iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** III **Month of publication:** March 2017

DOI: http://doi.org/10.22214/ijraset.2017.3142

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Modelling and Simulation of Fuzzy Logic Control Based Perturb & Observation Technique for Mppt in Photovoltaic System

P. Gokul[1], B. Priyadharshini[2], R. Sundar[3]
[1,2,3] *M.E. Scholar, Department of EEE, Sona College of Technology, Salem-636 005, Tamilnadu, India.*

Abstract: Solar Photovoltaic (PV) exploitation is a significant renewable energy source in our world. The energy converted directly from sunlight through PV panel is not stable due to different solar intensity. Maximum power point tracking (MPPT) is used extract maximum power from the solar panel, high-performance soft computing techniques like fuzzy logic controller can be used as a MPPT. In this paper, a fuzzy logic control (FLC) is proposed to monitor and control the MPPT for a photovoltaic (PV) system. The proposed technique uses a FLC for the enhancement of these Maximum Power Point (MPP) trackers are designed. The FLC based Perturb and Observe (P&O) results are compared with the conventional P&O under different conditions using MATLAB/Simulink.
Keywords: Fuzzy Logic Control (FLC), Maximum Power Point Tracking (MPPT), Perturb and Observe (P&O, Photovoltaic (PV), Maximum Power Point (MPP).

I. INTRODUCTION

The positive impact of solar generation in the current power systems is growing rapidly due to increase in power demands, depletion of fossil fuel sources and the environmental requirements of pollution reduction.

The electrical energy supplied by a photovoltaic power generation systems depends on the solar irradiation and temperature [1]. The PV system can supply the maximum power to the load at a particular operating point which is generally called as maximum power point, at which the entire PV system operates with maximum efficiency and produces its maximum power.

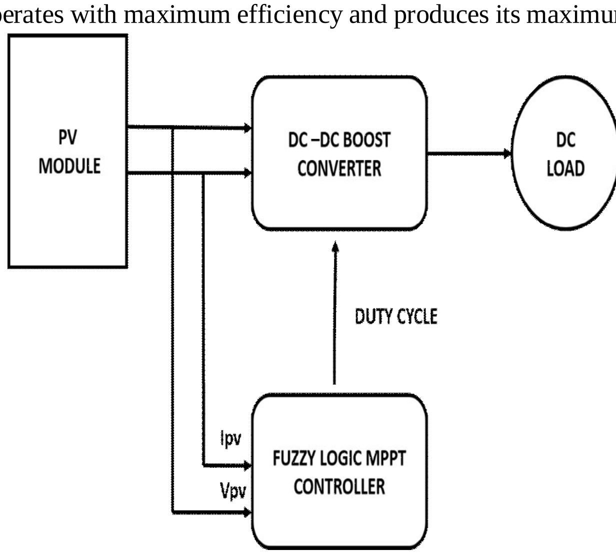


Fig.1 Block diagram of proposed system

Generally, MPPT is included to track the maximum power point in the PV system. The efficiency of MPPT depends on both the MPPT control algorithm and the MPPT hardware. The MPPT control algorithm is usually applied in the DC-DC Buck boost converter, which is normally used as the MPPT circuit.

Hence, a MPPT methods are used to maximize the PV panel output power by tracking continuously the maximum power point. MPPT methods are integrated with PV systems in order to maximize the energy obtained under all weather conditions and deal with the associated current - voltage nonlinearities. One of the most applied and studied MPPT method is the well-known P&O. In this project, a FLC for the enhancement of these MPP trackers are designed. The FLC based P&O results are compared with the conventional P&O under different conditions using MATLAB/Simulink. Block diagram of proposed system is shown in Fig. 1.

II. MAXIMUM POWER POINT TRACKING TECHNIQUES

A. Perturb and Observation (P&O)

One of the most simple and popular techniques of MPPT is the P&O technique. The main concept of this method is to push the system to operate at the direction which the output power obtained from the PV system increases. Following equation describes the change of power which defines the strategy of the P&O technique.

$$\Delta P = P_k - P_{k-1} \qquad (1)$$

If the change of power defined by (1) is positive, the system will keep the direction of the incremental Duty cycle as the same direction, and if the change is negative, the system will change the direction of incremental duty cycle command to the opposite direction [1]. This method works well in the steady state condition (the radiation and temperature conditions change slowly). However, the P&O method fails to track MPP when the atmospheric condition is rapidly changed. Flowchart of the P&O method is described in Fig. 2.

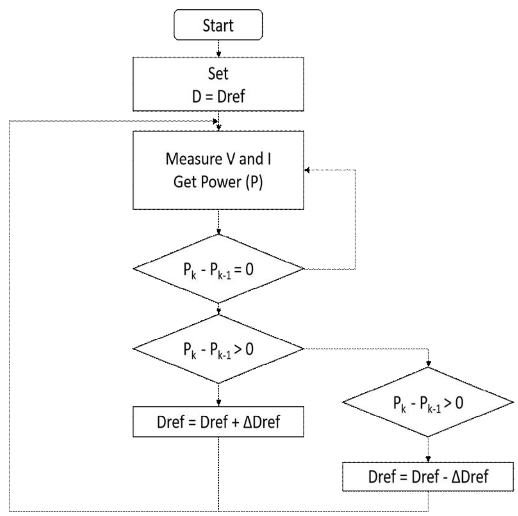


Fig.2 Flowchart of the P&O Method

B. FLC Based Perturb and Observation (P&O)

MPPT using Fuzzy Logic Control gains several advantages of better performance, robust and simple design. In addition, this technique does not require the knowledge of the exact model of system. The main parts of FLC, Fuzzification, rule-base, inference and Defuzzification, are shown in Fig. 3. In the proposed system, the input variables of the FLC are the change in PV array power (ΔPpv) and whereas the output of FLC is the magnitude of the change of boost converter Duty ratio (ΔDref). The duty ratio is the command for controlling the Duty cycle drawn from the PV. Flowchart of the proposed FLC is shown in Fig. 4.

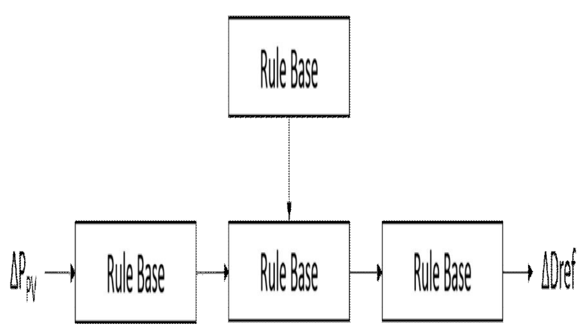


Fig.3 Fuzzy Logic Controller

In the proposed design, the universe of discourse for the input variable (ΔPpv) is assigned in terms of several linguistic variables by using five fuzzy subsets, which are denoted by NB (negative big), NS (negative small), Z (zero), PS (positive small) and PB (positive big) [1]. The membership functions for the variable are shown in Fig. 5. Fig. 6 shows the universe of discourse for the output variable (ΔD_{ref}), which is classified into 5 fuzzy sets, namely NB (negative big), NS (negative small), Z (zero), PS (positive small) and PB (positive big).

Based on the knowledge of the authors, the fuzzy system rules can be designed as shown in Fig 7. ΔPpv and ΔDref are the input and output variables. The fuzzy inference of the proposed FLC is based on the Mamdani method which is associated with the max-mincomposition.

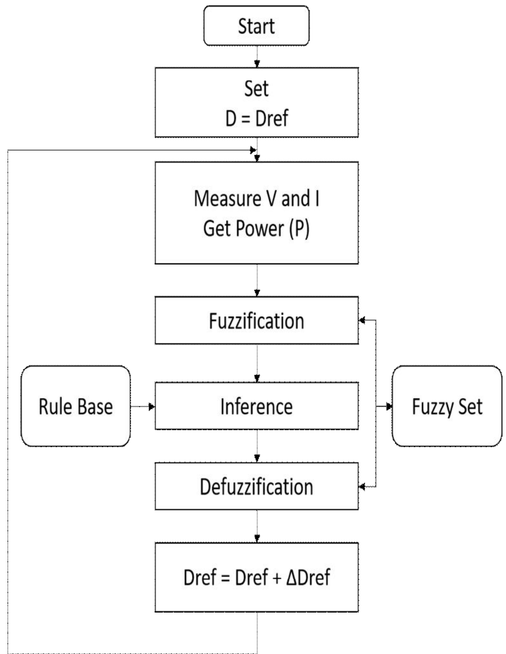


Fig.4 Flowchart of the proposed FLC method

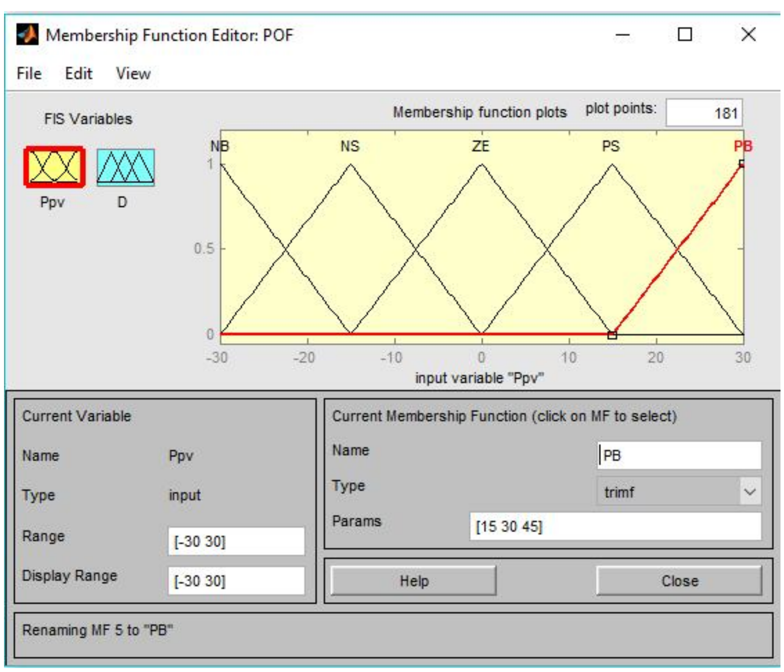


Fig.5 Membership Functions of the Input Variable (ΔPpv)

Volume 5 Issue III, March 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

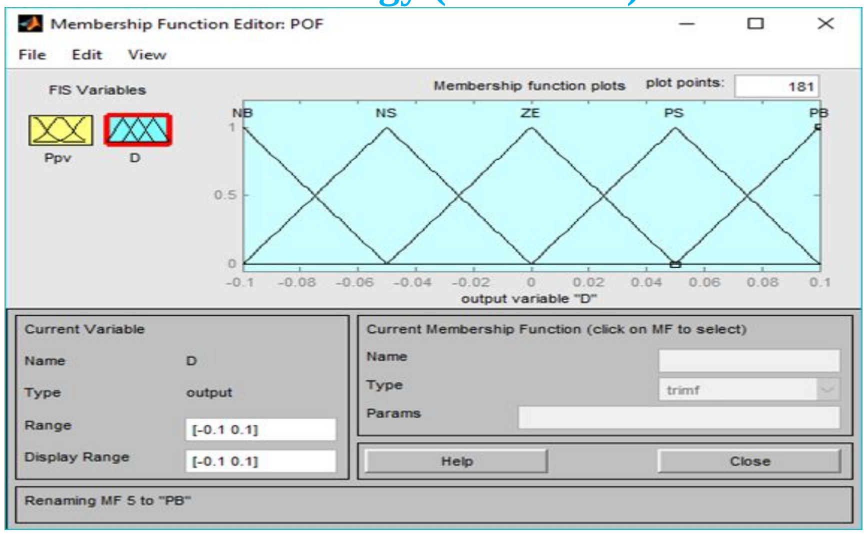


Fig.6 Membership Functions of the Output Variable (ΔD_{ref})

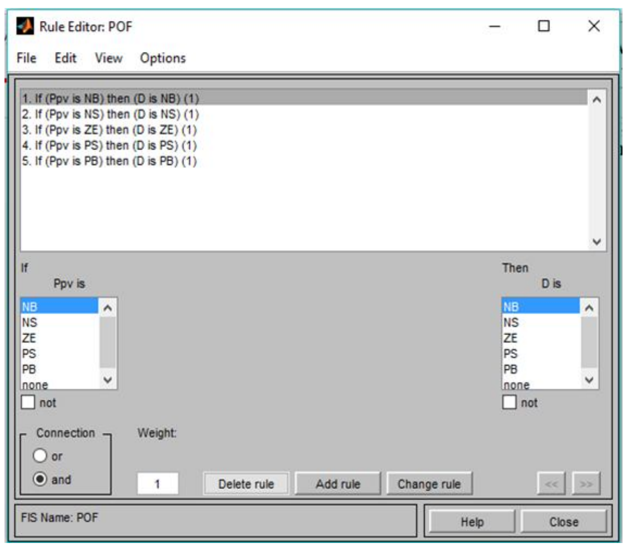


Fig.7 Rules of the proposed FLC based P&O

III. MODEL OF THE SYSTEM

A. Modelling of P&O MPPT

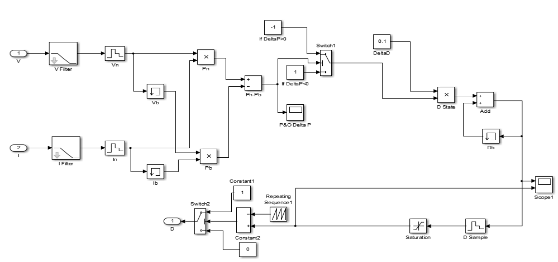


Fig.8 Simulink model of P&O MPPT in MATLAB

The Simulink model of Perturb and Observation Maximum power point tracking in MATLAB is shown in figure 8. In this model the new power is calculated by taking difference between the present power and the old power.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

B. Modelling of FLC Based P&O MPPT

The proposed Fuzzy Logic Control based P&O MPPT has been modeled and simulated using MATLAB/Simulink. Fig.9 shows our developed Simulink model of FLC based P&O MPPT. In the simulation study, the fuzzy logic based MPPT control is simulated and compared with the conventional P&O technique under the operating condition assuming the constant temperature and isolation 400 W/m2. The step size of duty ratio in the P&O technique uses the appropriate value found by trial and error technique. In FLC based P&O technique the duty ratio is obtained very accurately by fuzzy logic controller.

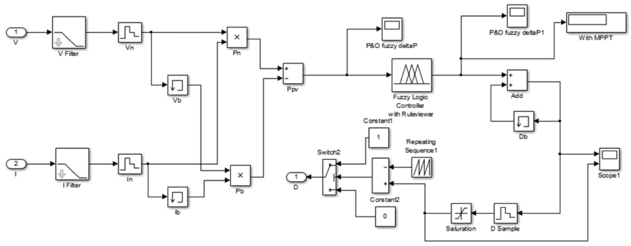


Fig.9 Model of FLC based P&O MPPT in MATLAB/Simulink

IV. RESULT AND DISCUSSION

A. Simulation Reults

Fig.10 Show the result for Conventional P&O MPPT technique. In Perturb and Observation MPPT the power oscillation magnitude is more at initial stage, after some time the power oscillation magnitude is reduced as shown in Fig.10 and also time taken to reach the Maximum Power Point is more, Nearly 1.3s.

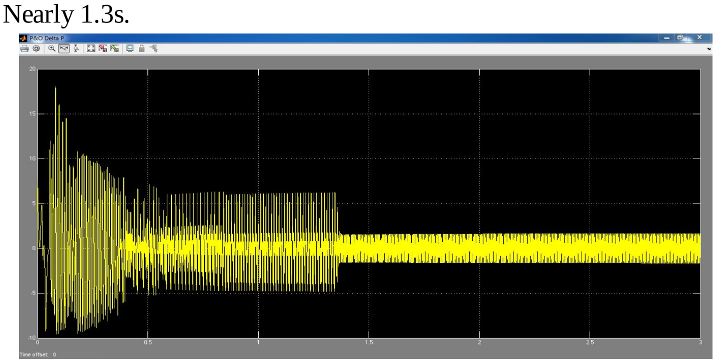


Fig.10 Simulation result of P&O MPPT

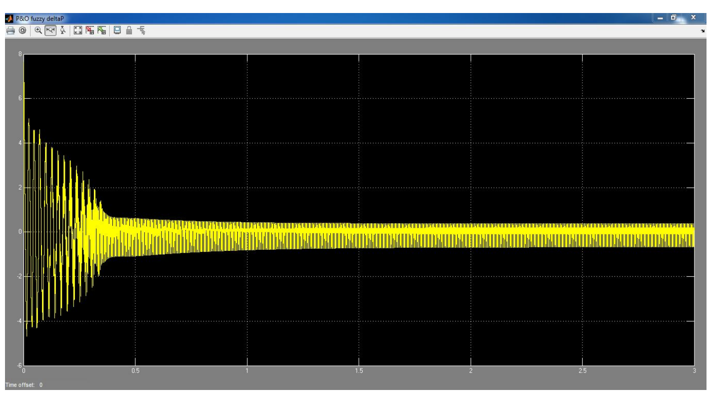


Fig.11 Simulation result of FLC based P&O MPPT

Fig.11 Show the result for FLC based P&O MPPT technique. In FLC based Perturb and Observation MPPT the power oscillation magnitude is less at initial stage compared to conventional Perturb and Observation MPPT as shown in Fig.11 and also time taken to reach the Maximum Power Point is less, nearly 0.3s only.

Fig.12 Show the comparison results for Conventional P&O MPPT technique and FLC based P&O MPPT technique. Table.1 shows the Simulation Results Comparisons for the conventional P&O and FLC based P&O [5].

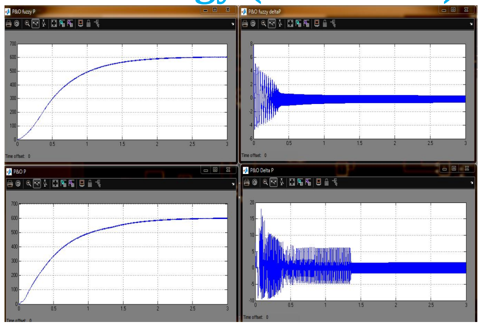


Fig.12 Simulation results of P&O and FLC based P&O MPPT

TABLE. 1 SIMULATION RESULTS COMPARISION

Technique	Irradiation	Temperature in degree Celsius	change in Pmin (Watts)	change in Pmax (Watts)	change in Power (Watts)	Time to reach MPP(approx.)
P&O	400	25	-10	17	27	1.3s
Fuzzy Based P&O	400	25	-5	8	13	0.3s

B. Analysis Based on Simulation Results

From the given proposed model, the lower input voltage is boosted up to higher voltage level. In Perturb and Observation MPPT the power oscillation magnitude is more at initial stage, after some time the power oscillation magnitude is reduced as shown in Fig.10 and also time taken to reach the Maximum Power Point is more, Nearly 1.3s.

In FLC based Perturb and Observation MPPT the power oscillation magnitude is less at initial stage compared to conventional Perturb and Observation MPPT as shown in Fig.11 and also time taken to reach the Maximum Power Point is less, nearly 0.3s only.

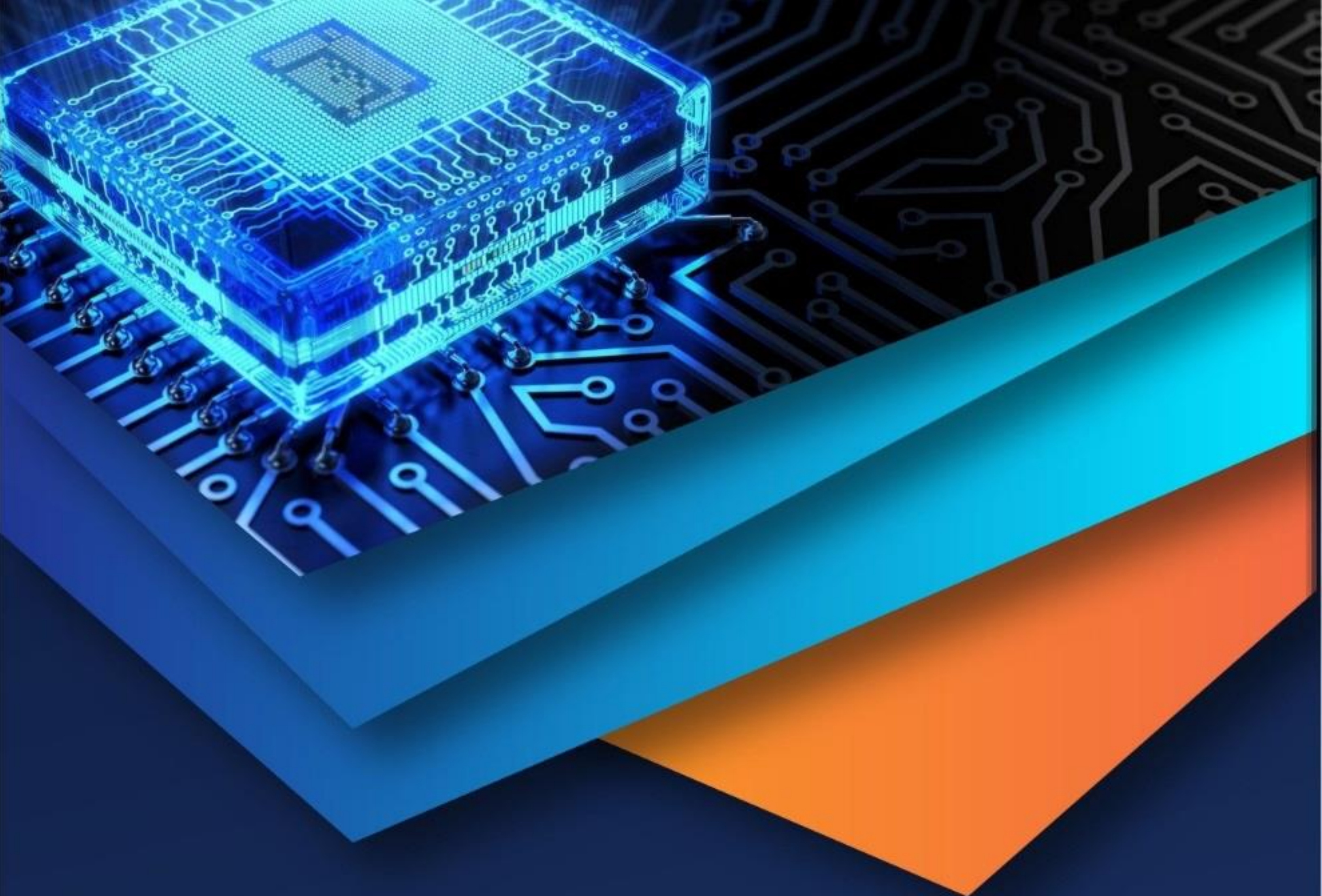
The Steady state change in power (power oscillation) is also reduced in FLC based P&O MPPT compared to P&O MPPT. The characteristics are represented in the figure 12.

V. CONCLUSION

In this paper an intelligent control strategy is developed for MPPT to the PV system using the FLC. Simulation results show that the proposed MPPT performance is better when compared to the conventional P&O method. For the future work, we intend to implement the proposed technique in the real PV system using Arduino based Fuzzy Logic Controller.

REFERENCES

[1] Pongsakor Takun, Somyot Kaitwanidvilai and Chaiyan Jettanasen, "Maximum Power Point Tracking using Fuzzy Logic Control for Photovoltaic Systems", Proceedings of the International Multi conference of Engineers and Computer Scientists 2011 Vol II, IMECS 2011, March 16 – 18, 2011 Hong Kong.
[2] Subiyanto, A Mohamed, M A Hannan, "Maximum Power Point Tracking in Grid Connected PV System Using A Novel Fuzzy Logic Controller", IEEE Student Conference on Research and Development, November 2009.
[3] Mohamed Azab, "A New Maximum Power Point Tracking for Photovoltaic Systems", World Academy of Science, Engineering and Technology, Vol. 34,October 2008.
[4] T. Esram; P.L. Chapman; , "Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques," IEEE Transactions on Energy Conversion, vol.22, no.2, pp.439-449, June 2007
[5] S. Jain; V. Agarwal; "Comparison of the performance of maximum power point tracking schemes applied to single-stage grid-connected photovoltaic systems," in Electric Power Applications, IET , vol.1, no.5, pp.753-762, Sept. 2007.
[6] Cheikh M. S. A., Larbes C., Kebir G. F. T. and Zerguerras A.,"Maximum power point tracking using a fuzzy logic control scheme", Revue des Energies Renouvelables, Vol. 10, No. 32, September 2007, pp. 387 – 395.
[7] Sofai. Lalouni, Djamila. Rekioua, "Modeling and Simulation of Photovoltaic System using Fuzzy Logic Controller", IEEE International Conference on Developments in Systems Engineering, 2009.
[8] Santos J. L., Antunes F., Chehab A. And Cruz C. C., "A maximum power point tracker for PV systems using a high performance boost converter", Science Direct. Solar Energy 80, 2006, pp. 772–778.
[9] Liu Bangyin, Duan Shanxu, Liu Fei, etal. Based on Improved Perturbation and Observation Method of PV Array Maximum Power Point Tracking [J]. Electro technical Society, 2009,24 (6): 91-94.
[10] Xie Ziqing, Ye Jianmei.Solar power MPPT control technology based on fuzzy control[J].Power Technique,2011, 35(6) : 691-692.



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY