International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 11 (2018) pp. 9549-9552

New approach of intelligent technique to Optimize Maximum power point tracking with PID controller by using the algorithm of fuzzy inference system

Adnan Adhab K. Al-saeedi[1] , Nidaa Ghalib Ali[2] , Muhanad Jabar Yaser[3]
[1, 2]Babylon Technical Institute,, Al-Furat AL-Awast Technical University, Kufa, Iraq.
[3]ShatrahTechnical Institute, Southern Technical University.

Abstract:

in this paper, new approach for maximum power point tracking MPPT with Proportional- Integral- Derivate PID controller is proposed to optimize the system. However, the main problem of classical MPPT is that the MPPT needs always to adjust voltage and current to obtained maximum output power which causes high steady state error and low response with oscillation fro photovoltaic system. Therefore, to improve the system performance, PID controller with fuzzy inference system FIS is proposed to minimize the steady state error and to decrease the rising time with no oscillation for current and voltage for whole system. The simulation results demonstrate that the system of MPPT based on FIS-PID is more effective and more accuracy with high efficiency as compared with traditional MPPT for photovoltaic system

Key words: MPPT charge controller, PID controller, fuzzy inference system FIS, photovoltaic system.

INTRODUCTION:

The maximum power point tracking is an electronics DC to DC convertor that interfacing or matching between photovoltaic system and battery. Many authors proposed a lot of researches about MPPT to enhance the system performance [1] [2][3]. PID controller is widely used in the industrial control system to remove the steady state error and to minimize the error between the reference and target output. Therefore, PID controller was used to overcome the problems caused by MPPT for adjusting the voltage and current measurement but still the system had overshoot and undershoot [4] [5]. Neural network with MPPT has been strongly developed to enhance the performance of photovoltaic system theoretically and practically to decrease the harmonics of output current but the system was slow response [6] [7] [8]. The control method of DC-DC converter has to switch regularly between MPPT control and constant voltage control, and these two modes make the whole system more complicated [9]. The photovoltaic system is perfect which has usually concerned the attention of society [10]. The algorithm of fuzzy inference system is applied to control and optimize the current and voltage machine [11].

To overcome the problems mentioned above, a new algorithm is proposed via FIS-PID control, which develops the same fuzzy rules. In this method, there is no need of the mathematical model of system and can not only modified the MPPT control, but also optimize the constant voltage output control.

MAXIMUM POWER POINT TRACKING BASED FIS-PID CONTROLLER

In this proposed method, fuzzy inference system FIS is used to optimize the MPPT performance. Fuzzy inference system (FIS) is commonly used for practise simulation or control. it can be calculated either from expert information or from data. FIS-PID controller is applied in this paper because of its simplicity, fast response, and no need mathematical model for the system.in addition, it has capability of self-tuning and on-line adaptation. The two input of FIS- PID controller are current and voltage. The current and voltage are optimized based on memberships and rules of FIS. The output of FIS-PID passes through MPPT to minimize the drawback of this classical MPPT. Also, PID controller is used with FIS for fast response of whole system. Figure 1, shows the Simulink of proposed method based on FIS-PID controller

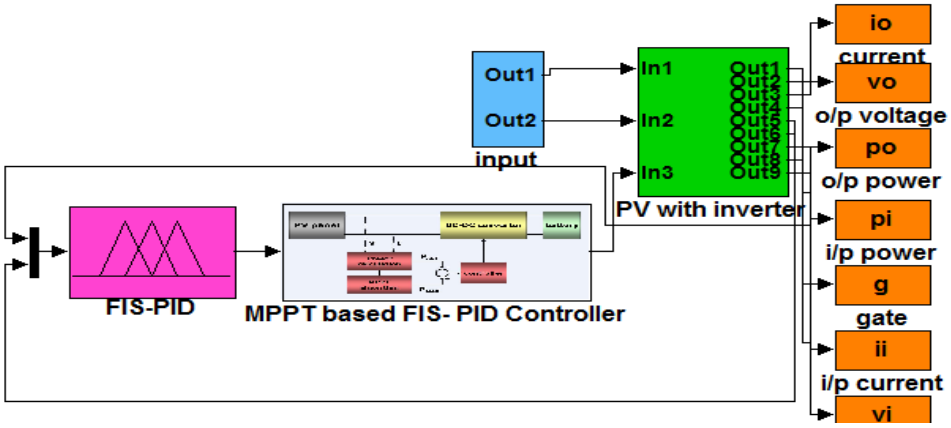

Figure 1. Simulink of Fuzzy inference system with PID controller to optimize MPPT

SIMULATION RESULTS AND DISCUSSION

This proposed method is applied by using Simulink Matlab based on toolbox. The type of FIS is called Mamdani which consists of two inputs and two outputs as shown in figure 2.

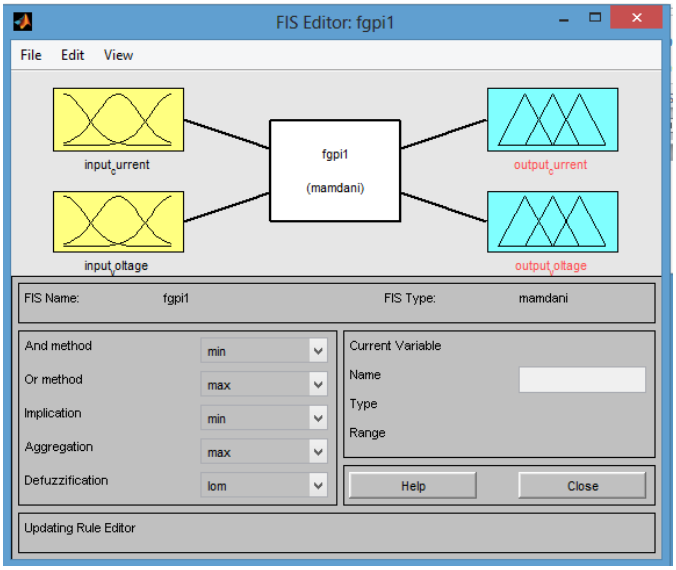

Figure 2. Simulink of FIS

The rule viewer and rules editor of FIS for this proposed method are shown in figure 3 and 4 respectively.

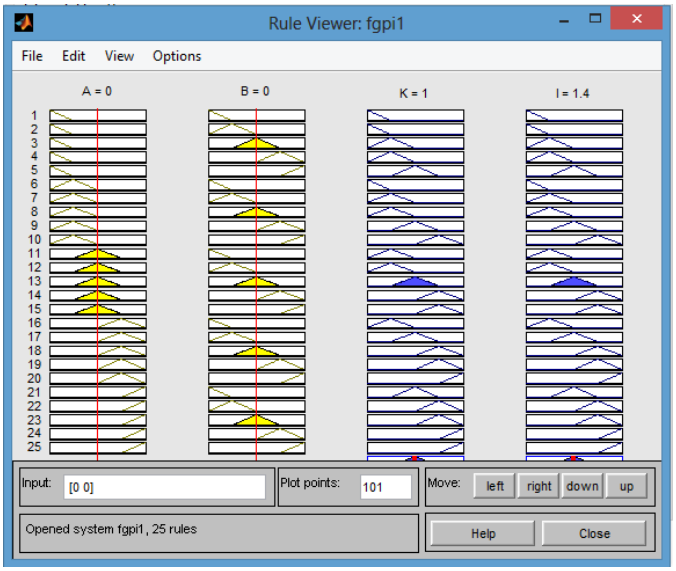

Figure 3. rule viewer of FIS

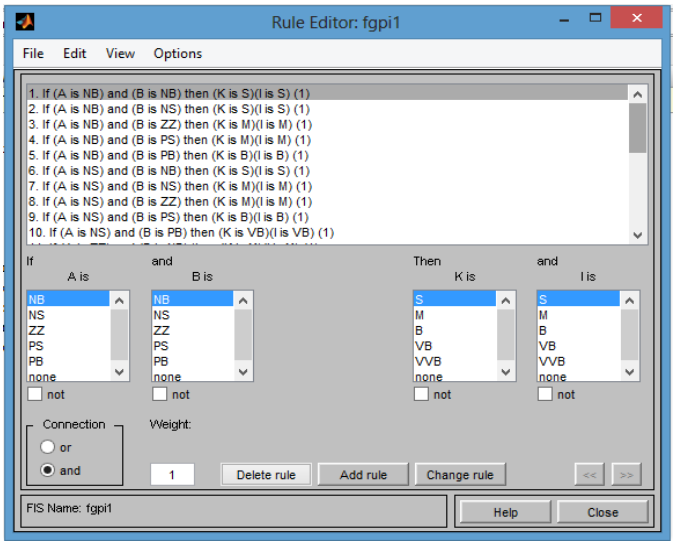

Figure 3. rule editor of FIS

In addition, the surface viewer of Proposed FIS is shown in Figure 4

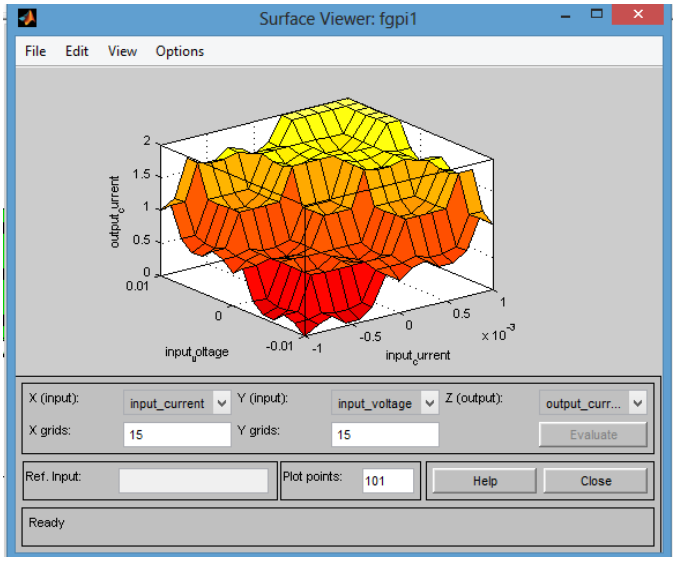

Figure 4. surface viewer of proposed FIS

From figure 5 and 6, it can be seen that the output current and voltage from inverter based on FIS-PID controller are smooth with low distortion as compared with classical MPPT.

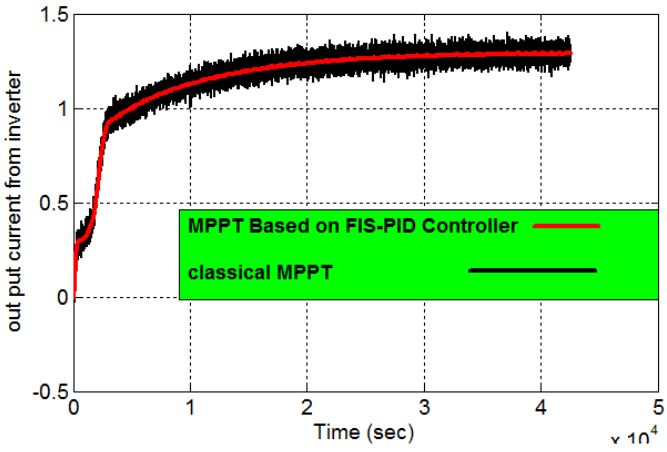

Figure 5. comparison of output current

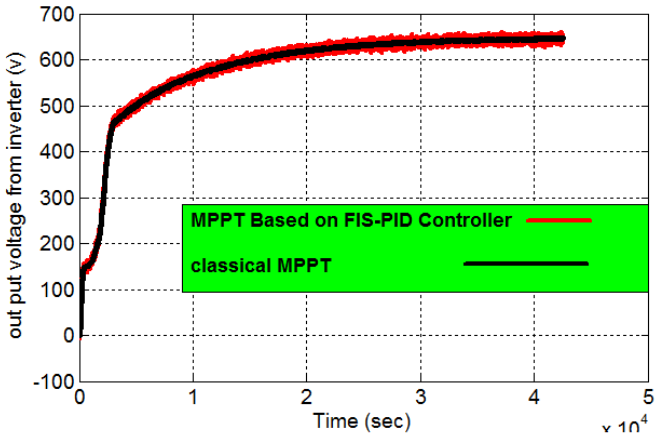

Figure 6. comparison of output voltage from inverter

Figure 7 shows that the output power from MPPT based on FIS –PID control is almost free of ripple with fast response. In contrast, the output power from classical MPPT is high ripple with slow response.

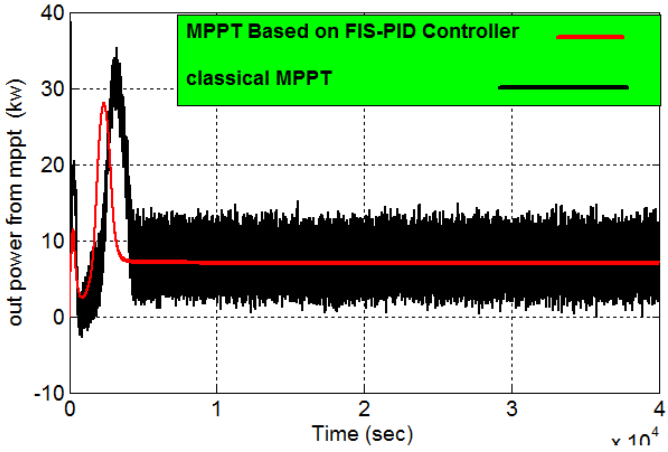

Figure 7. comparison results of output power from MPPT

The duty cycle from MPPT with respect to time based on FIS-PID controller is more sequence and without distortion as compared with duty cycle of traditional MPPT as shown in figure 8.

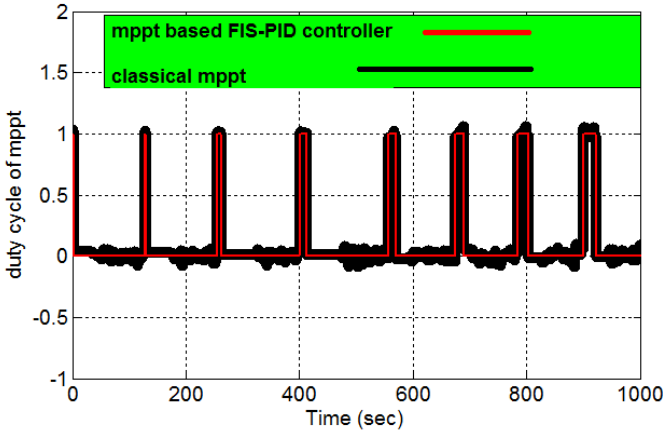

Figure 8. comparison results of duty cycle from MPPT.

CONCLUSION:

In this paper, the algorithm of FIS-PID control is proposed to optimize MPPT and to complete the constant voltage output. The proposed algorithm is exuted in Simulink Matlab and the results showed that the FIS-PID controller can not only optimize MPPT control, but also minimize the distortion of current and voltage output. In addition, the FIS-PID is used to reduce the amplitude of steady-state power fluctuation. The algorithm simplifies the control approach of MPPT system and modifies the stability of system efficiently.

REFERENCES

[1] M .G. Jaboori, M. M.Saied, and A.A Hanafy" A contribution to the simulation and design optimization of photovoltaic systems" IEEE Transaction Energy Conversion. Vol. 6. Pp. 401-406. 1991.

[2] Y. Kuo "Maximum power point tracking controller for photovoltaic energy conversion system" IEEE Transection indus. Electronics. Vol 48-2001.

[3] K. K. Tse, M.T. Ho, " A novel Maximum Power point tracking for pv channel using switching frequency modulation"IEEE Transection on power electronicsvol.17.no.6 November 2002.

[4] P. V. Niranjana, M. R. Shri, "A PV fed high step up converter with PID controller

[5] Wu.Z, Zhu. J. " cascade of PID controller of buck boost type DC/DC power converter in intelligent control and automation. WCICA 2006 the six world congress on. 8467-8471.

[6] Mahjoub Asseffi" Maximum power point tracking

control technique for photovoltaic system usingneural network" proceeding of sixth of annual international of renewable energy congress.2014. pp. 422-427.

[7] Liu. Y.and Lau. C. "neural network based MPPT for photovoltaic system operation under fast change environment solar energy. 2013. Pp. 42-53

[8] Ben Saleh. C. " Comparison of neural networks and fuzzy logic in maximum power point tracking for pv system. Electrical power system research.2011.pp.43-50.

[9] YUAN Jianhua,GAO Feng and GAO Houlei,"Unified energy control strategy of stand-alone photovoltaic system," Transactions of China Electrotechnical Society,vol. 26, Sup. 1,2011,pp.247-252.

[10] ZHANG Li,SUN Kai and WU Tianjin,"Energy conversion and management for DC microgrid based on photovoltaic generation,"Transactions of China Electrotechnical Society,vol. 28, Feb.2013,pp.248-254.

[11] Hassan Farhan Rashag, "Modified Direct Torque Control Using Algorithm Control of Stator Flux Estimation and Space Vector Modulation Based on Fuzzy Logic Control for Achieving High Performance from Induction Motors" Journal of Power Electronics (JPE), vol.13, no.3, 2013, pp. 369-380.