



Maximum Power Point Tracking for Photovoltaic Systems- Literature Review.

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ABSTRACT

This paper presents a technological literature review on Maximum Power Point Tracking for Photovoltaic Systems. An improved maximum power point tracking (MPPT) controller for PV systems. An Artificial Neural Network and the classical P&O algorithm were employed to achieve this objective. MATLAB models for a neural network, PV module, and the classical P&O algorithm are developed.

KEYWORDS

Maximum Power Point Tracking (MPPT), Photovoltaic System.

INTRODUCTION:

Photovoltaic systems are one of the direct solar energy systems. Whereas, photovoltaic systems collect light from the sun and convert it to electricity. PV systems are clean

whereas it reduces greenhouse gases, and it is non polluting. However, the typical photovoltaic system is consisted of PV modules, DC-AC inverter, charger controller and batteries. In a PV system, the PV modules generate D.C electricity which is used to charge batteries through a charge controller. Meanwhile, inverters convert the D.C current to A.C current. However, the main drawbacks of PV systems are the capital cost and the dependence on climate conditions such as solar radiation and ambient temperature.

LITERATURE REVIEW:

Mahmoud A. YOUNIS, Tamer KHATIB, Mushtaq NAJEEB, A Mohd ARIFFIN,

An improved MPPT algorithm has been proposed in this research. An Artificial Neural Network and the classical P&O algorithm were employed to achieve this objective. MATLAB models for the used neural network, the PV module, the classical P&O algorithm are developed. The improved MPPT algorithm extracts the maximum power point from the PV module corresponding with a load resistance in terms of solar radiation and ambient temperature. Simulation results showed that the response of the improved MPPT algorithm was faster than the classical P&O algorithm. Moreover, the average tracking efficiency of the developed algorithm was higher than the classical P&O algorithm [1].

Tamer KHATIB, Azah MOHAMED, In this paper a reliable maximum power point tracker for photovoltaic systems has been proposed. The new MPP controller tracks the MPP using the equivalent impedance of a load. Moreover, the response of the proposed tracker is faster than P&O method because there is no perturbation around the operation point. Such proposed controller increases the efficiency and the reliability of a photovoltaic system [2].

M. I. Arteaga Orozco, J. R. Vázquez, P. Salmerón, S. P. Litrán, F. J. Alcántara, In this paper, a sliding mode integral control of the boost converter has been analyzed. The reported controller uses the output power of the PV array, output voltage of the converter and an input signal, which in this case is the switching signal. The control law provides voltage regulation at the converter output, and guarantees the maximum power point of the PV array. A practical case developed in a Matlab/Simulink simulation platform has been presented, and the results confirm the adequate performance of designed control. Besides, the control law can be easily implemented by means of standard operational amplifiers, ana-

logue multipliers and digital devices in an experimental platform [3].

Steven L. Brunton, Clarence W. Rowley, Sanjeev R. Kulkarni, and Charles Clarkson, A novel ES algorithm that utilizes the natural inverter ripple was tested on a simulated array inverter system. This method was benchmarked against the popular PO method using 25 min of

rapidly varying irradiance data taken on June 2007 at Princeton University. The irradiance data represent a worst case scenario for MPPT due to the presence of fast moving, scattered cloud cover. It was shown that ES slightly outperforms PO in total power efficiency, and drastically outperforms in transient rise time to the maximum power point, with two orders of magnitude speed-up. Moreover, ES has guaranteed convergence and stability properties, which are ideal for variable weather conditions and unmodelled dynamics. The ES and PO algorithms are compared with voltage control and current control [4].

Sumedha Sengar, In this paper, the various MPPT algorithms has been reviewed. As has been

demonstrated, there are many ways of distinguishing and grouping the methods for tracking the MPP to the PV generator. Finally, it has been shown that other methods also exist by which MPP of PV module can be tracked [5].

Saleh Elkhalani Babaa, Matthew Armstrong, Volker Pickert, This paper presents an overview of MPPT methods, and considers their suitability in systems which experience a wide range of operating conditions. From this, it is clear that each MPPT method has its own advantages and

disadvantages and the choice are highly application-dependent. When using solar panels in residential locations, the objective is to reduce the payback time. To do so, it is necessary to constantly and quickly track the maximum power point. Furthermore, the MPPT should be capable of minimising the ripple around the MPP. Therefore, the two techniques stages—incremental conductance (IC) and perturbation and observation (P & O) algorithms are suitable. These two methods have been evaluated by simulating a standalone PV system, utilising a DC-DC boost converter to connect the PV panel to the load [6].

A. M. Zein Alabedin, E. F. El-Saadany, and M. M. A. Salama, This paper has introduced the design of two controllers for maximum power point tracking (MPPT) of PV systems using fuzzy logic and artificial neural networks. A literature review about MPPT, and the related published work was first

given. The PV system characteristics and components were presented. The design process of each controller was then thoroughly discussed. The entire PV system was simulated using Simulink models. The tracking performance of the two controllers was studied and analyzed under variable radiation levels. Fuzzy logic was found to be a simple, and easy to implement tool for MPPT. However, its transient performance was slow and included fluctuations in the output power. On the other hand, neural networks showed an excellent performance when applied with conventional P&O MPPT strategy [7].

Hussein Al-Bahadili, Hadi Al-Saadi, Riyad Al-Sayed, and M. Al-Sheikh Hasan, An MPPT controller for PV solar system is modeled in this paper using the P&O algorithm on MATLAB software. The simulated model demonstrated an excellent and flexible environment for studying various PV solar cells operating under different environments of irradiance and temperature. Many other parameters can be modeled and investigated using the same model which all left for future research. Furthermore, the same simulation approach can be equally applied to other renewable energy sources, such as the wind energy system [8].

CONCLUSION:

This Literature Review is dedicated to a comprehensive study of Maximum Power Point Tracking for Photovoltaic Systems. As a fact, each photovoltaic module has an optimum operation point, called maximum power point (MPP). This point varies depending on cell temperature, solar radiation, and load impedance. However, the MPPT is a power electronic device located between the PV modules and the loads, in order to ensure the maximum power operation. Many methods proposed in the literature to track the MPP for a PV system. MPPT is developed to avoid the oscillation in the classical P&O algorithm that compares only two points, which are the current operation and the subsequent perturbation point to observe their changes in power. Then, based on the difference in the output power the controller increase or decrease the PV module array output voltage.

REFERENCES

- [1] Mahmoud A. YOUNIS, Tamer KHATIB, Mushtaq NAJEEB, A Mohd ARIFFIN, "An Improved Maximum Power Point Tracking Controller for PV Systems Using Artificial Neural Network", Electrical Review, Malaysia, 2012. | [2] Tamer KHATIB, Azah MOHAMED, "A Reliable Maximum Power Point Tracker for Photovoltaic Systems", Electrical Review, Malaysia, 2012. | [3] M. I. Arteaga Orozco, J. R. Vázquez, P. Salmerón, S. P. Litrán, F. J. Alcántara, "Maximum power point tracker of a photovoltaic system using sliding mode control", International Conference on Renewable Energies and Power Quality (ICREPO'09) Valencia (Spain), 15th to 17th April, 2009. | [4] Steven L. Brunton, Clarence W. Rowley, Sanjeev R. Kulkarni, Fellow, IEEE, and Charles Clarkson, "Maximum Power Point Tracking for Photovoltaic Optimization Using Ripple-Based Extremum Seeking Control", IEEE Transactions on power electronics, Vol. 25, No. 10, Oct. 2010. | [5] Sumedha Sengar, "Maximum Power Point Tracking Algorithms for Photovoltaic System: A Review", International Review of Applied Engineering Research, Volume 4, Number 2 (2014). | [6] Saleh Elkelani Babaa, Matthew Armstrong, Volker Pickert, "Overview of Maximum Power Point Tracking Control Methods for PV Systems", Journal of Power and Energy Engineering, Aug. 2014, 2, 59-72. | [7] A. M. Zein Alabedini, Student Member, IEEE, and E. F. El-Saadany, Senior Member, IEEE, and M. M. A. Salama, Fellow, IEEE, "Maximum Power Point Tracking for Photovoltaic Systems Using Fuzzy Logic and Artificial Neural Networks", IEEE Transactions 2011. | [8] Hussein Al-Bahadili, Hadi Al-Saadi, Riyad Al-Sayed, and M. Al-Sheikh Hasan, "Simulation of Maximum Power Point Tracking for Photovoltaic Systems", 1st International Conference & Exhibition on the Applications of Information Technology to Renewable Energy Processes and Systems, 2013. |