International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 06 | June 2021 www.irjet.net p-ISSN: 2395-0072

AN ANFIS-PI BASED BOOST CONVERTER CONTROL OF SOLAR PV

SIVAPRIYA.J[1], MOHANKUMAR.G[2]

[1]P.G Scholar, Department of EEE, PRIST UNIVERITY, Thanjavur, Tamil Nadu (Puducherry Campus)
[2]Assistant Professor& Head, Department of EEE, PRIST UNIVERITY, Thanjavur, Tamil Nadu (Puducherry Campus)

Abstract – *In this paper, design and implementation of ANFIS based MPPT control scheme with open loop boost converter is designed. The PI algorithm has proven to be a popular and widely used control method due to its relative simplicity and robustness but it doesn't provide optimal control to non-linear systems. This paper presents a novel method of improving the performance of the PI controller using an ANFIS network to provide gain scheduling.* Moreover, a comparative study between the proposed ANFIS-based MPPT controller and the commonly used, perturbation and observation (P&O) MPPT technique is presented. *The proposed model will be developed using MATLAB/Simulink.*

Key Words: Photovoltaic (PV), Fuzzy logic Controller and Maximum Power Point Tracker (MPPT)

1.INTRODUCTION

The interest in the utilization of renewable energy sources for electric power generation has increased Due to fast depletion of fossil fuel reserves and environmental degradation. It is necessary to harness the renewable energy sources to their maximum potential for the purpose of electric power generation in order to meet the ever increasing energy demands globally. Sunlight is an excellent renewable energy source which can be used for electric power generation. Solar energy helps to reduce the emission of green house gases that causes global warming offers a great potential for providing a carbon-free response to mankind's energy demand. Solar PV systems use solar PV modules/arrays to directly convert solar energy into electric energy. The efficiency of solar PV system can be increased by extracting the maximum available power using maximum power point tracker (MPPT) from the solar PV modules at different environmental conditions such as solar irradiance and temperature. Designing of ANFIS combines the advantages of neural networks and fuzzy logic and hence deals efficiently with non linear behavior of solar PV modules based MPPT scheme which is interfaced with open loop boost converter is presented. Maximum power transfer between load and solar PV module is also carried out for designing of open loop DC-DC boost converter.

2. SYSTEM DESCRIPTION

The main goal of the solar PV cell system is to create a stable power supply. The output of the solar cell is applied firstly to a pre-regulator which is used to apply a MPPT algorithm and finally to a boost converter control features the novel ANFIS-PI control solution to provide the stable output.

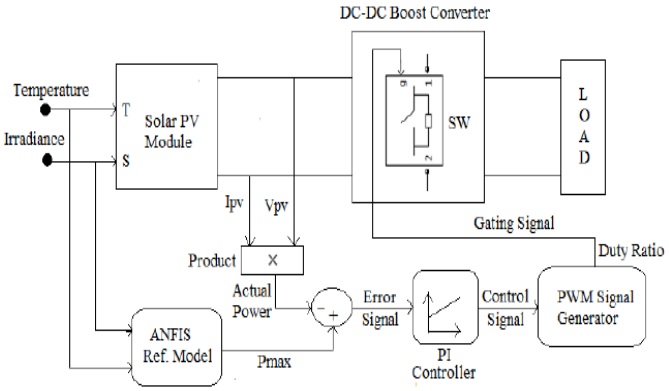

Figure 1 ANFIS based MPPT controller structure

Figure1 shows the full circuit diagram showing the PV cell, the boost converter and a pair of ANFIS-PI controllers. As shown in Figure1, there are two PI controllers in the system - the inner PI controller is shown by the bounded area labeled inner control loop and controls the inductor current whilst the other is labeled outer control loop and controls the output voltage. The performance of the boost converter circuit is influenced heavily by the current through the inductor. The converter behavior is considerably simpler to model when the inductor isn't allowed to fully discharge during a switching period. The converter to maintain this operating condition and therefore preferential known as continuous conduction mode.

The PID controller consists of three separate branches -proportional, integral and derivative. With the proportional part acting immediately on the current error, the integral adding a contribution equivalent to the history of all errors and the derivative action predicting the future contribution of the errors. The addition of the integral and derivative actions to the basic proportional element by reducing steady state error.

The operating characteristics of solar PV cells are influenced by both temperature and solar irradiation. In order to utilize the maximum available power from the PV cell a Maximum Power Point Tracking (MPPT) algorithm is Included in the system. There are a number of different algorithms available for MPPT with two of the most widely Used being the Perturb and Observe (P&O) and Incremental Conductance (INC). These techniques are popular as they are relatively simple to implement, exhibit good efficiency and are technology independent.

3. FUZZY LOGIC FOR TUNING A PI CONTROLLER

The basic block diagram of fuzzy logic controller is shown in figure2, which mainly consist of three blocks which are Defuzzifier, Decision rules, Fuzzifier. Fuzzifier is one which measures inputs and are converted into fuzzy inputs. The decision rule block which enables the FLC to take intelligent decisions is based on upon a set of if- then rules. The defuzzifier block converts the control output generated by the decision rule in to the numerical value. Fuzzy logic has been applied to many fields from control theory to artificial intelligence.

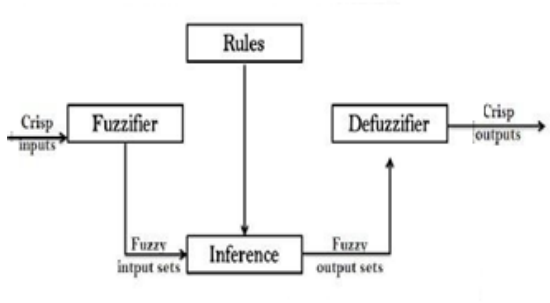

Figure 2 Fuzzy logic controller

Conventional PI controller does not give desirable performance for systems. In order to achieving effective response it is necessary to automatically tune the PI parameters. Using fuzzy logic controller, the automatic tuning of PI controller has been done. A linguistic control transforms into an automatic control strategy by means of fuzzy logic system. Figure3 shows the block diagram of a fuzzy PI controller. The inputs to the fuzzy controller are the error (e) and the rate of change of error (Δe) while the outputs are controller gains *KP&Ki.*

The fuzzy sets have been determined as: Negative Large (NL), Negative Medium(NM), Negative Small(NS), zero(ZE), Positive Small(PS), Positive Medium(PM), Positive Large(PL) respectively as shown in table 1by fuzzy linguistic variables.

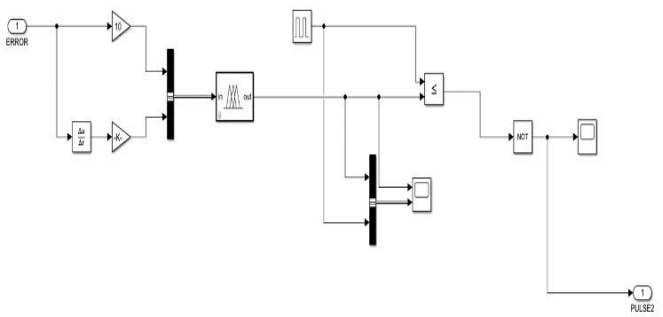

Figure 3 Block diagram of Fuzzy Controller

Δe \ e	NB	NS	EZ	PS	PB
NB	NB	NB	NS	NS	EZ
NS	NB	NS	NS	EZ	PS
EZ	NB	NS	EZ	PS	PS
PS	NS	EZ	PS	PS	PB
PB	EZ	PS	PS	PB	PB

Table1 Fuzzy linguistic variables

The following advantages of fuzzy logic controller are

a) It is cheap compared to other conventional controllers.

b) It does not require a prior mathematical model.

c) It reduces the switching losses

d) It reduces the total harmonic distortion compared to others

4. SIMULATIONS AND RESULTS

The software MATLAB was used to simulate the proposed circuit with MPPT controller as shown in figure 4 and with fuzzy logic controller as shown in figure 12.

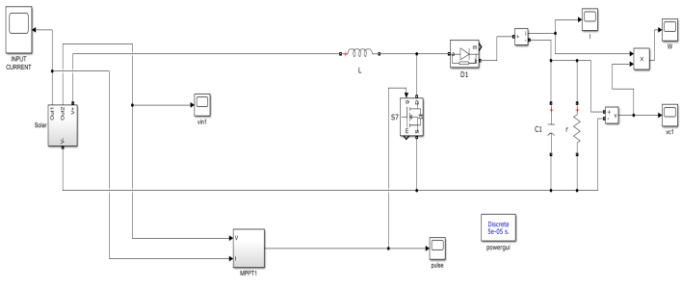

Figure 4 Simulation Circuit with MPPT

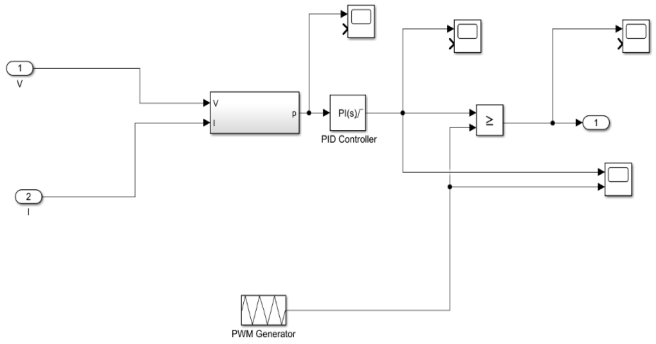

Figure 5 MPPT Controller

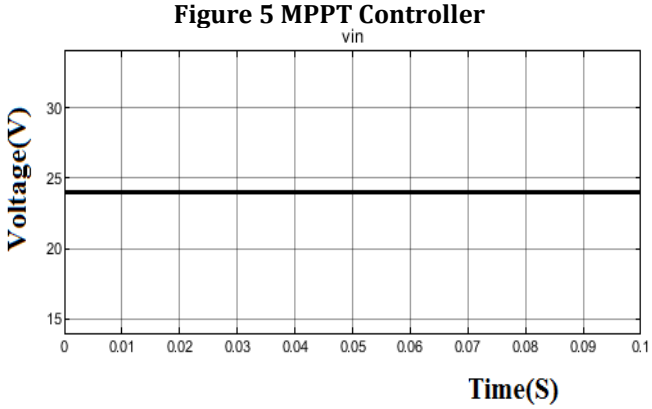

Figure 6 Input voltage

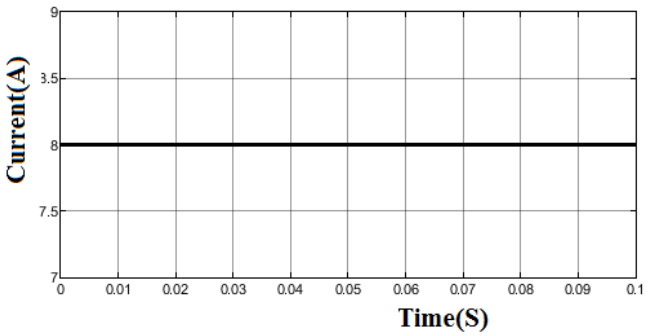

Figure 7 Input Current

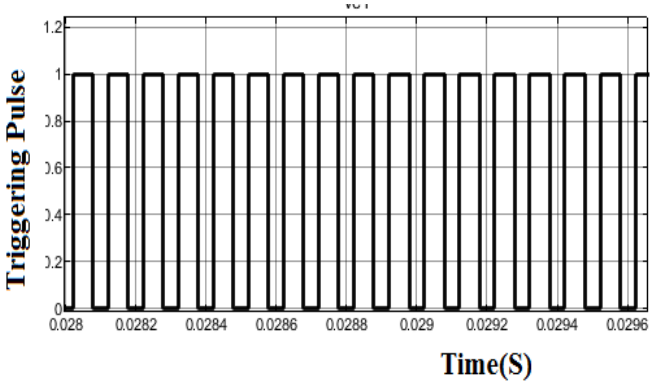

Figure 8 Triggering pulse

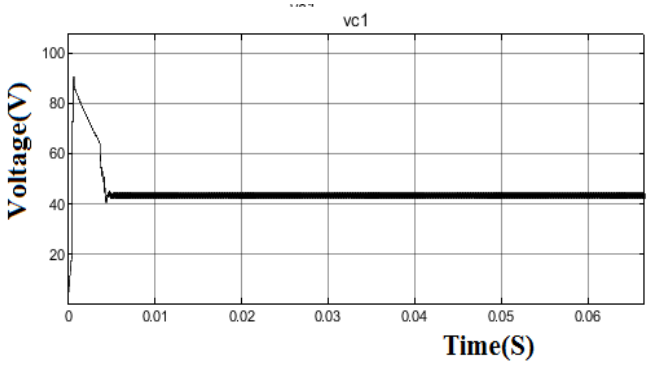

Figure 9 Output voltage

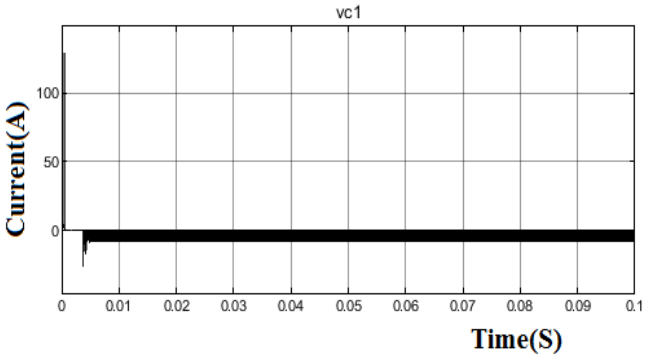

Figure 10 Output voltage

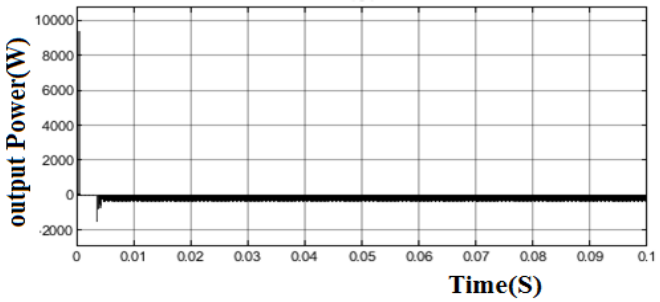

Figure 11 Output Power

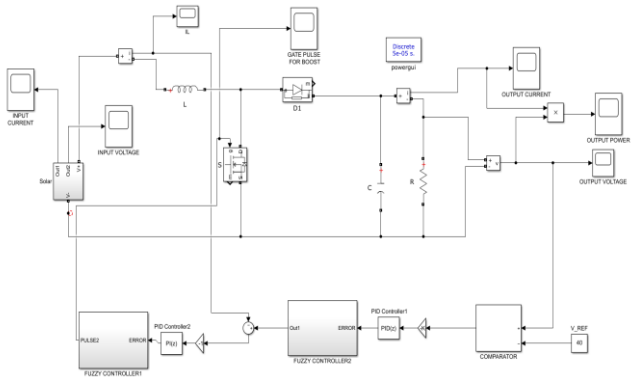

Figure 12 Simulation Circuit with Fuzzy Controller

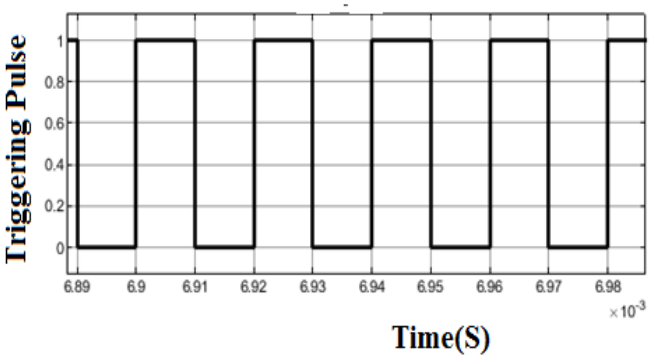

Figure 13 Triggering pulse

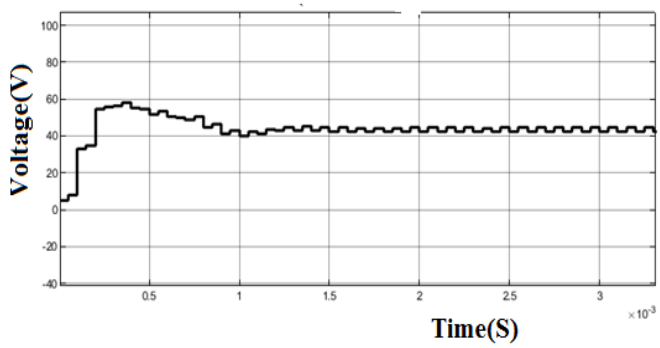

Figure 14 Output voltage

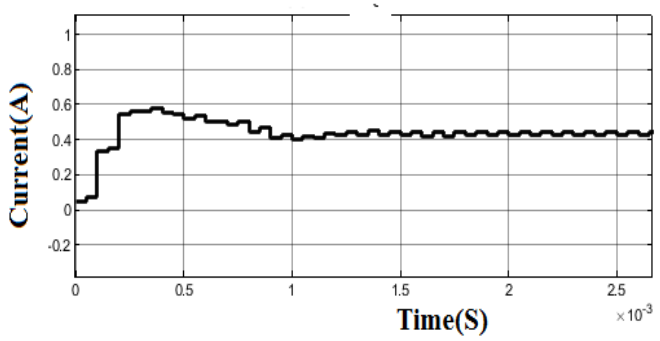

Figure 15 Output Current

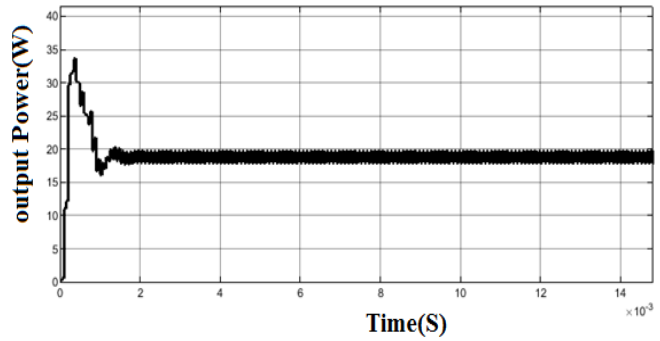

Figure 16 Output Power

5. CONCLUSION

In this paper, design and implementation of ANFIS based MPPT control scheme with open loop boost converter was designed and simulated using MATLAB/simulink. The simulation results demonstrated the effectiveness of the proposed technique since the controller can extract the maximum available power Moreover, a comparative study between the proposed ANFIS-based MPPT controller and the commonly used, perturbation and observation (P&O) MPPT technique is presented. The simulation results reveal that the proposed ANFIS-based MPPT controller is more efficient than the P&O method since it shows a better dynamic response with few oscillations about the maximum power point (MPP).

REFERENCES

[1]M. F. Ansari, R. K. Kharb, S. Luthra, S. L. Shimmi and S. Chatterji, "Analysis of barriers to implement solar power installations in India using interpretive structural modeling technique", Renewable and Sustainable Energy Reviews, vol. 27, pp.163–174, 2013.

[2] V. Lingareddy, G. Ravichandra and P. K. Maddukrui, "Effective Strategy for MPPT in PV/Wind Hybrid Electric Power System Interconnected with Electrical Utility Grid," International Journal of Advanced Research in Computer Science and Software Engineering. Volume 3, Issue 7. July 2013.

[3]S. D. Saravana, "Modeling and Simulation of Incremental Conductance MPPT Algorithm for Photovoltaic Applications," International Journal of Scientific Engineering and Technology, ISSN: 2277-1581, Volume No.2, Issue No.7, pp: 681-685. 1 July 2013.

[4] M. Lokanadham and K. V. Bhaskar, "Incremental Conductance Based Maximum Power Point Tracking (MPPT) for Photovoltaic System," International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622, Vol. 2, Issue 2, pp.1420-1424. March-April 2012.

[5] C. Chukwuka and K. A. Folly, "Technical and Economic Modeling of the 2.5kW Grid-Tie Residential Photovoltaic System," InternationalJournal of Renewable Energy Research. Vol.3, No.2. 2013.

[6] M. K. Gupta and R. Jain, "MPPT Simulation with DC Submersible Solar Pump using Output Sensing Direct Control Method and Cuk Converter," International Journal of Renewable Energy Research. Vol.3, No.1. 2013.

[7] R. Singh and M. Pandit, "Controlling Output Voltage of Photovoltaic Cells using ANFIS and Interfacing it with Closed Loop Boost Converter," International Journal of Current

Engineering and Technology. ISSN 2277 – 4106. Vol. 3, No.2. June 2013.

[8] D. Radianto, D. A. Asfani, T. Hiyama and Syafaruddin, "Partial Shading Detection and MPPT Controller for Total Cross Tied Photovoltaic using ANFIS," ACEEE International Journal on Electrical and Power Engineering, Vol. 03, No. 02. May 2012.

[9] A. Durgadevi and S. Arulselvi, "ANFIS Modeling and Experimental Study of Standalone Photovoltaic Battery Charging System," International Journal of Modern Engineering Research (IJMER), Vol.2, Issue.4, pp-2516-2520. July-Aug, 2012.

[10] R. R. Maziar, R. R. Mani, S. Akbari and S. A. Taher, "Using ANFIS, PSO, FCN in Cooperation with Fuzzy Controller for MPPT of Photovoltaic Arrays," Advance in Electrical Engineering Systems, Vol. 1, No. 1. March 2012.

BIOGRAPHIES

J.SIVAPRIYA Received the Engineer degree in 2007 from Anna University, Chennai, Tamilnadu. From July 2012 to till now Working as Assistant Engineer /O&M/ Ananthapuram in Gingee Division, TNEB Working hard. Her Specialization in TNEB is Operation & Maintenence in Distribution Network.