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MAXIMUM POWER POINT TRACKING: AN OVERVIEW

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Abstract: To increment or to amplify the output power of photo-voltaic system Maximum power point tracking (MPPT) techniques are utilized. These techniques give greatest output power, regardless of the irradiation condition, temperature and load electrical characteristics. With the end goal of tracking the greatest power the MPPT techniques utilize some electronic converters. This paper presents relative investigation of three surely understood greatest power point tracking algorithms-perturb-and-observe (P&O), incremental conductance (INC), and fractional open-circuit voltage (FVoc).
Keywords: Maximum Power Point Tracking, Pertub and Observe, Incremental Conductance, Fractional Open-circuit voltage.

I. INTRODUCTION

MPPT or Maximum Power Point Tracking is algorithm that incorporated into charge controllers utilized for separating maximum accessible power from PV module under specific conditions. The voltage at which PV module can deliver maximum power is called 'maximum power point' (or pinnacle power voltage). Maximum power changes with solar radiation, encompassing temperature and solar cell temperature.

Maximum power point following (MPPT or in some cases just PPT) is a strategy utilized ordinarily with wind turbines and photovoltaic (PV) solar frameworks to expand power extraction under all conditions.

Albeit solar power is primarily secured, the guideline applies for the most part to sources with variable power: for instance, optical power transmission and thermo-photovoltaic.

PV solar frameworks exist in a wide range of designs with respect to their relationship to inverter frameworks, outer grids, battery banks, or other electrical loads. Despite a definitive goal of the solar power, however, the focal issue tended to by MPPT is that the efficiency of power transfer from the solar cell relies on upon both the measure of daylight falling on the solar boards and the electrical qualities of the load. As the measure of daylight differs, the load trademark that gives the highest power transfer efficiency changes, so that the efficiency of the framework is enhanced when the load trademark changes to keep the power transfer at highest efficiency. This load trademark is known as the maximum power point and MPPT is the way toward discovering this point and keeping the load trademark there. Electrical circuits can be intended to show subjective loads to the photovoltaic cells and after that change over the voltage, current, or recurrence to suit different devices or frameworks, and MPPT takes care of the issue of picking the best load to be displayed to the cells keeping in mind the end goal to get the most usable power out.

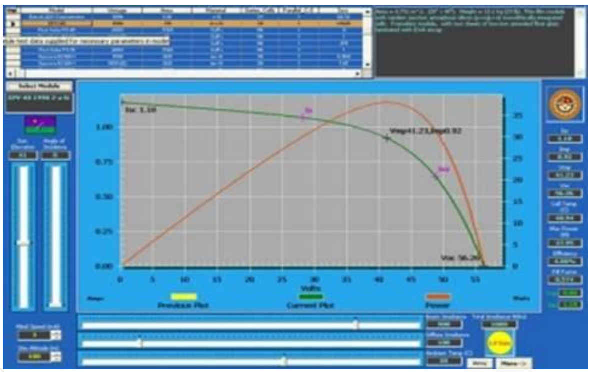

Figure 1. The I-V curves show maximum power from PV modules when exposed to irradiance 1000 W/m^2

Solar cells have a complex relationship amongst temperature and aggregate resistance that delivers a non-linear output efficiency which can be dissected in light of the I-V curve.[6][7] It is the reason for the MPPT framework to test the output of the PV cells and apply the correct resistance (load) to acquire maximum power for any given environmental conditions.[8] MPPT devices are regularly incorporated into an electric power converter framework that gives voltage or current change, sifting, and control for driving different loads, including power grids, batteries, or motors.

Figure 2 The I-V curves show maximum power from PV modules when exposed to irradiance 100 W/m^2

Solar inverters change over the DC power to AC power and may consolidate MPPT: such inverters test the output power (I-V curve) from the solar modules and apply the best possible resistance (load) in order to acquire maximum power.

As the graphs in figure 1 and 2., we see that at the different solar radiations, PV modules deliver the variations in parameters as follows:

(1) Maximum power; Pm
(2) Maximum power voltage; Vpm
(3) Open circuit voltage; Voc
(4) Maximum power current; Ipm
(5) Short circuit current; Isc

II. BASIC WORKING OF MPPT

The major standard of MPPT is to remove the maximum accessible power from PV module by making them work and no more effective voltage (maximum power point). That is to state:

MPPT checks output of PV module, looks at it to battery voltage then fixes what is the best power that PV module can deliver to charge the battery and believers it to the best voltage to get maximum current into battery. It can likewise supply power to a DC load, which is associated specifically to the battery.

MPPT is best under these conditions:

- Cold weather, cloudy or hazy days: Normally, PV module works better at icy temperatures and MPPT is used to concentrate maximum power accessible from them.
- When battery is deeply discharged: MPPT can remove more present and charge the battery if the state of charge in the battery is brings down.

III. MPPT IMPLEMENTATION

At the point when a load is straightforwardly associated with the solar panel, the operating point of the panel will once in a while be at peak power. The impedance seen by the panel infers the operating point of the solar panel. In this manner by shifting the impedance seen by the panel, the operating point can be moved towards peak power point. Since panels are DC devices, DC-DC converters must be utilized to transform the impedance of one circuit (source) to the next circuit (load). Changing the duty ratio of the DC-DC converter brings about an impedance change as observed by the panel. At a specific impedance (or duty ratio) the operating point will be at the peak power transfer point. The I-V curve of the panel can shift extensively with variety in climatic conditions, for example, brilliance and temperature. Therefore it is not practical to settle the duty ratio with such powerfully changing operating conditions.

MPPT usage utilize algorithms that as often as possible specimen panel voltages and streams, then change the duty ratio as required. Microcontrollers are utilized to execute the algorithms. Present day executions regularly utilize bigger computers for analytics and load forecasting.

IV. CLASSIFICATION

Controllers can take after a few techniques to streamline the power output of an array. Maximum power point trackers may execute distinctive algorithms and switch between them in view of the operating conditions of the array.

4.1 Perturb and observe

In this strategy the controller changes the voltage by a little sum from the array and measures power; if the power increments, encourage alterations toward that path are attempted until power never again increments. This is known as the petrub and observe technique and is most normal, in spite of the fact that this strategy can bring about motions of power output. It is alluded to as a slope climbing technique, since it relies on upon the rise of the curve of power against voltage beneath the maximum power point, and the fall over that point. Irritate and observe is the most generally utilized MPPT strategy because of its simplicity of usage. Bother and observe technique may bring about top-level efficiency, gave that an appropriate prescient and versatile slope climbing methodology is received.

4.2 Incremental conductance

In the incremental conductance technique, the controller measures incremental changes in PV array current and voltage to foresee the impact of a voltage change. This strategy requires more calculation in the controller, yet can track changing conditions more quickly than the petrub and observe technique (P&O). Like the P&O algorithm, it can deliver motions in power output. This technique utilizes the incremental conductance (dI/dV) of the photovoltaic array to figure the indication of the adjustment in power concerning voltage (dP/dV).

The incremental conductance technique registers the maximum power point by comparison of the incremental conductance (Iδ/Vδ) to the array conductance (I/V). At the point when these two are the same (I/V = Iδ/Vδ), the output voltage is the MPP voltage. The controller keeps up this voltage until the illumination changes and the procedure is rehashed.

The incremental conductance strategy depends on the perception that at the maximum power point dP/dV = 0, and that P = IV. The current from the array can be communicated is a component of the voltage: P = I(V)V. Therefore dP/dV = VdI/dV + I(V). Setting this equivalent to zero yields: dI/dV = - I(V)/V. Therefore, the maximum power point is accomplished when the incremental conductance is equivalent to the negative of the immediate conductance.

4.3 Current sweep

The current sweep strategy utilizes a sweep waveform for the PV array current with the end goal that the I-V characteristic of the PV array is acquired and refreshed at fixed time interims. The maximum power point voltage can then be figured from the characteristic curve at similar interims.

1.4.4 Constant voltage

The expression "constant voltage" in MPP following is utilized to depict distinctive systems by various authors, one in which the output voltage is managed to a constant incentive under all conditions and one in which the output voltage is directed in light of a constant ratio to the deliberate open circuit voltage (VOC). The last system is alluded to interestingly as the "open voltage" strategy by some authors.[22] If the output voltage is held constant, there is no endeavor to track the maximum power point, so it is not a maximum power point following procedure in a strict sense, however it has a few favorable circumstances in situations when the MPP following has a tendency to come up short, and therefore it is some of the time used to supplement a MPPT technique in those cases.

In the "constant voltage" MPPT technique (otherwise called the "open voltage strategy"), the power conveyed to the load

is momentarily interrupted and the open-circuit voltage with zero current is measured. The controller then continues operation with the voltage controlled at a fixed ratio, for example, 0.76, of the open-circuit voltage VOC. This is generally an esteem which has been resolved to be the maximum power point, either experimentally or in view of displaying, for expected operating conditions. The operating point of the PV array is therefore kept close to the MPP by directing the array voltage and coordinating it to the fixed reference voltage Vref=kVOC. The estimation of Vref might be likewise given ideal performance in respect to different factors and in addition the MPP, yet the focal thought in this method is that Vref is resolved as a ratio to VOC.
One of the inherent approximations to the "constant voltage" ratio strategy is that the ratio of the MPP voltage to VOC is just around constant, so it leaves space for further conceivable enhancement.

V. CONCLUSION

This paper gives a complete idea about the MPPT algorithm, how its implemented and its classification. Our main motive is to let the readers know the complete overview about the MPPT.

REFERENCES

[1] Seyedmahmoudian, M.; Horan, B.; Soon, T. Kok; Rahmani, R.; Than Oo, A. Muang; Mekhilef, S.; Stojcevski, A. (2016-10-01). "State of the art artificial intelligence-based MPPT techniques for mitigating partial shading effects on PV systems – A review". Renewable and Sustainable Energy Reviews. 64: 435–455. doi:10.1016/j.rser.2016.06.053.

[2] Seyedmahmoudian, Mehdi; Horan, Ben; Rahmani, Rasoul; Maung Than Oo, Aman; Stojcevski, Alex (2016-03-02). "Efficient Photovoltaic System Maximum Power Point Tracking Using a New Technique". Energies. 9 (3): 147. doi:10.3390/en9030147.

[3] "What is Maximum Power Point Tracking (MPPT)".

[4] "A Survey of Maximum PPT techniques of PV Systems - IEEE Xplore" (PDF). Retrieved 2016-10-04.

[5] Seyedmahmoudian, M.; Rahmani, R.; Mekhilef, S.; Maung Than Oo, A.; Stojcevski, A.; Soon, Tey Kok; Ghandhari, A.S. (2015-07-01). "Simulation and Hardware Implementation of New Maximum Power Point Tracking Technique for Partially Shaded PV System Using Hybrid DEPSO Method". IEEE Transactions on Sustainable Energy. 6 (3): 850–862. doi:10.1109/TSTE.2015.2413359. ISSN 1949-3029.

[6] Seyedmahmoudian,Mohammadmehdi; Engineering, School of; Science, Faculty of; Environment, Engineering & Built; University, Deakin; Victoria; Australia; Mohamadi, Arash; Kumary, Swarna. "A Comparative Study on Procedure and State of the Art of Conventional Maximum Power Point Tracking Techniques for Photovoltaic System". International Journal of Computer and Electrical Engineering. 6 (5): 402–414. doi:10.17706/ijcee. 2014.v6.859.

[7] Seyedmahmoudian, Mohammadmehdi; Mekhilef, Saad; Rahmani, Rasoul; Yusof, Rubiyah; Renani, Ehsan Taslimi (2013-01-04). "Analytical Modeling of Partially Shaded Photovoltaic Systems". Energies. 6 (1): 128–144. doi:10.3390/en6010128.

[8] Surawdhaniwar, Sonali; Mr. Ritesh Diwan (July 2012). "Study of Maximum Power Point Tracking Using Perturb and Observe Method". International Journal of Advanced Research in Computer Engineering & Technology. 1 (5): 106–110.

[9] Seyedmahmoudian, Mohammadmehdi; Mekhilef, Saad; Rahmani, Rasoul; Yusof, Rubiyah; Shojaei, Ali Asghar (2014-03-01). "Maximum power point tracking of partial shaded photovoltaic array using an evolutionary algorithm: A particle swarm optimization technique". Journal of Renewable and Sustainable Energy. 6 (2): 023102. doi:10.1063/1.4868025. ISSN 1941-7012.

[10] "University of Chicago GEOS24705 Solar Photovoltaics EJM May 2011" (PDF).

[11] Sze, Simon M. (1981). Physics of Semiconductor Devices (2nd ed.). p. 796.

[12] Rahmani, R., M. Seyedmahmoudian, S. Mekhilef and R. Yusof, 2013. Implementation of fuzzy logic maximum power point tracking controller for photovoltaic system. Am. J. Applied Sci., 10: 209-218.

[13] "Maximum Power Point Tracking". zone.ni.com. zone.ni.com. Retrieved 2011-06-18.

[14] "ADVANCED ALGORITHM FOR MPPT CONTROL OF PHOTOVOLTAIC SYSTEM" (PDF). solarbuildings.ca. Retrieved 2013-12-19.

[15] "Comparative Study of Maximum Power Point Tracking Algorithms". doi:10.1002/pip.459.

[16] "Performances Improvement of Maximum Power Point Tracking Perturb and Observe Method". actapress.com. Retrieved 2011-06-18.

[17] Zhang, Q.; C. Hu; L. Chen; A. Amirahmadi; N. Kutkut; I. Batarseh (2014). "A Center Point Iteration MPPT Method With Application on the Frequency-Modulated LLC Microinverter". IEEE Transactions on Power Electronics. 29 (3): 1262–1274. doi:10.1109/tpel.2013.2262806.

