AN IMPLEMENTATION OF SOLAR BASED MPPT CONTROL USING ADVANCED FUZZY LOGIC TECHNIQUE IN SIMULINK

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Abstract—*This paper implement the advance of a fuzzy logic based MPPT controller used to track the maximum power of PV generator system composed of PV panel powering a resistive load via a DC-DC boost converter controlled using the proposed single sensor neural network MPPT. The presented fuzzy logic MPPT has been implemented and compared to the classical single sensor MPPT using Matlab/Simulink environment. Simulation results show that the proposed fuzzy logic MPPT performs better compared to the classical one regarding all considered metrics. The presented MPPT controller can effectively track the maximum power using only one sensor compared to other thus reducing the cost and the complexity of the PV MPPT controller*

Keywords**: **Solar Panel, computational efficiency, Maximum Power Tracking, Fuzzy Logic.

INTRODUCTION

Worldwide energy consumption has increased quickly due to world population growth. Solar energy from the sun is fruitful without environmental pollution. It does not consume the earth's resources and cause global warming. A solar panel is a device comprised of a number of solar cells connected series/parallel units which are used to convert solar energy into electricity. Solar panels have been used more and more each day. As the solar panel has been constructed, the only need is sunlight to create energy. The economic value of the solar panel is a popular choice to battle the rising cost of electricity. The solar energy technology has been developed for many years, but it is utilized today more than ever. One main reason for its rising usage is its renewable capability. The sun will always provide the Earth with more energy continuously than human being can consume.

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Objective

This paper implement the Fuzzy PI MPPT control method that is supplementing cumulative error and activity response characteristic. The Fuzzy PI MPPT method proposed analyses control characteristics about condition of radiation changing and compares with conventional methods.

METHODOLOGY

Disturbance observation (P&O) is also known as climbing method[7-10], its principle is that the output voltage of the photovoltaic system is disturbed, the output power changes of the system before and after disturbances are judged, and the system is controlled according to the principle of increasing the output power. Photovoltaic system controller in each control period use smaller step length to change the output of the photovoltaic array, the changing step length is a certain, the direction can be increased and can also be reduced, and the control object can be the output voltage or current of photovoltaic array, this process is called "disturbance"; the schematic diagram is shown in Figure 1,

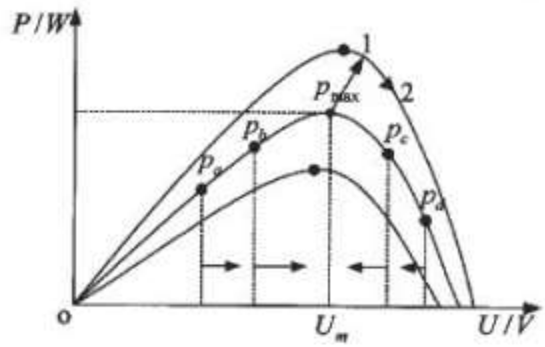


Figure 1: P&O Schemetic algorithm

Assuming that the initial point power of the photovoltaic battery working is Pa, as the voltage increases, the operating point moves to Pb at the next time, at this time HP=(Pb-Pa)>0, it shows voltages "disturbance" is in the right direction, and can continue "disturbance" according to the original direction, if the initial point of power is Pc, use the disturbance HP=(Pd-Pc)<0 of stated above methods, it shows voltage "disturbance" is in the wrong direction, at this moment, the direction of disturbance is changed to make the working point climb to the summit of the mountain from the other direction, so control repeatedly the change of the photovoltaic battery working point voltage, in order to realize that the operating point can work steadily near a Pmax of maximum power point in the end. Since the P&O algorithm has the advantages of a simple structure and easy to implement hardware circuit, it is widely used in maximum power point tracking of photovoltaic system.

But when external conditions such as the temperature of the light change quickly, tracking algorithm may fail to get wrong tracking direction by judging

FUZZY LOGIC MPPT CONTROL

Various meaningful MPPT techniques have formulated by many researchers [13, 14]. Recently, intelligence-based MPPT control techniques have been presented [15, 16, 17, 18]. In this paper, a fuzzy logic-based intelligent control technique associated with an MPPT controller is expressed to improve tracking efficiency. Fuzzy logic MPPT controller measures the voltage and current values at the output of the P.V. array and determines the P.V. power to derive the controller's inputs. The data to the fuzzy logic controller are taken as the error E and change in error C.E. The error E is set as the change in power concerning the change in voltage and is expressed as:

$$E = \frac{P(k) - P(k-1)}{V(k) - V(k-1)}$$

Hence CE can be written as:

$$CE = E(k) - E(k-1)$$

where P(k) and V(k) are the instantaneous power and voltage of the P.V. array. Figure and Figure show the input membership functions. The crisp output of the controller is the shoot-through duty ratio of the converter, and its membership function is shown in Figure. There are 49 inference rules applied and are summarized in Table 1 and shown in

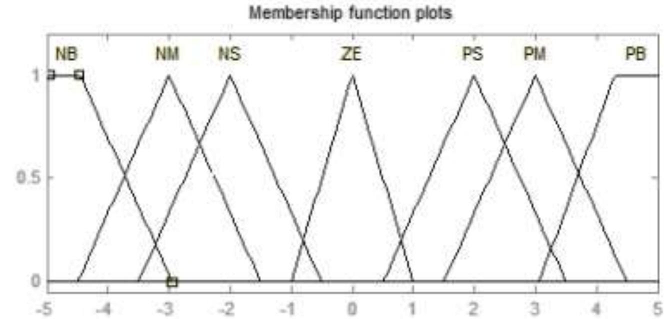


Figure. Membership function plots for E.

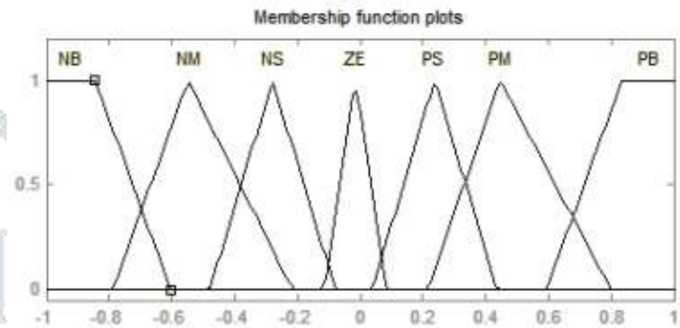


Figure. Membership function plots for C.E.

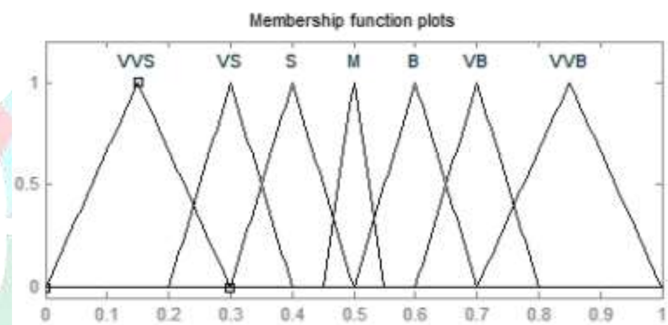


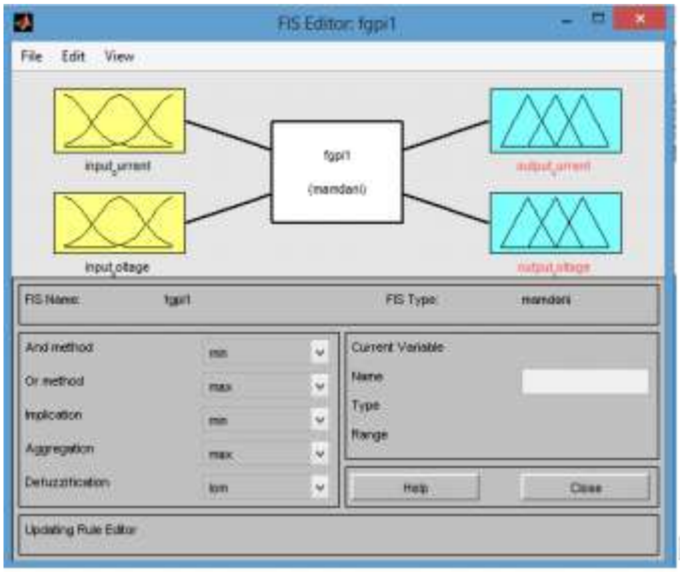
Figure. Membership function plots for D

E/CE	NB	NM	NS	ZE	PS	PM	PB
NB	M	M	M	VVS	VVS	VVS	VVS
NM	M	M	M	VS	VS	VS	VS
NS	S	M	M	S	S	S	S
ZE	VS	S	M	M	M	B	V.B.
PS	VB	B	B	B	M	M	B
PM	VB	VB	VB	VB	M	M	M
PB	VVB	VVB	VVB	VVB	M	M	M

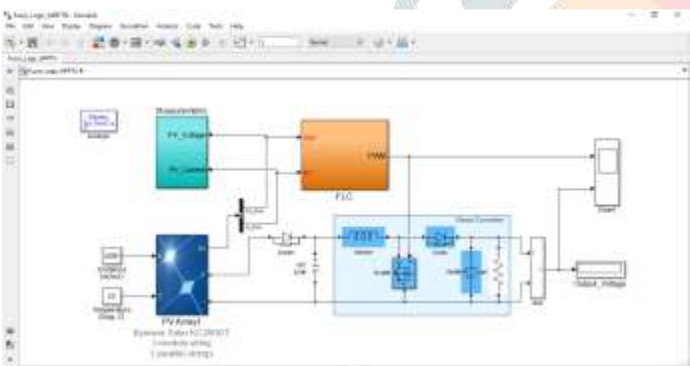
Table 1. Fuzzy rule base table.

RESULT AND DISCUSSION

The fuzzy agent with two input parameters, which are E=¨P/¨V and its change ¨E, enhanced by an initial estimation for the MPP voltage VMPP using the fractional open circuit voltage technique leads to a good power response. This presented 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.



This technique can achieves the maximum possible output power from the P.V. module (185 W) without any steady state error in a small searching time (10 m sec). The improvement can achieve by the proposed technique compared to the traditional fuzzy technique appears in the small searching time of the MPP by reducing the searching time to 20% from its traditional value. The developed MPPT technique shows a good response even under variable atmospheric conditions depending on the temperature adaptation of the initial estimation of VMPP and the closed loop advantage of the fuzzy control scheme



The output PV power has a maximum dependent on the atmospheric conditions. To convert the energy available with the best performance, it is essential to work around an optimal operating point corresponding to the maximum power delivered by the PV generator. This is possible byadapting constantly the generator through the converter used for the indirect coupling mode that acts as an adaptive impedance.

CONCLUSION

In this describe a methodology, an MPPT technique is designed to control the photovoltaic system. In this paper, the algorithm of FIS-PID control is implenmented to optimize MPPT and to complete the constant voltage output. The proposed algorithm is executed 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.

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