IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

PERFORMANCE ANALYSIS OF STANDALONE PV SYSTEM USING FLCMPPT SCHEME

[1]K.Ramesh,[2]M. Madhusudhan Reddy,[3]Dr.A.Ramesh,

[1]PG student,[2]Assistant Professor,
[1]EEE Department,
[1]Dr.K V Subba Reddy Institute of Technology, Kurnool,India
[3]B.I.T.Institute of Technology,Hindupur.

Abstract:This paper presented the Fuzzy Logic Controller (FLC) based MPPT scheme for the PV system**.**The projectedPV system istype of standalone PV system which consists of boost converter. Boost converter requires the duty cycle to control it. The duty cycle reference signal is produced using FLC signal. The projected FLC is verified in diverse situation of irradiance. The projected controller performance is contrast with Perturb and Observe (P & O), Incremental Conductance and improved Incremental conductance. The projected work is implemented in Matlab software.

***Index Terms* - Fuzzy Logic Controller,MPPT,PV system,Irradiance,Boost Converter.**

I. INTRODUCTION

One of the primary worries in the power industry is that the daily demand for electricity is rising, but there are not enough resources available to satisfy that demand using traditional forms of energy. In order to satisfy the need for energy, there has been a growth in the demand for conventional energy generation systems to work in conjunction with renewable energy sources.This is one of the most significant challenges facing the industry [1].In this context, the primary energy sources that are being employed are renewable sources such as wind energy and solar energy.The consistent consumption of fossil fuels has led to a depletion of fossil fuel deposits, as well as severe negative effects on the surrounding environment, such as the destruction of the biosphere and a cumulative contribution to global warming [2]. Because solar energy is readily available in such large quantities, it can now be collected and utilized in an effective manner. Depending on the proximity of an existing power grid, solar energy can either function as a generator that operates independently or as a generator that is connected to the grid. As a result, it can be put to use to provide power to remote areas, where there is a very limited availability of grids. One additional benefit of utilizing solar energy is the portability of the operation, which may be done whenever and wherever it is necessary.Power from photovoltaic (PV) devices, such as solar panels, must be converted from direct current (DC) to utility frequency (AC) before it can be used by consumers who are not connected to the grid [3].Throughout the past few decades, the control problem of grid-connected PV inverter systems has attracted a lot of attention due to the rising demand for solar power [4].On the other hand, the enormous weather swings mean that the amount of sunlight is not always predictable, and the dispersed installation of solar panels makes it harder to identify when there is a problem with the system.Because of these circumstances, it will be difficult to maintain control of the PV inverters and ensure that they continue to function effectively [5-8].The Maximum Power Point Tracking (MPPT) module is an essential component of the inverter system. Within the permissible range of voltage, there is a maximum power point that can be reached by each type of solar panel, which experiences its own unique level of insolation.In the research that has been done on MPPT, a great number of different ways have been suggested. Some examples of these methods include the Perturb and Observe (P&O) methods, the Incremental Conductance (IC) methods, improved Incremental conductance and the Artificial Neural Network method.These methods differ from one another in a variety of ways, including ease of use, speed of convergence, ease of hardware implementation, number of sensors required, cost, usefulness across a range of situations, and requirement for parameterization [9-10].

II. PHOTOVOLTAIC

In order to obtain high voltage and current output, a PV module is constructed comprised of PV cells connected in series and parallel.The common technologies for photovoltaic cells can be broken down into four categories: multi-crystalline, mono-crystalline, thin-film, and multi-junction PV cells.In most cases, the photovoltaic (PV) model will include a photocurrent source, resistors and diodes.A solar photovoltaic panel is a device that can be used to generate power.The V-I property of the photovoltaic (PV) cell can be represented by the equation (1).

$$I = I_{SC} - I_0\left(e^{\frac{q(V+IR_s)}{kT}} - 1\right) - \left(\frac{V+IR_s}{R_p}\right) \quad (1)$$

Where, R_s and R_p are the resistances that are considered while analyzing the effect of shading and losses respectively.Irradiation and temperature are, without a doubt, two critical aspects that must be taken into consideration in the process of calculating the amount of power that may be produced by a solar photovoltaic panel.These parameters have a significant impact on the properties of solar photovoltaic panels.A DC/DC converter known as a boost converter is one that has the capability of producing V_{OUT} voltages that are higher than V_{IN} voltages.The basic circuit used for a boost converter and its waveforms are given in Fig. 1.While the switch (Q1) is in the "ON" position, the boost converter makes use of an inductor (L) to store the energy coming from the input source. The inductor (L) is energized by the input voltage while Q_1 is closed for a time period of T_{ON}; hence, the inductor current increases linearly from its current value, I_{L1}, to its final value, I_{L2}.

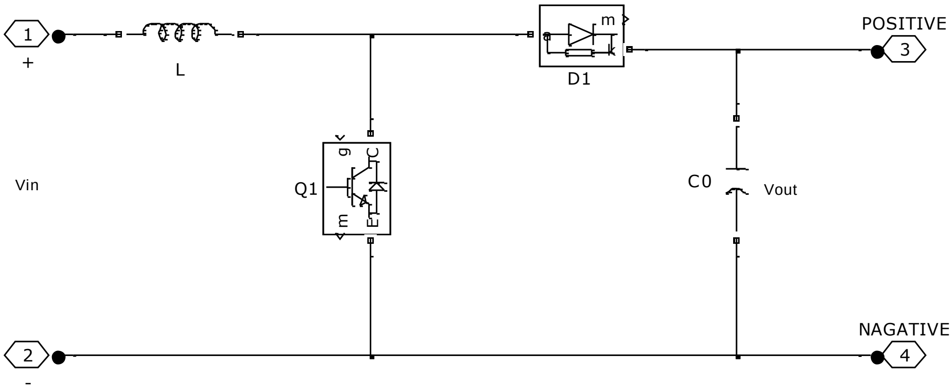


Fig.1: Boost circuit

III. MAXIMUM POWER POINT TRACKING

A maximum power point tracking controller, or MPPT controller, is a type of controller that monitors the maximum power point locus of a photovoltaic array.General block diagram of MPPT controller is illustrated in Fig.2.

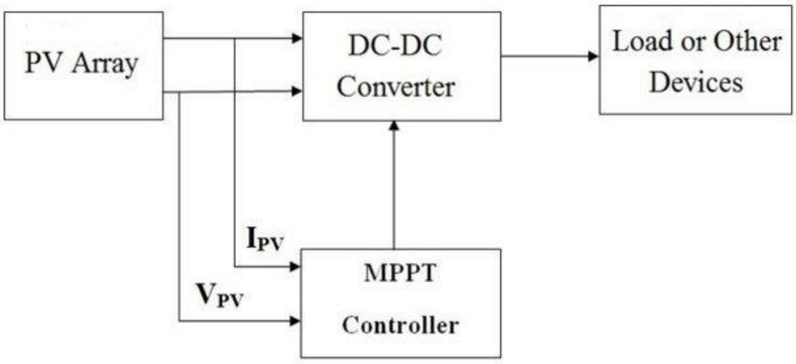
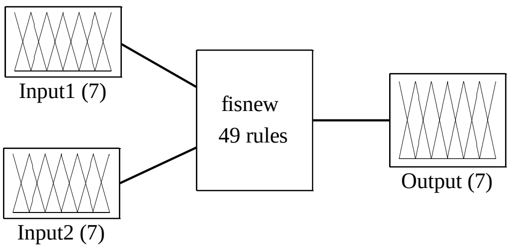


Fig.2: Block diagram of MPPT

Assuming the solar irradiation quickly rises to 1000 W/m^2 before the next MPPT decision is made. Because of this, the algorithm is able to deduce that there has been an increase in both the power and the voltage, as evidenced by the fact that it has moved from one spot to another. As a direct consequence of this, the algorithm issues instructions to the system to raise the voltage.The sample interval and the duty-cycle perturbation of the algorithm both have an influence on the performance of the Perturb and Observe technique.It is recommended that the sample interval of the algorithm be set as low as feasible without causing the system to oscillate or to deviate from the MPP. In that case, the instability will bring to a reduction in the PV's efficiency. The problems that are inherent in the Perturb and Observe approach are resolved by using the Incremental conductance method. It takes use of the fact that there is no change in the power's derivative with respect to the voltage while it is at its maximum power point. The incremental conductance can make the determination that the MPPT has arrived at the MPP, at which point the operating point will no longer be perturbed. The FLC has found widespread use in the MPPT for solar photovoltaic (PV) systems, which allows for improved performance in comparison to traditional approaches. The primary steps that are involved in FLC systems. These stages include the fuzzification stage, the fuzzy inference engine and the defuzzification stage. With FLC systems designed for use in MPPT applications, one output is generated using a combination of two inputs. This allows the system to function in the MPP mode. The proposed FLC model is presented in Fig.3.FIS system of FLC includes two input membership functions, 49-rule based system and output membership function is shown in Fig: 4. Triangular membership functions of an input1, input2, and output signals are presented in Fig: 5 and Fig: 6 respectively. The 7X7 rules based MFs are listed in Table 1.



System fisnew: 2 inputs, 1 output, 49 rules

Fig. 3: FLC membership functions (MF) with two input and single output

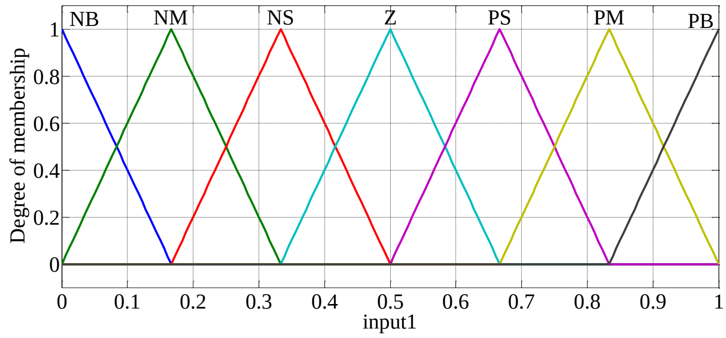


Fig. 4: Triangular MF of input1

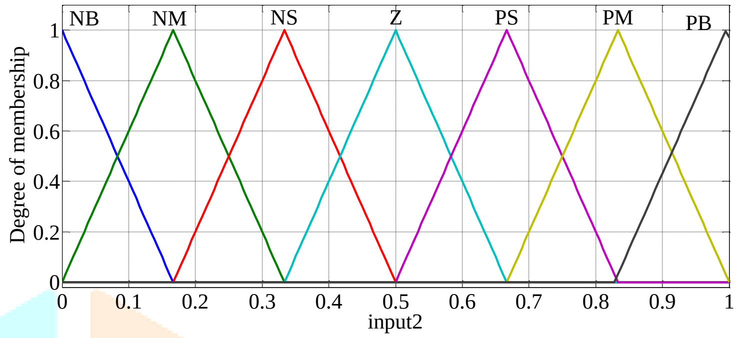


Fig. 5: Triangular MF of input2

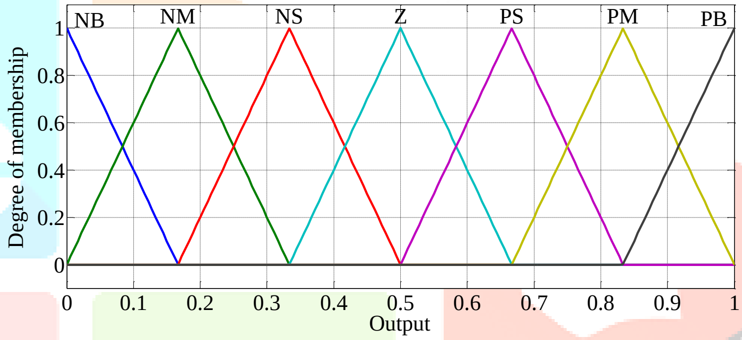


Fig. 6: Triangular MF of output

ble1: MF Rules

	Capacitor Voltage Error							
Capacitor Voltage Change of Error		NB	NM	NS	Z	PS	PM	PB
	NB	NB	NB	NB	NB	NM	NS	Z
	NM	NB	NB	NB	NM	NS	Z	PS
	NS	NB	NB	NM	NS	Z	PS	PM
	Z	NB	NM	NS	Z	PS	PM	PB
	PS	NM	NS	Z	PS	PM	PB	PB
	PM	NS	Z	PS	PM	PB	PB	PB
	PB	NB	NM	NS	Z	PS	PM	PB

IV. RESULTS AND DISCUSSION

Simulations are performed using MATLAB/SIMULINK software for tracking MPPs of the solar PV array whose specifications and parameters are in Table 2. The variation of irradiance is shown in Fig.7.

Table 2: Simulation parameters

S. No.	Description	Values
1.	Maximum power, P_{max}	22 W
2.	Short-circuit current, *Is* c	1.34 A
3.	Open-circuit voltage, *Voc*	21.99 V

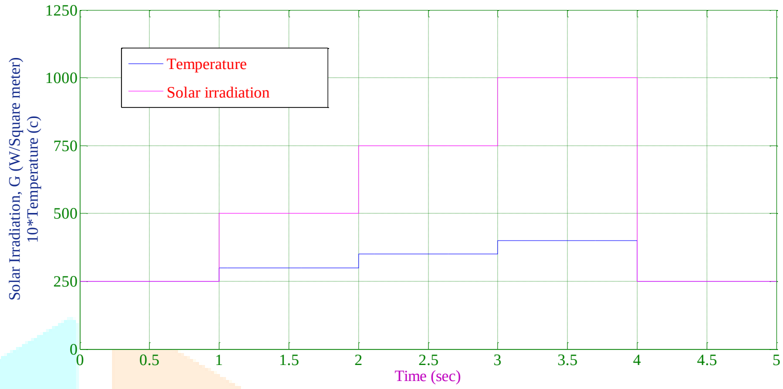


Fig.7:The variations of the solar irradiation and temperature

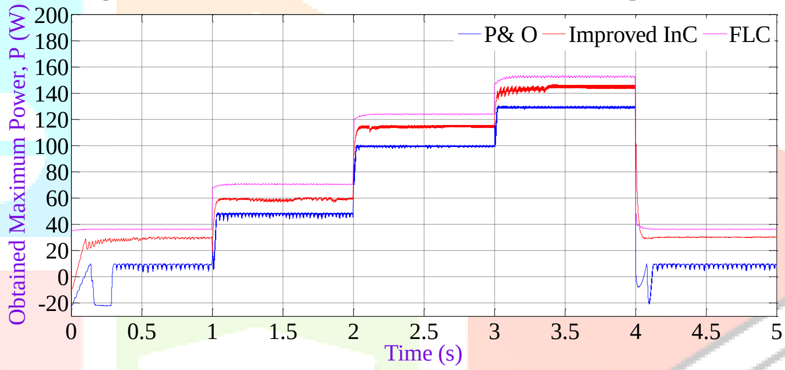


Fig.8:OMP with the P&O, improved InC algorithms and FLC under the variation of the solar irradiation

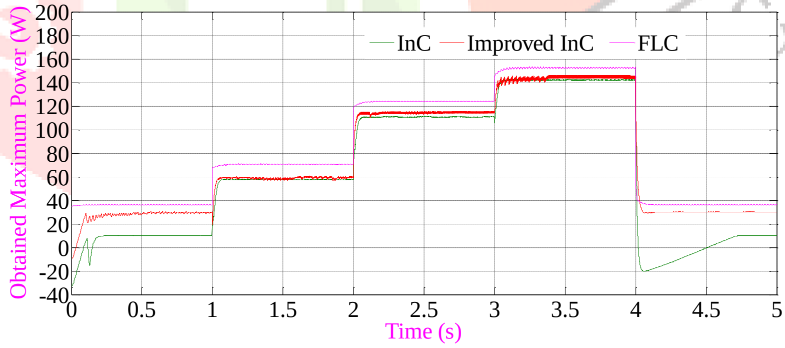


Fig.9:OMP with the InC and improved InC algorithms under the variation of the solar irradiation

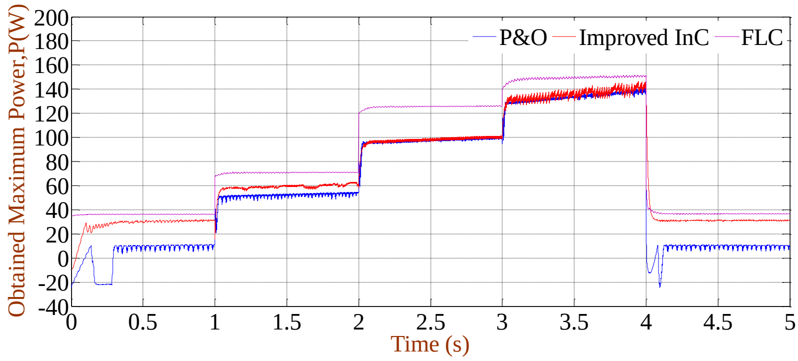


Fig.10:OMP with the P&O and improved InC algorithms under both the variations of the solar irradiation and temperature

The acquired output powers are displayed as Fig. 8, Fig. 9, Fig.10, &Fig.11 utilizing the P&O, InC, enhanced InC algorithms, and FLC under the variation of both the temperature and the sun irradiation. These figures were created using the P&O, InC, better InC algorithms, and FLC. It is possible to recognize that the simulation results of the instances using the FLC are always superior to the cases using the P&O, improved InC algorithm, and FLC algorithms combined. This is the case regardless of the circumstances. The better results can be seen through the algorithm's convergence and the MPPs' capacity to track, particularly in light of the rapid variation in temperature and sun irradiance. This indicates that the flaws that were present in the InC method have been fixed by employing the FLC algorithm that was proposed.

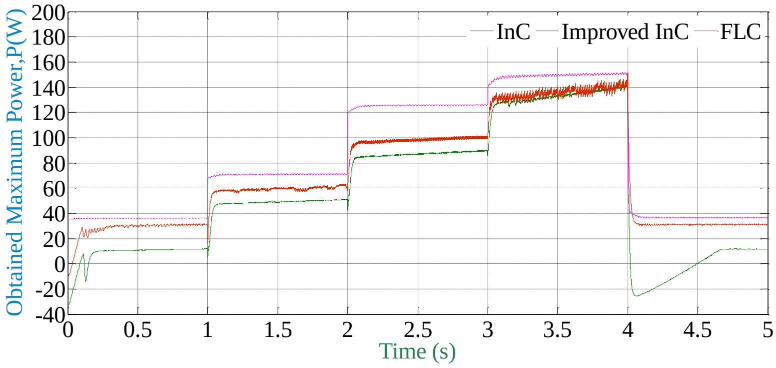


Fig.11:OMP with the InC and improved InC algorithms under both the variations of the solar irradiation and temperature

V. Conclusion

The InC algorithm is an improvement on the traditional InC algorithm. This improvement comes in the form of an approximation that lowers the computational burden, as well as the application of the CV algorithm to limit the search space and speed up the convergence of the InC algorithm. Both of these features help the InC algorithm converge more quickly. This enhancement eliminates the deficiencies that were previously present in the InC algorithm. Validation of the FLC control technique in the solar PV panel was accomplished through simulation studies by comparing it to P & O, Inc and improved Inc.

Refeences

[1] J. H. R. Enslin, M. S. Wolf, D. B. Snyman, and W. Sweigers, “Integrated photovoltaic maximum power point tracking converter,” IEEE Trans. Ind. Electron., vol. 44, no. 6, pp. 769–773, Dec. 1997.

[2] D. C. Huynh, T. N. Nguyen, M. W. Dunnigan, and M. A. Mueller, “Dynamic particle swarm optimization algorithm based maximum power point tracking of solar photovoltaic panels,” in Proc. IEEE Int. Symp. Ind. Electron, 2013, pp. 1–6.

[5].D. C. Huynh, T. M. Nguyen, M.W. Dunnigan, andM. A.Mueller, “Global MPPT of solar PV modules is using a dynamic PSO algorithm under partial shading conditions,” in Proc. IEEE Int. Conf. Clean Energy Technol., 2013, pp. 133–138.

[6].G. M. Master, “Renewable and efficient electric power systems,” in Renewable and Efficient Electric Power Systems. New York, NY, USA: Wiley, 2004, pp. 385–604.

[7].B. Liu, S. Duan, F. Liu, and P. Xu, “Analysis and improvement of maximum power point tracking algorithm based on incremental conductance method for photovoltaic array,” in Proc. 7th Int. Conf. Power Electron.Drive Syst., 2007, pp. 637–641.

[8].W. Ping, D. Hui, D. Changyu, and Q. Shengbiao, “An improved MPPT algorithm based on traditional incremental conductance method,” in Proc.4th Int. Conf. Power Electron. Syst. Appl., 2011, pp. 1–4.

[9].Y. Zhihao and W. Xiaobo, “Compensation loop design of a photovoltaic system based on constant voltage MPPT,” in Proc. Asia-Pacific Power Energy Eng. Conf., 2009, pp. 1–4.

[10].K. A. Aganah and A. W. Leedy, “A constant voltage maximum power point tracking method for solar powered systems,” in Proc. IEEE 43rd Southeastern Symp. Syst. Theory, 2011, pp. 125–130.