Webpage: www.ijaret.org
eISSN 2320-6802
Volume 6, Issue VIII, Aug 2018

INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY

WINGS TO YOUR THOUGHTS.....

Maximum Power Tracking Techniques for PV Array

Piyush Nehra*, Charanjeet Madan**

*M.Tech Scholar, ** Assistant Professor
Electrical Engineering Department, HCE, Sonipat

***Abstract**—The maximum operating point of solar Photovoltaic (PV) panels changes with environmental conditions. Many methods have been proposed to locate and track the maximum power point (MPP) of PV cells. The difficulties that face these methods are the rapid changes in solar radiation and the variety in cell temperature which affects the MPP setting. External sensors are used in many approaches to measure solar irradiation and ambient temperature to estimate the MPP as a function of data measured.*

I. Introduction

Renewable energy becomes an essential source for many applications in the last four decades. It is difficult to supply electrical energy to small applications in remote areas from the utility grid or from small generators. Stand alone photovoltaic (PV) systems are the best solutions in many small electrical energy demand applications such as communication systems, water pumping and low power appliances in rural area [1][3]. In general, the cost of electricity from the solar array system is more expensive compared to electricity from the utility grid. For that reason, it is necessary to study carefully the efficiency of the entire solar system to design an efficient system to cover the load demands with lower cost. There are many external and internal influences which have an effect on the efficiency of the PV panel [4].

The maximum power point (MPP) of a PV system depends on cell temperature and solar irradiation, so, it is necessary to continually track the MPP of the solar array [1]. Therefore, the tracking control of MPP is a complicated problem. Many tracking control strategies have been proposed to overcome this problem such as; perturb and observe, incremental conductance, parasitic capacitance, constant voltage, neural network and fuzzy logic control[5][6]. The drawbacks of these methods comes from its high cost, difficulty, complexity, and non-stability. The main purpose of such controlling techniques is the way of adjustment the duty cycle of the shunt MOSFET transistor of maximum power point tracking (MPPT) converter. The MPPT converter is used to maintain the PV array's operating point at the MPP. MPPT controller does this by controlling the PV array's voltage or power independently of the load [8]. The fuzzy controller introduced in [5] uses dP/dI and its variations (dP/dI), as the inputs and computes MPPT converter duty cycle. The previous type of search is called on-line search algorithm which does not need reference MPP parameters. Therefore, it does not require measure of temperature and solar irradiation. Fast and stable MPP tracking under a high environment changes need reference MPP parameters. A solar radiation is used to obtain a reference power and voltage. The maximum power point voltage (Vmax) is obtained as a reference voltage as a function of open circuit voltage (Voc). The paper presents a method based on ANFIS to estimate the MPP using the data collected from several experiments performed in different environmental conditions. This paper utilizes analysis methods to analyze the data of experiment that has been collected in different environmental conditions.

This paper is organized as follows. Section I explains the basic introduction PV system, section II gives the overview of design configuration, section III introduces the ANFIS model, and result & discussion section IV is a conclusion.

II. Design Configuration

The advantage of the fuzzy inference system is that it can deal with linguistic expression. The idea behind neural network and fuzzy inference combination is to design a system that uses a fuzzy system to represent knowledge in an interpretable manner and has the learning ability derived. Simulink is a block diagram environment for multi domain simulation and Model-Based Design. It is integrated with MATLAB, enabling you to incorporate MATLAB algorithms into models and Export simulation results to MATLAB for further analysis. The goal of this module was to provide enough of an introduction to get you started on the development of open- and closed-loop simulations.

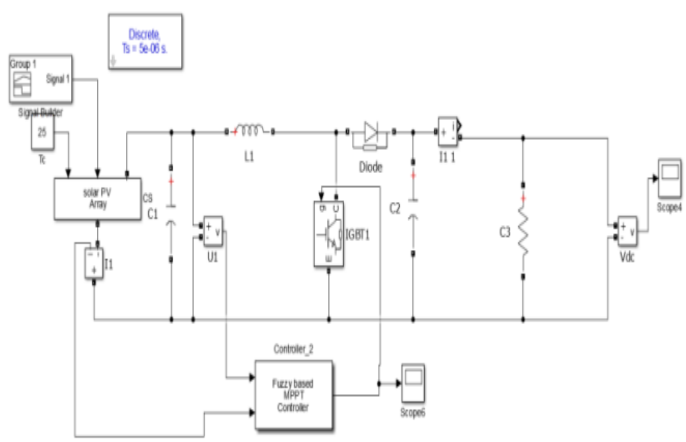

Figure 1: Proposed Simulink Model

The Resistance is applied for receiving of the output of the signal. ANFIS Controller in PV Array is shown in Fig 2. The fuzzy logic Controller & different delay are provided in this block diagram.

INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY
WINGS TO YOUR THOUGHTS…..

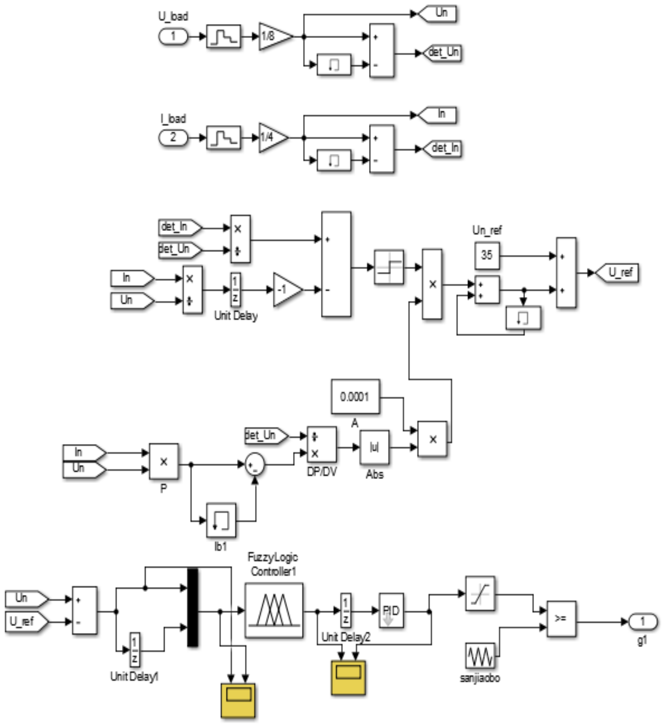

Figure 2: ANFIS Controller in PV array

III. Results and Discussion

The Solar power before ANFIS is less as compared to After ANFIS. Solar current after ANFIS based Controller MPPT. The Current is increased to 10.1 ampere then it is decrease to 9 ampere then it becomes 11 ampere and overall Simulation done for 5 sec.

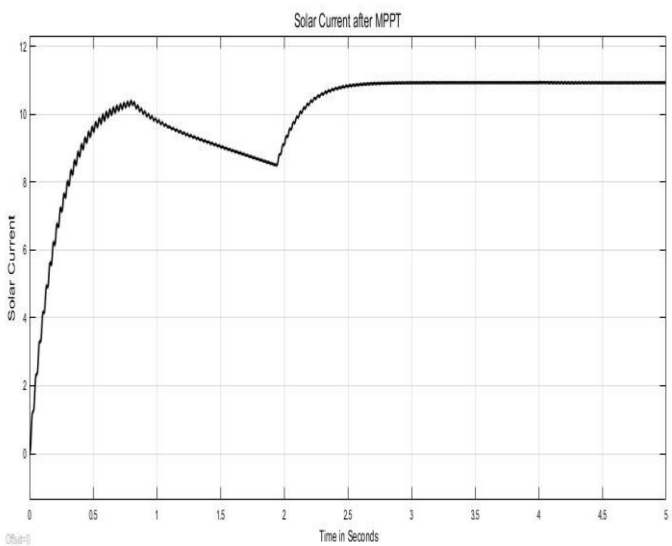

Figure 3: Solar Current after ANFIS based Controller MPPT

Solar voltage after MPPT is shown in fig 4. Initially the voltage is 0 volt then it is upgraded to 500 volt then it becomes 410V then is improved to 520 V up to 5 sec.

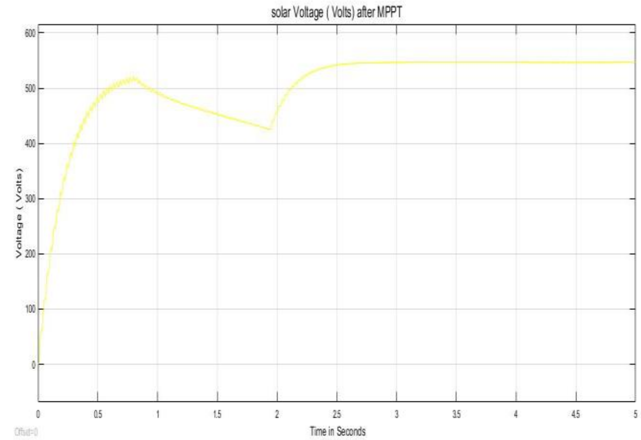

Figure 4: Solar Voltage after ANFIS based Controller MPPT

Solar DC Power after ANFIS based controller MPPT is shown in Fig 5. Initial power is boost up to 5000 Watt. Then it was decrease to 3900 watt & then it is improved to 6000 watt.

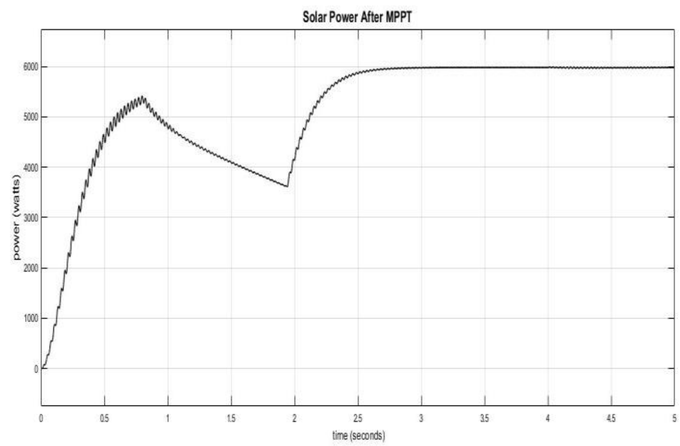

Figure 5: Solar DC Power after ANFIS based Controller MPPT

Table 1 Comparison analysis of model

Sr. No	Previous model analysis	Proposed model analysis
1.	In this Maximum power is not tracked.	ANFIS track maximum power
2.	The objective of MPPT algorithm is to draw maximum power from PV modules for changing solar irradiance (G) and temperature (T) conditions.	Artificial neural network fuzzy interface system (ANFIS) is used to find the solution for the nonlinear PV system model, output MPP reference voltage. The ANN is used to estimate the optimal reference voltage in real time, which corresponds to maximum power at any given input insolation and temperature.

3.	The previous model system doesn't shows a good dynamic performance to track the MPP of the PV units even under the rapid change of irradiation and cell temperature	The proposed system shows a good dynamic performance to track the MPP of the PV units even under the rapid change of irradiation and cell temperature
4.	Efficiency is low in Perturb & Observer MPPT Control Algorithm	Efficiency is very High as compare to other control technique 1. Perturb & Observer 2. Hill Climbing 2. Fuzzy MPPT 4. ANN MPPT 5. ANFIS is better than all of these control Algorithm
5.	Very high switching frequency of P & O control technique to get Maximum power but it is less than ANFIS	2 KHz switching frequency ANFIS control technique to get Maximum power

IV Conclusion

In conclusion, this research was successful. The author was able to explore the many facets of maximum power point tracking as well as the interleaved boost converter. Studying the PV system's surrounding conditions is very important on designing PV systems, avoiding a descent in power generated from PV system due to alteration in environment conditions. The MPPT with ANFIS model can predict using in Matlab Toolbox function to find out directly a minimum number of input data clusters with minimum number of rules. Also, ANFIS Model can estimate a per unit data of both panels to generalize the predict output for PV panels and systems.

References

[1] ***Abdalla, I., Zhang, L., &Corda, J. (2011). "Voltage-Hold Perturbation &ObservationMaximum Power Point Tracking Algorithm (VH-P&O MPPT) for Improved Tracking over the Transient Atmospheric Changes," presented at Power Electronics and Applications (EPE 2011) of the 2011-14th European Conference, (pp.1–10).***

[2] ***Abdulmajeed, Q. M., Kazem, H. A., Mazin, H., AbdMalek, M. F., Maizana, D.,Alwaeli, A. H. A., Albadi, M. H., Sopian, K., & Said Al Busaidi, A. (2013). "Photovoltaicmaximum tracking power point system: review and researchchallenges," International Journal of Advanced Trends in Computer Scienceand Engineering (IJATCSE), Vol. 2, No. 5. (pp.16–21).***

[3] ***Ali, A., Saied, M., Mostafa, M., &Moneim, T. (2012). A survey of maximum PPTtechniques of PV Systems. Energytech, 2012 IEEE.Amrouche, B., Belhamel, M., &Guessoum, A. (2007). "Artificial intelligencebased P&O MPPT method for photovoltaic systems," Revue des EnergiesRenouvelables ICRESD, Vol. 7, (pp. 11–16).***

[4] ***Azab, M. (2008). A new maximum power point tracking for photovoltaic systems.World Academy of Science, Engineering and Technology, 44, 571–574.***

[5] ***Brito, M., Galotto, L., Sampaio, L., Melo, G., &Canesin, C. (2013). Evaluation ofthe Main MPPT Techniques for Photovoltaic Applications. IEEE Transactionson Industrial Electronics, 60(3), 1156–1167.***

[6] ***Busa, V., Narsingoju, K. K., & Kumar, G. V. (2012). Simulation analysis of maximumpower control of photo voltaic power system. International Journalon Advanced Electrical and Electronics Engineering (IJAEEE), 1(1), 9–14.***

[7] ***Chen, C. J. (2011). Physics of solar energy. New Jersey: Wiley.Coelho, R., Concer, F., & Martins, D. (2010). "A MPPT Approach Based on TemperatureMeasurements Applied in PV Systems," IEEE/IAS InternationalConference on Industry Applications, (pp. 1–6).***

[8] ***Esram, T., & Chapman, P. (2007). Comparison of photovoltaic array maximumpower point tracking techniques. IEEE Transactions on Energy Conversion,22(2), 439–449.***

[9] ***Faranda, R., &Leva, S. (2008a). Energy comparison of MPPT techniques for PVsystems. Wseas Transaction on Power Systems, 3, 446–455.***

[10] ***Faranda, R., &Leva, S. (2008b). Energy comparison of MPPT techniques for PVsystems. Wseas Transaction on Power Systems, 3, 446–455.***

[11] ***Ghazanfari, J., &Farsangi, M. (2013). Maximum power point tracking usingsliding mode control for photovoltaic array. Iranian Journal of Electrical &Electronic Engineering, 9(3), 189–196.***

[12] ***Go, S., Ahn, S., Choi, J., Jung, W., Yun Yun, S., & Song, II. "Simulation and Analysisof Existing MPPT Control Methods in a PV Generation System." Journal ofInternational Council on Electrical Engineering, Vol. 1, No. 4, pp. 446-451,2011.***

[13] ***Hohm, D. P., &Ropp, M. E. (2003). "Comparative Study of Maximum PowerPoint Tracking Algorithms," Progress in Photovoltaic: Research and Application,(pp. 47–62).***

[14] ***Hu, J., Zhang, J., & Wu, H. (2009). "Novel MPPT control algorithm based on numericalcalculation for PV generation systems," presented at Power Electronics andMotion Control Conference (pp. 2103–2107). China: Baoding.***

[15] ***Israel, J. (2015). "Summary of maximum power point tracking methods forphotovoltaic cells," electronic matter, retrieved on May 2015.***

[16] ***Jain, S., &Agarwa, V. (2007). Comparison of the performance of maximumpower point tracking schemes applied to single-stage grid-connectedphotovoltaic systems. The Institution of Engineering and Technology PowerAppl., 1(5), 753–762.***

[17] ***Ji, Y. H., Jung, D. Y., Won, C. Y., Lee, B. K., & Kim, J. W. (2009). Maximum powerpoint tracking method for PV array under partially shaded condition.Energy***

Conversion Congress and Exposition, 2009. ECCE 2009. IEEE. (pp.307–312).

[18] ***Jiang, J., Huang, T., Hsiao, Y., & Chen, Ch. (2005). Maximum power tracking forphotovoltaic power systems. Tamkang Journal of Science and Engineering,8(2), 147–153.***

[19] ***Jusoh, A., Sutikno, T., Guan, T. K., &Mekhilef, S. (2014). A Review on favourablemaximum power point tracking systems in solar energy application.Telkomnika, 12(1), 6–22.***

[20] ***Kamarzaman, N., & Tan, C. W. (2014). A comprehensive review of maximumpower point tracking algorithms for photovoltaic systems. Renewable andSustainable Energy Reviews, 37, 585–598.***

[21] ***Khatib, T. T. N., Mohamed, A., &Amim, N. (2010). An improved indirectmaximum power point tracking method for standalone photovoltaicsystems," presented at Proceedings of the 9th WSEAS InternationalConference on Applications of Electrical Engineering, Selangor, Malaysia,pp. (56–62).***

[22] ***Charan Jeet Madan and Naresh Kumar, "Fuzzy grey wolf optimization for controlled low-voltage ride-through conditions in grid-connected wind turbine with doubly fed induction generator", Sage publication, Simulation: Transactions of the Society for Modeling and Simulation International, June 2017.***