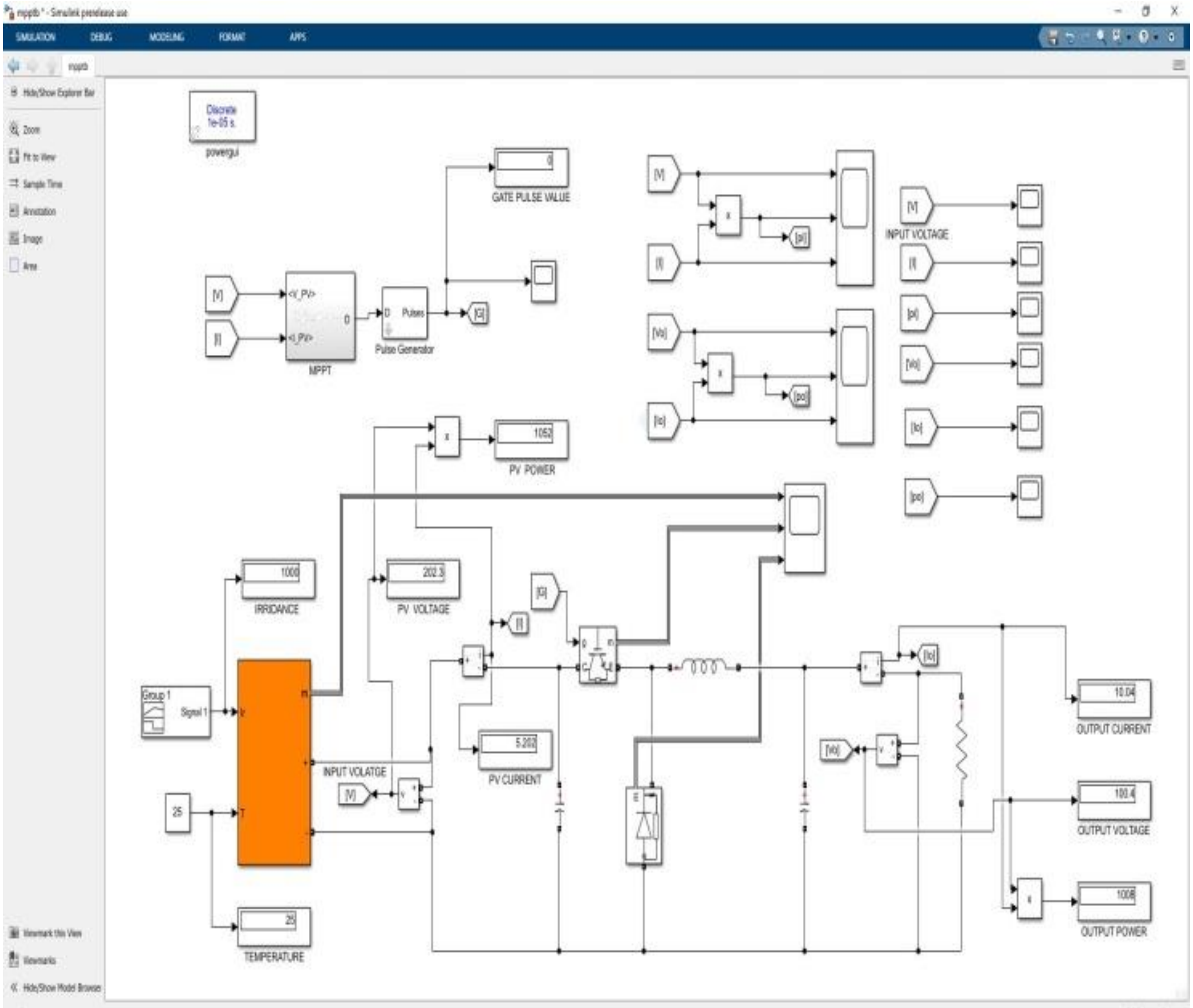


Fig.10 Simulink model of MPPT System using Perturb & Observe Method Algorithm

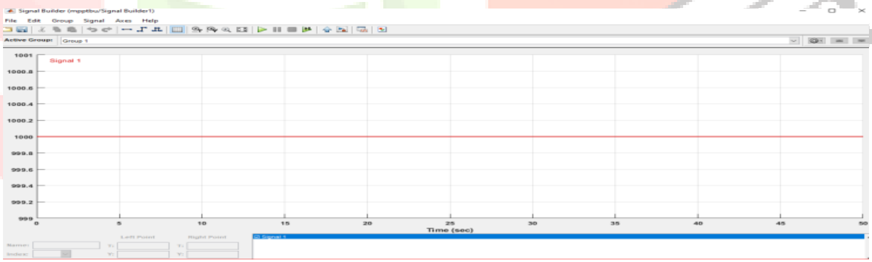


Fig.11 when Signal is given at Irradiance value of 1000 ($w/m2$)

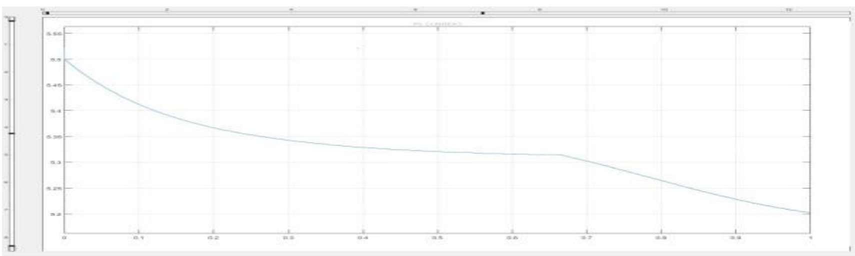


Fig.12 (a)

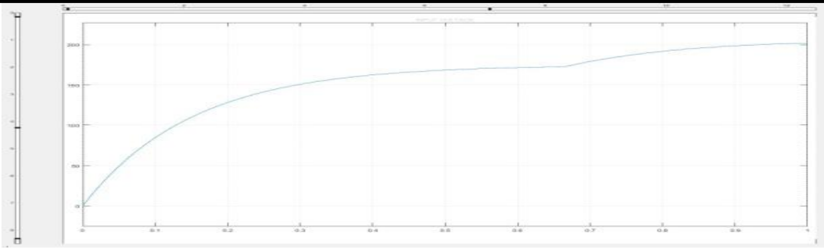


Fig.12 (b)

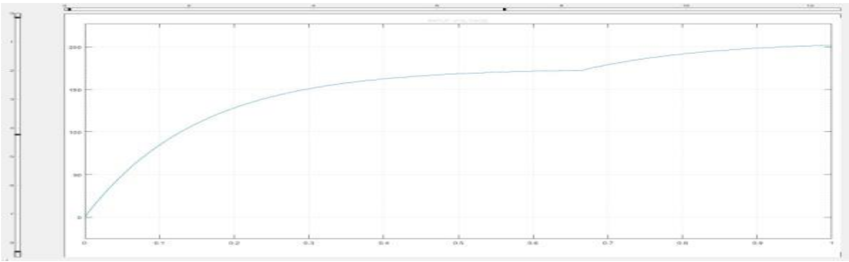


Fig.12 (c)

Fig.12 (a), (b), (c) Input current, voltage, power waveforms w.r.t time

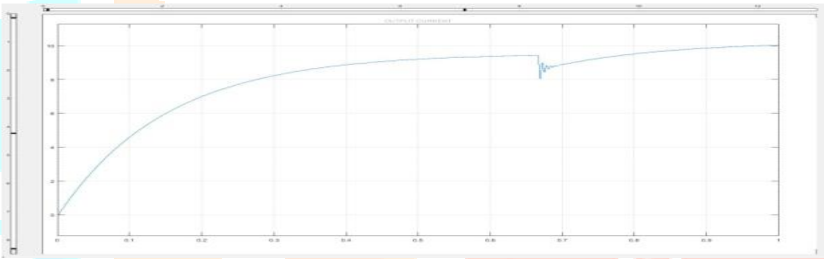


Fig.13 (a)

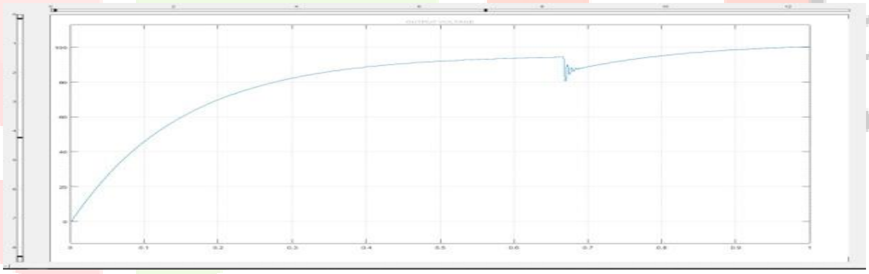


Fig.13 (b)

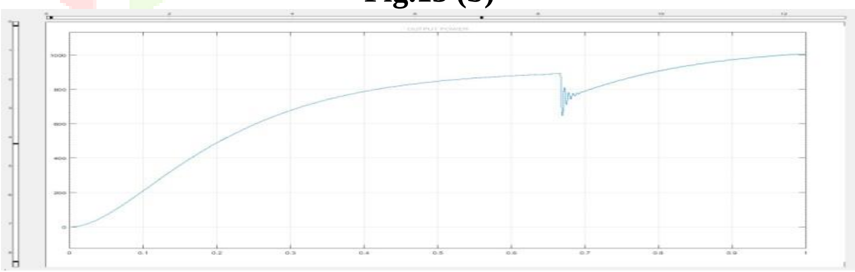


Fig.13 (C)

Fig.13 (a), (b), (c) Output current, voltage, power waveforms w.r.t time

Table 1 Simulation results with Irradiance ($w/m2$) at Constant Temperature at 25 ℃

Irradiance	Photovoltaic current	Photovoltaic voltage	Photovoltaic power	O/P current	O/P voltage	O/P power
1000	5.20	202.3	1052	10.04	100.4	1008
800	4.20	164.9	703.2	8.16	81.6	667.3
600	3.22	125.1	403.7	6.17	61.7	381.6
400	2.17	84.53	183.5	4.15	41.5	172.3
200	1.09	43.32	47.42	2.09	20.91	43.71

Case ii When Solar Irradiance=1000 w/m2 and Temperature=45 ℃

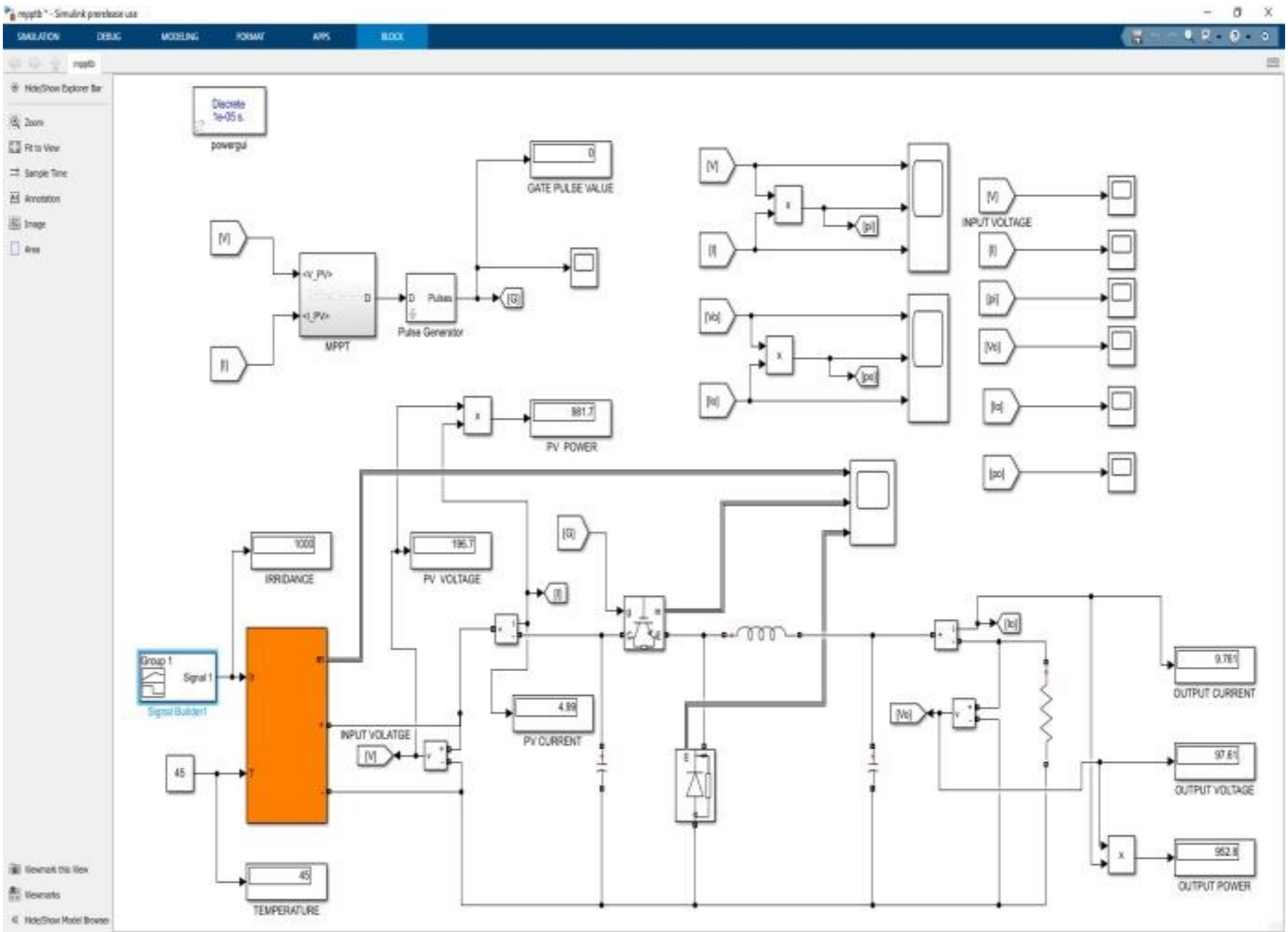


Fig.14 Simulink model of MPPT System using Perturb & Observe Method Algorithm

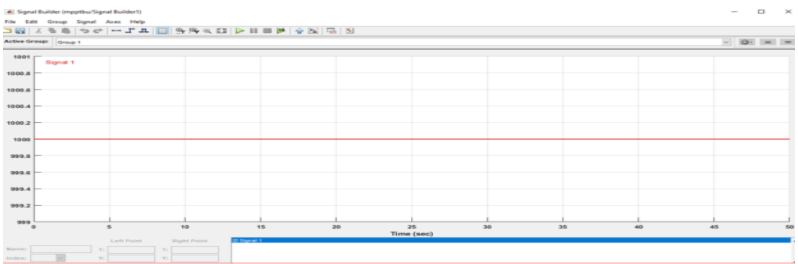


Fig.15 when Signal is given at Irradiance value of 1000 ($w/m2$)

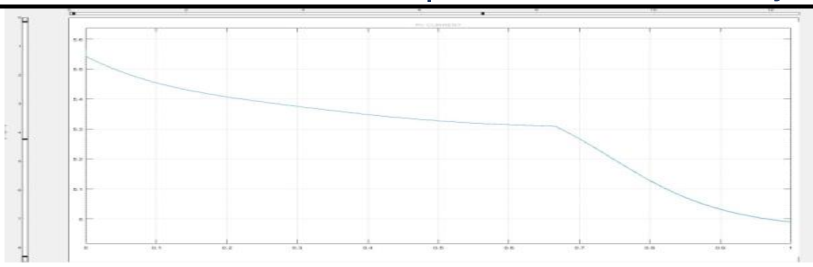


Fig.16 (a)

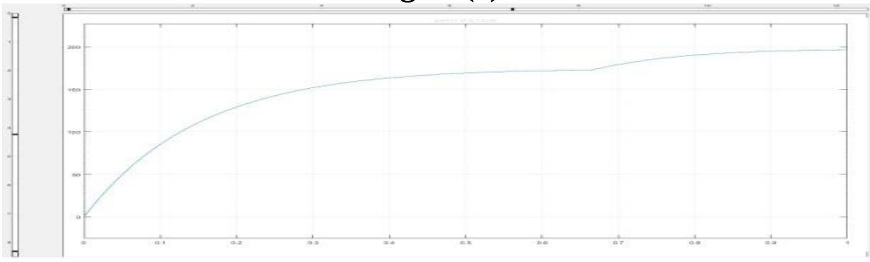


Fig.16 (b)

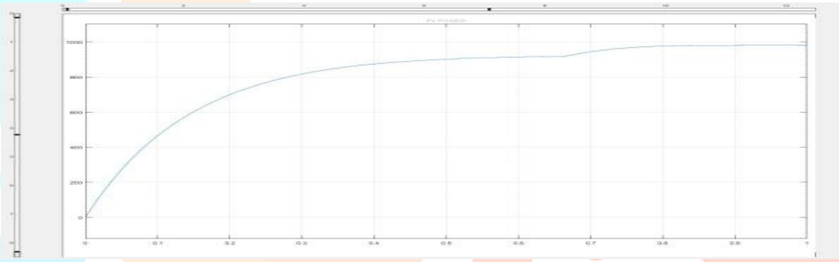


Fig.16 (c)

Fig.16 (a), (b), (c) Input current, voltage and power waveforms w.r.t time

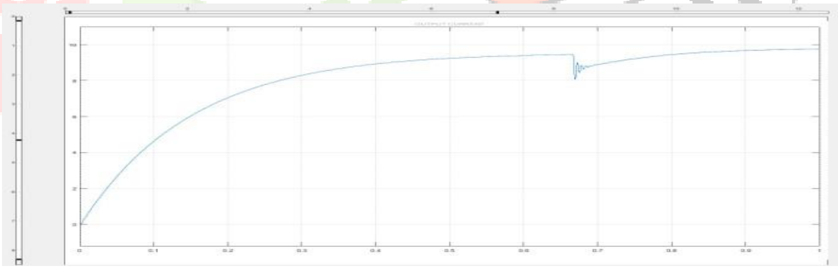


Fig.17 (a)

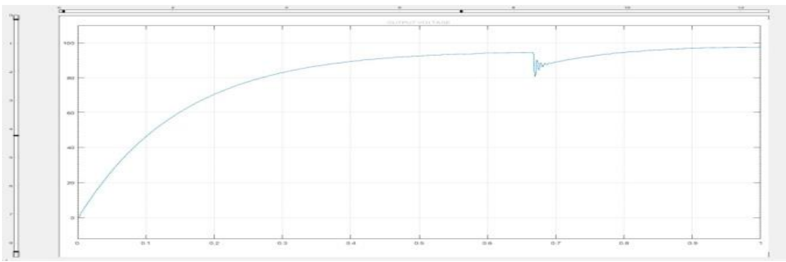


Fig.17 (b)

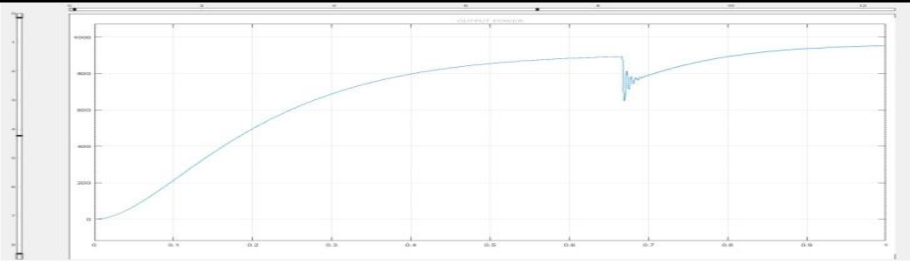


Fig.17 (C)

Fig.17 (a), (b), (c) Output current, voltage and power w.r.t time

Table 2 Simulation results with Irradiance ($w/m2$) at Constant Temperature at 45 ℃

Temperature	Photovoltaic current	Photovoltaic voltage	Photovoltaic power	O/P current	O/P voltage	O/P power
45	4.9	196.7	981.7	9.7	97.6	952.8
40	5.05	198.8	1006	9.8	98.6	972.9
35	5.10	200.4	1026	9.9	99.4	988.8
30	5.16	201.5	1041	10	100	1000
25	5.2	202.3	1052	10.04	100.4	1008

Case iii When Solar Irradiance=800 $w/m2$ and Temperature=30 ℃

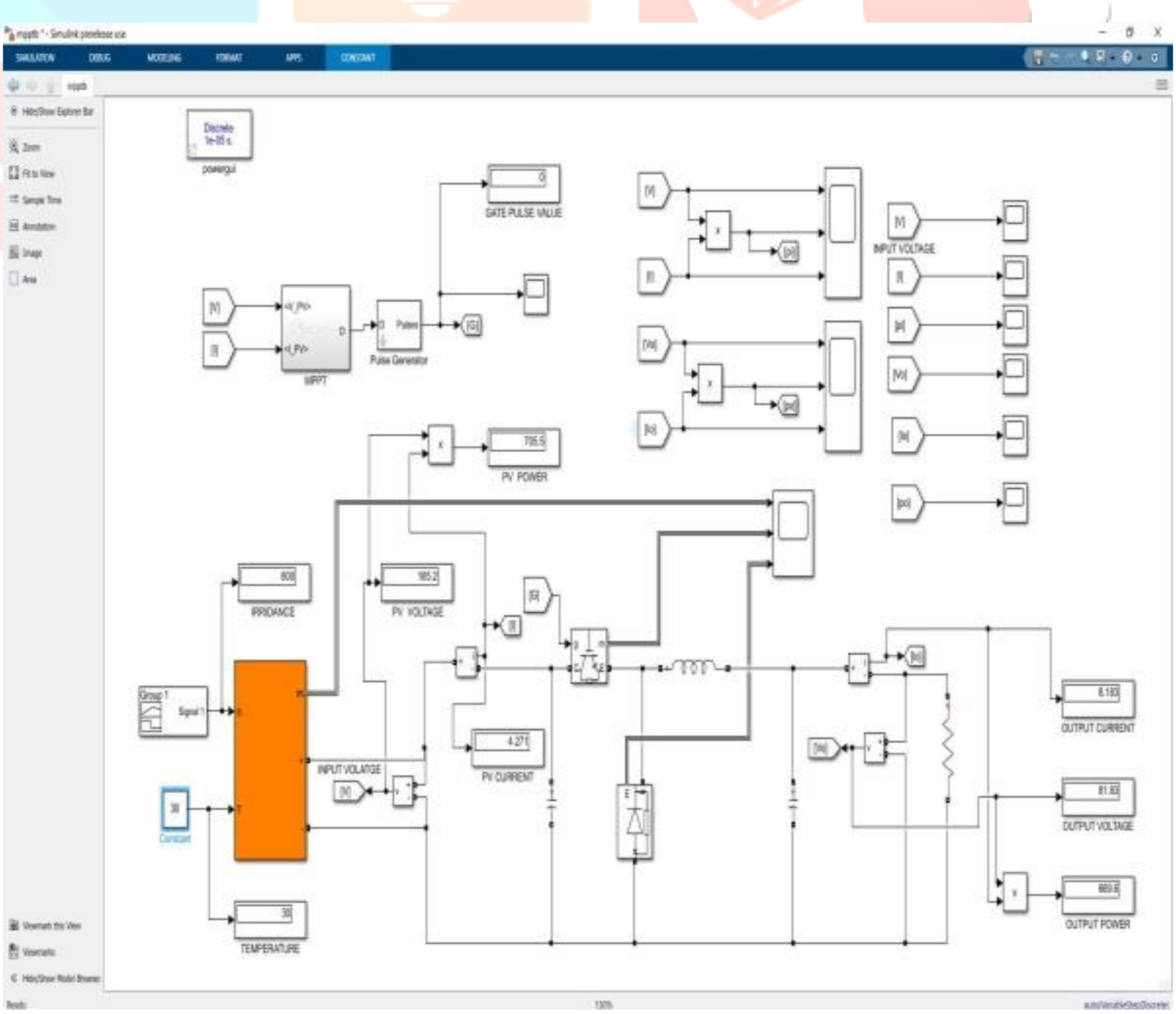


Fig.18 Simulink model of MPPT System using Perturb & Observe Method Algorithm

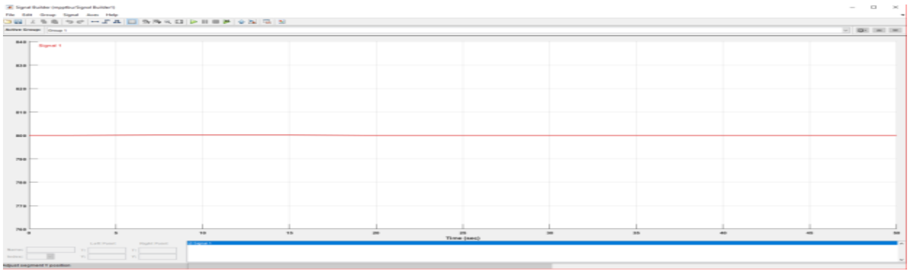


Fig.19 when Signal is given at Irradiance value of 1000 ($w/m2$)

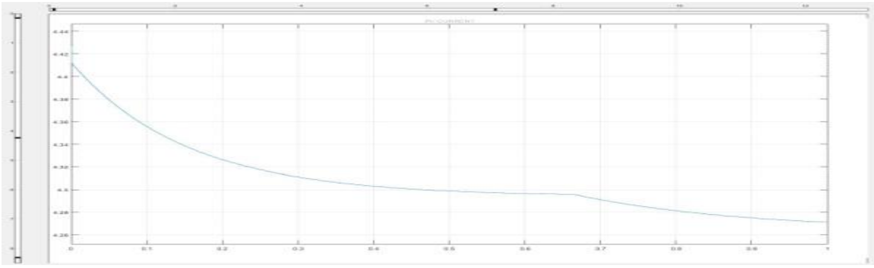


Fig.20 (a)

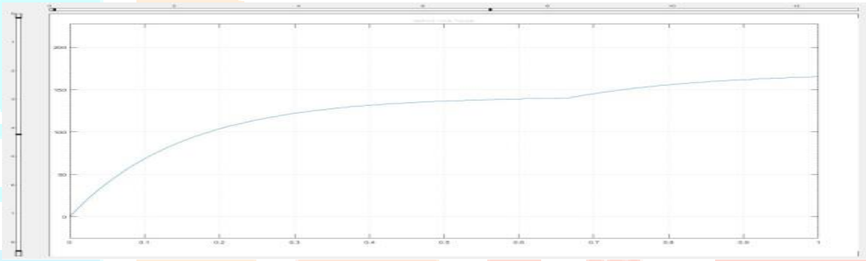


Fig.20 (b)

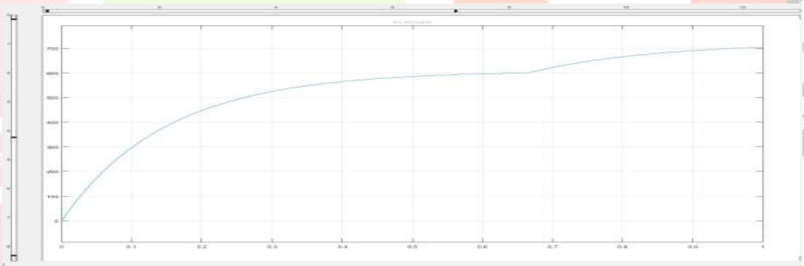


Fig.20 (C)

Fig.20 (a), (b), (c) Input current, current and voltage w.r.t time

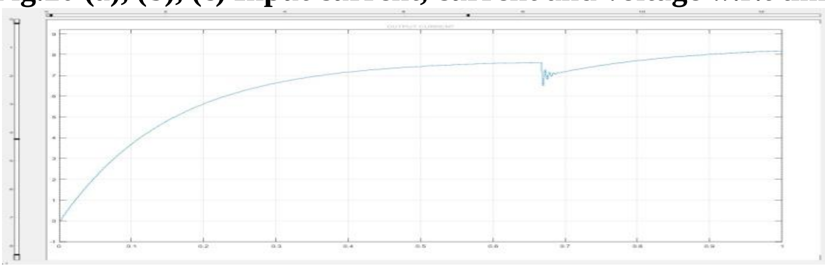


Fig.21 (a)

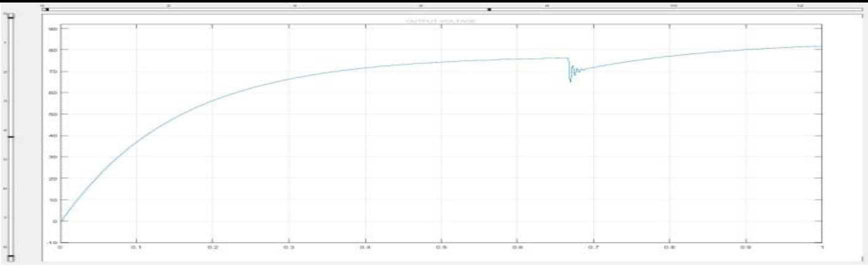


Fig.21 (b)

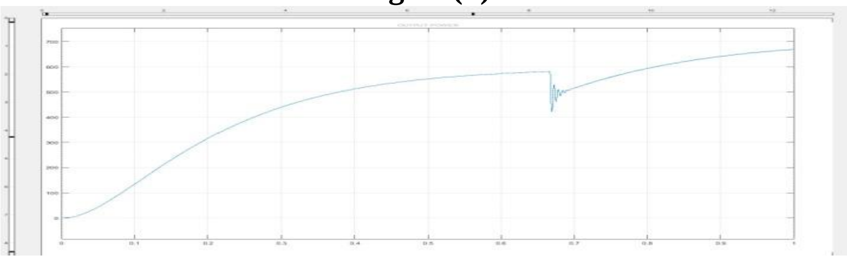


Fig.21 (C)

Fig.21 (a), (b), (c) Output current, voltage and power w.r.t time

Table 3 Simulation results with Irradiance ($w/m2$) and Temperature °C

Irradiance	Temp	Photovoltaic current	Photovoltaic voltage	Photovoltaic power	O/P current	O/P voltage	O/P power
1000	25	5.2	202.3	1052	10.04	100.4	1008
800	30	4.2	165.2	705.5	8.1	81.8	669.6
600	35	3.2	125.5	406.8	6.2	62.02	384.6
400	40	2.1	85.01	185.6	4.1	41.7	174.3
200	45	1.1	43.64	48.15	2.1	21	44.3

Case iv When Solar Irradiance=200 w/m2and Temperature=25 °C

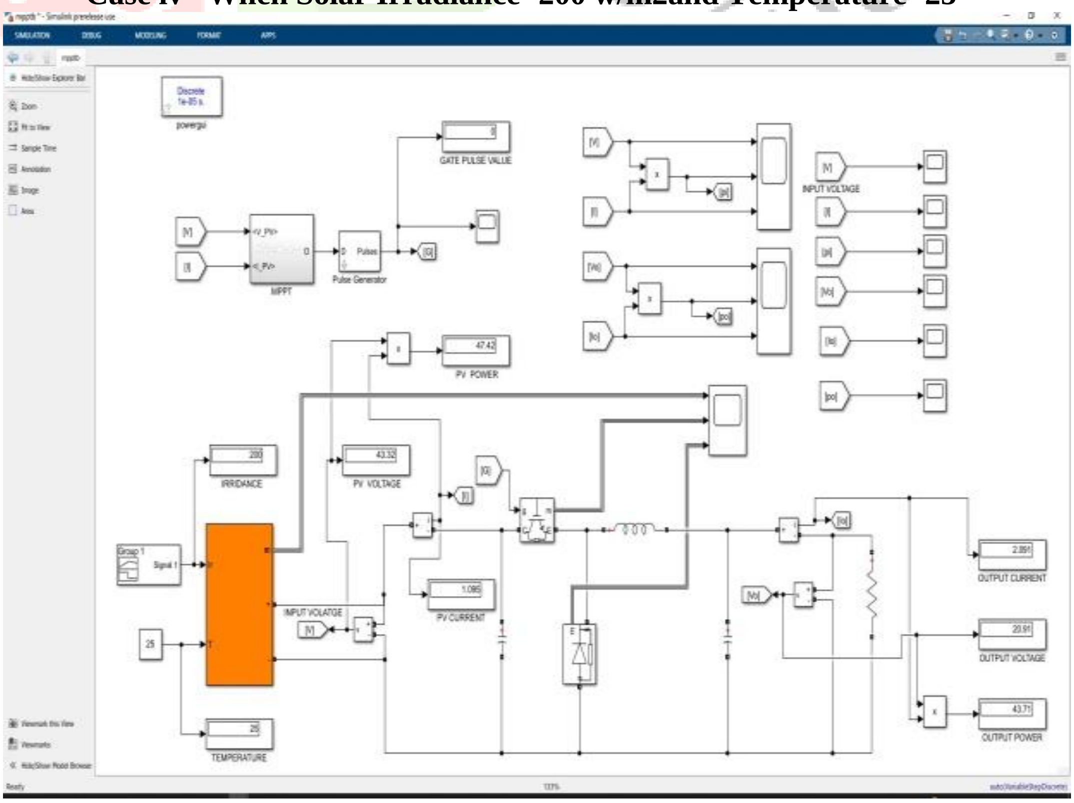


Fig.22 Simulink model of MPPT System using Perturb & Observe Method Algorithm

Fig.23 when Signal is given at Irradiance value of 1000 ($w/m2$)

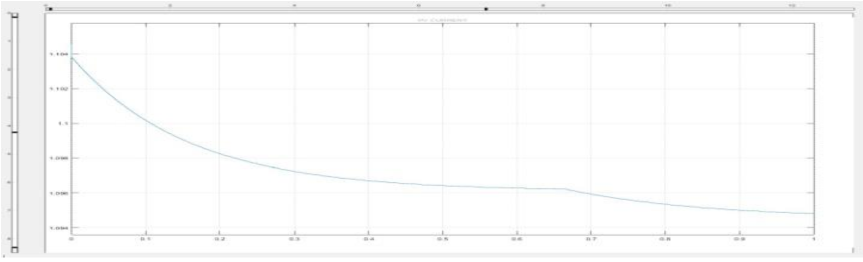


Fig.24 (a)

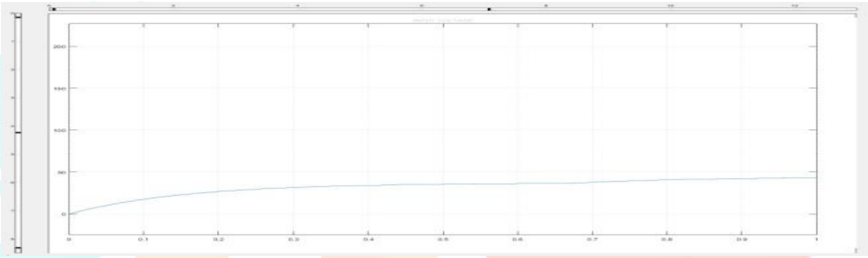


Fig.24 (b)

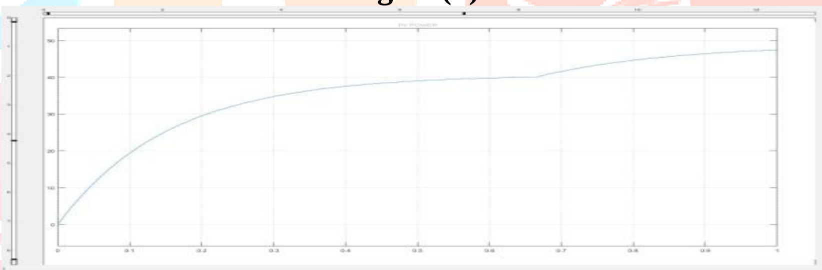


Fig.24 (C)

Fig.24 (a), (b), (c) Input current, voltage and power w.r.t time

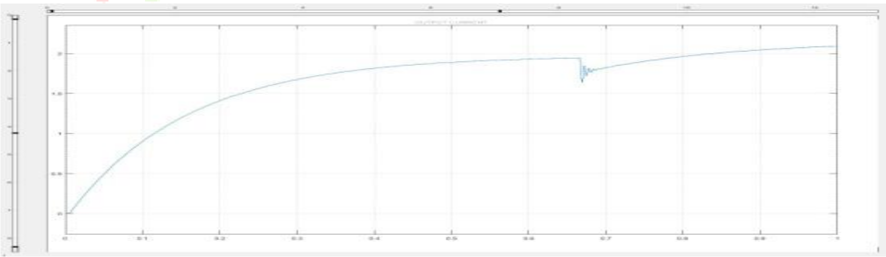


Fig. 25(a)

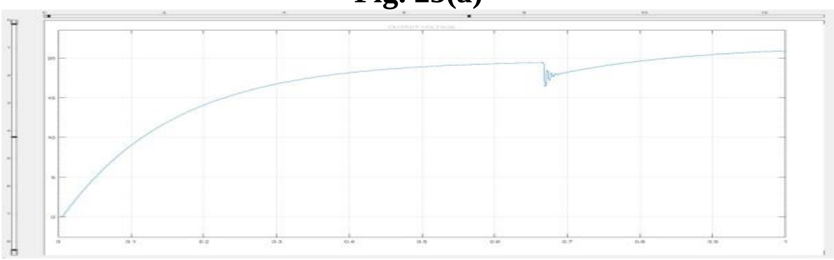


Fig.25 (b)

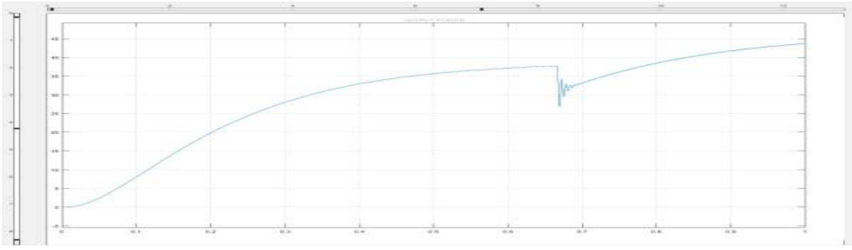


Fig.25 (C)

Fig.25 (a), (b), (c) Output current, voltage and power w.r.t time.

Table 4 Simulation results with Irradiance (w/m2) and Temperature (℃)

Irradiance	Temp	Photovoltaic current	Photovoltaic voltage	Photovoltaic power	O/P current	O/P voltage	O/P power
200	25	1.09	43.3	47.4	2.09	20.9	43.71
400	30	2.1	84.6	184.2	4.1	41.5	173
600	35	3.2	125.5	406.8	6.2	62.02	384.6
800	40	4.2	165.6	708.8	8.2	82.05	673.3
1000	45	4.9	196.7	981.7	9.7	97.6	952.8

6. Discussion

6.1 Discussion of Perturb & observe method

Case i When Solar Irradiance=1000W/m2 and Temperature=25 ℃

The SIMULINK model of MPPT for a PV System working with a Buck Converter using Perturb and Observe algorithm with the value of irradiance 1000 w/m2 and for temperature25 ℃ as shown in Fig10, Accordingly the value of input current, voltage and power are found, and output current, voltage and power are found during the running of P & O method algorithm. The magnitude of the signal is taken as 1000 w/m2, as shown in Fig 11. The Input current, voltage & power waveform obtained with respect to time as shown in Fig 12 (a), (b), (c) for irradiance=1000 w/m2 and for temperature=25 ℃. Now The Output current, voltage and power waveform were obtained with respect to time as shown in Fig 13 (a), (b), (c) for irradiance=1000 w/m2 and for temperature=25 ℃.The system has been designed for a duty cycle of 0.61.Hence, the input voltage of 202.3 V has been reduced to 100.4 V under standard conditions, i.e. 1000 w/m2 irradiance and 25 ℃ temperature. It can be seen and noticed that the current, voltage and power are at their maximum at 1000 w/m2 and 25 ℃ whose magnitude is highest as reflected & matched as shown in Table 1. It is also noticed that the input PV current value is less than the output current for different irradiance. Similarly, the input PV voltage value is greater than the output voltage for different irradiance. It has been observed that the value of input PV power and out power also decreases as the value of irradiance decreases. The maximum value of output power obtained is 1008 w under value of irradiance=1000 w/m2 and for temperature=25 ℃

Case ii When Solar Irradiance=1000W/m2 and Temperature=45 ℃

The SIMULINK model of MPPT for a PV System working with a Buck Converter using Perturb and Observe algorithm with the value of irradiance=1000w/m2 and for temperature=45 ℃ as shown in Fig 14, Accordingly the value of input current, voltage and power are found, and output current, voltage and power are found during the running of P & O method algorithm. The magnitude of the signal is taken as 1000 w/m2

, as shown in Fig 15. The Input current, voltage and power waveform obtained with respect to time as shown in Fig 16 (a), (b), (c) for irradiance=1000 w/m2 and for temperature=45 ℃. Now The Output current, voltage and power waveform were obtained with respect to time as shown in Fig 17 (a), (b), (c) for irradiance=1000 w/m2 and for temperature=45 ℃.The system has been designed for a duty cycle of 0.61.Hence, the input voltage of 196.7 V has been reduced to 97.6 V under high temperature conditions, i.e. 1000 w/m2 irradiance and 45 ℃ temperature. It can be seen and noticed that the current, voltage and power are at their maximum at 1000 w/m2 and 45 ℃,whose magnitude is lowest as reflected & matched as shown in Table 2.It is also noticed that the input PV current value is less than the output current for constant irradiance 1000 (w/m2). Similarly, the input PV voltage value is greater than the output voltage for Constant irradiance 1000 w/m2. It has been observed that the value of input PV power and out power also increases as the value of temperature decreases. The maximum value of output power obtained is 952.8 V under value of irradiance=1000 w/m2 and for temperature=45 ℃.

Case iii When Solar Irradiance=800 w/m2 and Temperature=30 ℃

The SIMULINK model of MPPT for a PV System working with a Buck Converter using Perturb and Observe algorithm with a value of irradiance=800 w/m2 and for temperature=30 ℃ as shown in Fig 18, Accordingly the value of input current, voltage and power are found and output current, voltage and power are found during the running of P & O method algorithm. The magnitude of the signal is taken as 800 w/m2, as shown in Fig 19. The Input current, voltage and power waveform were obtained with respect to time as shown in Fig 20 (a), (b), (c) for irradiance=800 w/m2and for temperature=30 ℃. Now The Output current, voltage and power waveform were obtained with respect to time as shown in Fig 21 (a), (b), (c) for irradiance=800 w/m2 and for temperature=30 ℃.The system has been designed for a duty cycle of 0.61.Hence, the input voltage of 165.2 V has been reduced to 669.6 V under nominal operating temperature conditions, i.e. 800 w/m2 irradiance and 30 ℃ temperature. It can be seen and noticed that the current, voltage and power are at their maximum at 800 w/m2 and 30 ℃ whose magnitude is intermediate as reflected & matched as shown in Table 3.It is also noticed that the input PV current value is less than the output current for different irradiance (1000 w/m2, 800 w/m2 , 600 w/m2, 400 w/m2, and 200 w/m2) similarly, the input PV voltage value is greater than the output voltage for different irradiance (1000 w/m2, 800 w/m2, 600 w/m2 , 400 w/m2, and 200 w/m2). It has been observed that the value of input PV power and out power also decreases as the value of irradiance decreases. The maximum value of output power obtained is 1008 undervalue of irradiance=1000 w/m2 and for temperature=25 ℃ and the minimum value of output power obtained is 44.3 under value of irradiance= 200 w/m2 and for temperature=45 ℃.

Case IV When Solar Irradiance=200 w/m2 and Temperature=25 ℃

The SIMULINK model of MPPT for a PV System working with a Buck Converter using Perturb and Observe algorithm with a value of irradiance=200 w/m2 and for temperature=25 ℃ as shown in Fig 22, Accordingly the value of input current, voltage and power are found and output current, voltage and power are found during the running of P & O method algorithm. The magnitude of the signal is taken as 200 w/m2, as shown in Fig 23. The Input current, voltage and power waveform were obtained with respect to time as shown in Fig 24 (a), (b), (c) for irradiance=200 w/m2 and for temperature=25 ℃. Now The Output current, voltage and power waveform were obtained with respect to time as shown in Fig 25 (a), (b), (c) for irradiance=200 w/m2 and for temperature=25 ℃.The system has been designed for a duty cycle of 0.61.Hence, the input voltage of 43.32V has been reduced to 20.91V under low standard conditions, i.e. 200 w/m2 irradiance and 25 ℃ temperature. It can be seen and noticed that the current, voltage and power are at their maximum at 200 w/m2 and 25 ℃ whose magnitude is intermediate as reflected & matched as shown in Table 4.It is also noticed that the input PV current value is less than the output current for different irradiance (200, 400, 600, 800, and 1000 w/m2) similarly, the input PV voltage value is greater than the output voltage for different irradiance (200, 400, 600, 800, and 1000 w/m2). It has been observed that the value of input PV power and out power also increases as the value of irradiance increases. The maximum value of output power obtained is 952.8 under value of irradiance=1000 w/m2 and for temperature=45 ℃ and the minimum value of output power obtained is 43.71 under value of irradiance= 200 w/m2 and for temperature=45 ℃.

7 Conclusion

In the end, this Paper demonstrates an effective photovoltaic system capable of tracking the highest power point utilizing perturbations and the observed technique. The simulation results in MATLAB are used to discuss the tracking accuracy and performance efficiency in depth. It has been noted that the current, voltage and power are at their maximum at 1000W/m2 and 25 °C at standard temperature conditions. Perturb and observe method is better where ambient temperature and incident solar radiation are almost constant throughout the day. Finally, it is concluded that in terms of its applications point of view the P&O is easy implementation and low cost in comparison to INC method under constant temperature and solar radiation.

The perturb and observe method has been implemented on SIMULINK/ MATLAB for has advocated for a gradual reduction in sun irradiation from current levels from 1000 to 200 w/m2 for various temperature levels, as follows changes from 45 °C to 25 °C It is noticed that the maximum value of output power obtained under value of irradiance 1000w/m2 and for temperature at 25 °C.There is a slightly decrease in the value of output power when the temperature will increase from 25 °C to 45 °C under value of constant irradiance 1000 w/m2 .Again it has been noticed that when there is variation of both irradiance and temperature such that an decrease of irradiance value and increase in temperature value will result in rapidly decrease of output power. Similarly, when there is variation of both irradiance and temperature such that an increase of irradiance value and increase in temperature value will result in rapidly increase of output power. It has been determined that Perturb and observe method is most efficient where constant temperature and constant incident solar radiation are almost throughout the day.

References

- Hairul Nissah Zainudin, Saad Mekhilef (2010) Comparison Study of Maximum Power Point Tracker Techniques for PV Systems.
- Ananya Dutta, Niloy Barua, Aninda Saha,(2016) "Design of an Arduino based Maximum Power Point Tracking (MPPT) Solar Charge Controller."
- Aichadjalab, Mohamed Mounir Rezauoiu, Ali Teta (2018) Comparative Study of Perturb & Observe and Incremental Conductance MPPT Methods for PV System.
- Ekrem Kandemir, Numan S. Cetin, Selim Borekci (2017) A Comparison of Perturb & Observe and Fuzzy-Logic Based MPPT Methods for Uniform Environment Conditions.
- I. William Christopher and Dr.R. Ramesh (2013) Comparative Study of P&O and Inc MPPT Algorithms
- Ahteshamul Haque (2014) Maximum Power Point Tracking (MPPT) for Solar Photovoltaic System.
- U. SrikanthP.Pavan Kumar, K.V.V. Prasada (2017) Comprehensive Comparison of MPPT Algorithms with DC-DC Converters for Solar PV Array.
- Rohit Kumar, Anurag Choudhary, Govind Koundal, Amritpreet Singh, AkhilendraYadav (2017) modelling/Simulation of MPPT Techniques for Photovoltaic Systems Using MATLAB.
- Kotak, V.C. and Tyagi, P. (2013) ‘DC To DC Converter in Maximum Power Point Tracker’, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering.
- Kumari, S.J., Babu, C.S. and Professor, A. (2011) ‘Comparison of Maximum power Point Tracking Algorithms for Photovoltaic System’ International Journal of Advances in Engineering & Technology ©IJAET.
- Rahman, S., Sultana, N. and Masud, Q. (2012) Design of a Charge Controller Circuit with Maximum Power Point Tracker (MPPT) for Photovoltaic System. Thesis Report, BRAC University.
- Yadav APK, Thirumaliah S, Haritha G. (2012) Comparison of MPPT Algorithms for DC – DC Converters Based PV Systems. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering.
- Yeong-Chau K, Tsorng-Juu L, Jiann-Fuh C. Novel (2001) Maximum Power Point Tracking Controller for Photovoltaic Energy Conversion System. IEEE Transactions on Industrial Electronics.
- Esram, T.; Chapman, L. P. (2007) Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques. IEEE Trans. Energy Conv.
- Solanki S. Chetan. (2012) Solar Photovoltaics’: Fundamentals, Technologies and Applications, New Delhi, PHI.
- A. Reza Reisi, M. Hassan Moradi, and S. Jamasb, (2013) “Classification and comparison of maximum power point tracking techniques for photovoltaic system: a review,” Renewable and Sustainable Energy Reviews.

- R. G. Tapre and R. G. Deshbhratar, (2015) “Comparative study and simulation of different maximum power point tracking (MPPT) techniques in a solar power generation,” International Journal on Recent and Innovation Trends in Computing and Communication.
- S. J Deshmukh and Dr.P .B.Shelke(2017) Comparative study of perturb and observe method and Incremental conductance method under atmospheric perturbations.
- P. Bhavana and Dr.S. Janna Rubavathy (2021) Maximum power extraction in low power PV FED high voltage gain boost converter using optimization algorithm (PO & INC) by limiting the oscillations.