SOLAR CELL MODELLINGANDBASIC DC-DC CONVERTERS USING NEURAL NETWORK

[1]Abdul Basit Khan, [2]Dr. Imran Khan, [3]Dr. Malik Rafi

Electrical Engineering Department,
Azad Institute of Engineering and Technology affiliated to Dr.A.PJ.Abdul Kalam Technical University
Lucknow, 226002, Uttar Pradesh, India

***Abstract*: This article represents an overview of the Maximum power characteristics of Via MPPT with Neural Network, The Neural network, the Perturb and, observe (P&O) and Neural + PID are the most known and utilized strategies. Other altered routines, for example, the incremental Conductance (INC) method, the Neural Network system (NN) strategy, and fluffy rationale controller procedure have been likewise answered to enhance the execution of these methods.**
The enhancements of neural network MPPT by learning the neural MPPT by taking observations of P&O and further addition of PID controllers can reduce the response time along with harmonic distortion. Thus the network is very effective, however, if the fuzzy logic controller can replace the PID controller then neural with fuzzy logic can further improve these two distinct parameters further.

***Keywords*: MPPT, NEURAL NETWORK, INCREASE EFICIENCY OF SOLAR PANNEL**

1. Introduction

The generation of Electrical Energy Worldwide based on very limited finite non-renewable Capital (petroleum, Water, Nuclear). Issues of globalization and environmental pollution due to energy have become a big concern As a result. It can be decreased by the utilization of photovoltaic (PV) array. Photovoltaic has the capacity to Produce electricity quiet reliable. Thus, the photovoltaic process is convert electricity from sunlight. PV cells transform sunlight directly into electricity

Without generating any unwanted material. The Neural network, the Perturb and, Observe (P&O) and Neural + PID are the most known and utilized strategies. Other altered routines, for example, the (INC) method, the Neural Network system (NN) strategy, and fluffy rationale controller procedure have been likewise answered to enhance the execution of these methods. The extra control circle brings about an increment in the P&O proficiency, as the framework shows a speedier dynamic execution. The P&O strategy is usually utilized in light of its straightforwardness and simplicity of execution. Moreover, P&O (with a little step size) in ostensible conditions can have MPPT efficiencies, for the most part, the same as other complex procedures, and still less demanding execution. However, the drawback of this technique is that the operating point of the PV array oscillates around the MPP. Therefore, the power loss may increase. Furthermore, when the solar radiation changes rapidly, the P&O method probably fails to way the MPP. Some disadvantage is that the MPPT may not be to locate the MPP as the number of sunlight decreases because the PV curve flattens out. In this dissertation performance of P&O method, Neural Network and Neural + PID method has been done and shown very precisely.[1]

2. Structures of Photovoltaic Cells

In the conversion of sunlight into electricity by a photovoltaic cell (PV cell), the physical process involved is Photoelectric effect. The device that converts solar radiation into electricity is called a photovoltaic cell. The light is absorbed and the electrons in the atoms of the PV cell and get energy from the absorbed light. And hence after absorbing energy these electrons start their position and becomes a part of the current in the circuit.

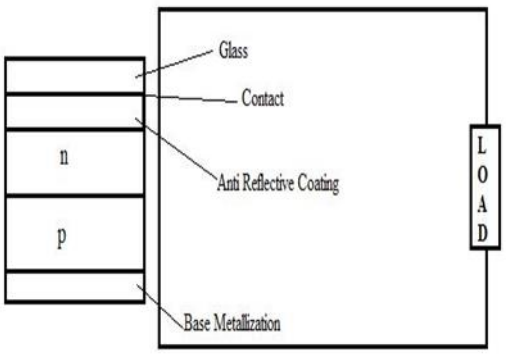

Figure 1 Structures of Photovoltaic Cells

2.1 Solar Cell Model

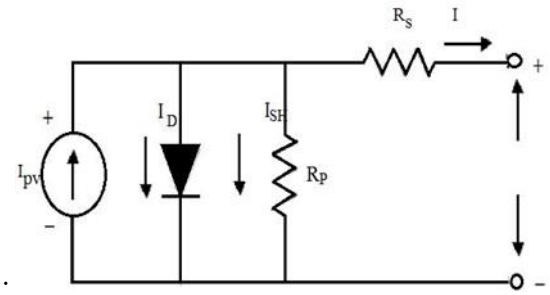

Figure 2 Single Diode Mathematic Model of PV Cell

$$I_{pv} = I_{ph} - I_s\left[exp^{\left(\frac{V_{pv}+R_{S,pv}T_{pv}}{nN_sV_T}\right)-I}\right][2]$$

Where I= The photovoltaic output current
V=The photovoltaic output voltage.
$V = N_S\ kT$= The thermal voltage of array with N_s cells connected in series q
Q=The electron charge ($1.60217646e^{-19}C$)
K= Boltz man Constant
T= The Temperature of P-n Junction
α = The Diode Ideality Constant.

2.2 PV ModuleCharacteristics

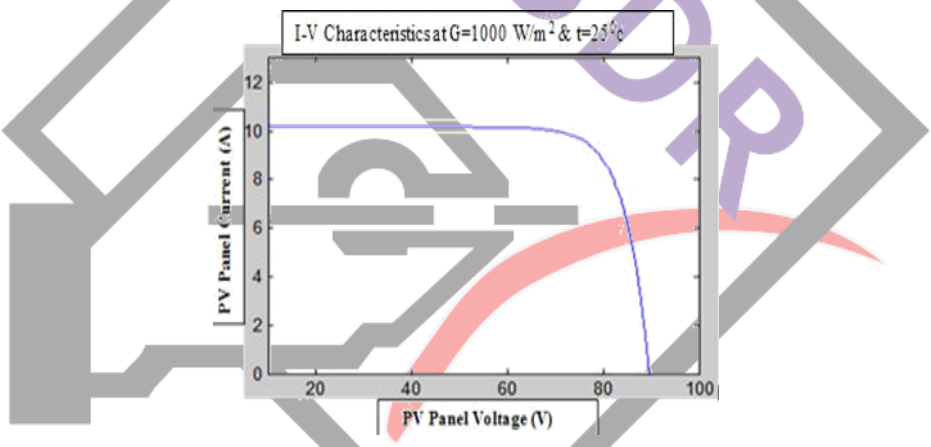

Figure 3 I-V Characteristics of Photovoltaic Panel

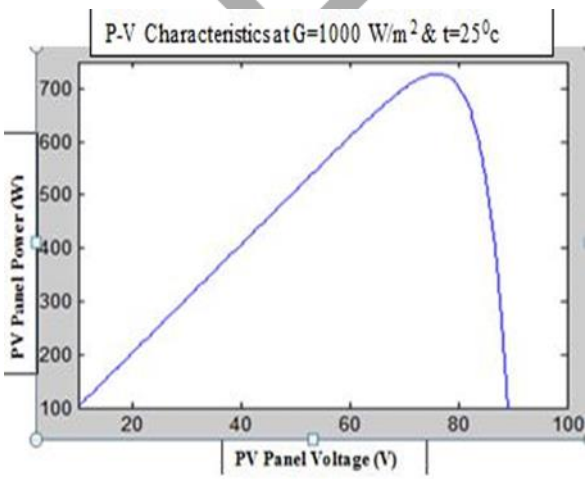

Figure 4 V-I Characteristics of Photo Voltaic Panel

3. Maximum Power Point Tracking (MPPT)

Maximum power point tracking (MPPT) is a power electronic system which tracks the maximum power point on the characteristic curve of the PV module. In this system of power electronics, the maximum power point is tracked on the characteristic curve of the PV module, line, the solar insulation is varying throughout the day. A fundamental component of MPPT is an efficient DC-to-DC converter. Whose control is done by power electronics switch operated by an algorithm?

Power based methods which utilize iterative algorithms to track continuously the MPP

Through the current and voltage measurement of the PV module. In this category, one of the most successful and used methods is perturbation and observation (P&O).[3]

A dynamic following strategy is important to separate the greatest power from the PV cells [7]. Numerous looks into has been created concerning the various calculations for the most extreme power point following (MPPT) thinking about the varieties of the framework parameters and additionally climate changes [3],[7], for example, bother and watch technique, open and short out strategy, neural system and neural system with PID, gradual conductance calculation, fluffy rationale. The square graph in Figure presents a PV framework with MPPT [8]. The heap can be bolstered from a PV board utilizing a MPPT circuit with a particular controller to follow the pinnacle power produced by the PV board. Other assurance gadgets can be included. The control circuit takes voltage and current criticism and produces the obligation cycle D of the Boost converter [9]. Numerous MPPT control methods have been considered for this reason these last decades [11]. They can be named:

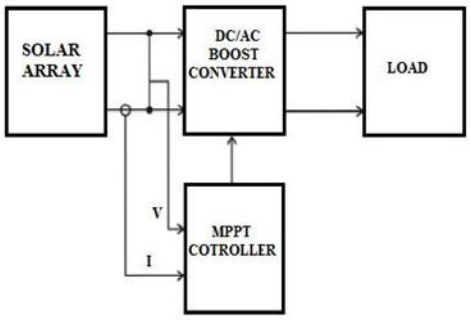

Figure 5: Operation of Block Diagram of the PV System

4. P&O controller method

It is less complex MPPT control. Perturb & Observe (P&O) is on the array output power and on the change (add or subtracting) of the power respect to change in array voltage or current. The simplest one used to maintain the PV array voltage. Its implementation cost is less. The Perturb, and Observe (P&O) method define that defines that when the operating voltage, of the PV panel is perturbed by a small addition and the resulting change in power P is positive, then it means that the direction of MPP is followed and the system continues to perturbation in the same direction.

5. Neural Network based MPPT

A system of program and data structure that approximate the operation of the human brain is known as Neural Network. A large number of parallel operating processes are involved in the neural network. A Neural Network is trained firstly, i.e. a large amount of data and rules are fed. A program is used to let the network know how to behave in response to an internal stimulus or how to initiate an activity on its own.[5]

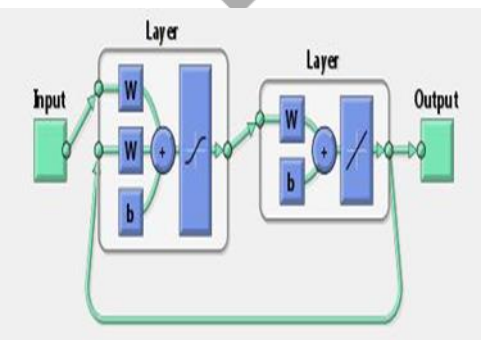

Figure 6: Architecture of Neural Network using MATLAB

Natural sensory systems are used to enliven these components. A neural system can be trained to perform a specific capacity by conforming the qualities of the weights between components. For nonlinear dynamic systems, artificial neural networks are proved

to be universal approximations. A multilevel Neural Network is to emulate nonlinear systems [7]. Neural Network is used to provide an improved method of deriving nonlinear models which is complementary to the conventional technologies.

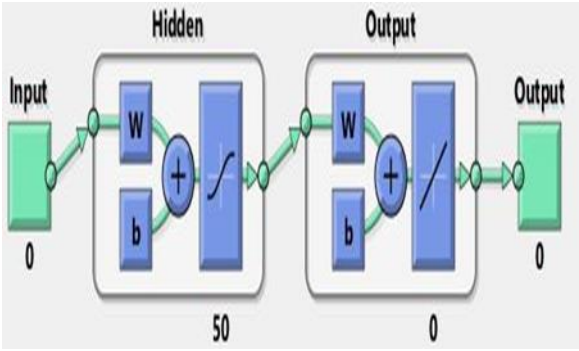

Figure 7: Architecture of Feed-Forward Neural Neural Network using MATLAB

6. Neural Network with PID Based MPPT

A. PID Controller

The majority of control loops in the different industry consist of Proportional-Integral-Derivative (PID) controllers. The output process can be regulated easily with the help of a PID controller[5]. In the process control industry, the optimal operation of Proportional-Integral-Derivative (PID) controller is needed. These optimal operations are economical. Recently the robust control is very important in control engineering. In this dissertation, the design method of obtaining the Proportional-Integral-Derivative (PID) controller is robust and stabilized in the process of time delay. This design method is dependent on the frequency response of the system. Therefore is method reduces the complexity present in plant modeling. Our controller design method is very important for the process control because time delay is parametric uncertainties are present in the real-time process. In this design method DC model with a communication delay and single area not reheat stream generation unit is used. The result obtained is satisfactory. For the perturb plants the robust stability is achieved. The integral controller reduces steady-state error and proportionally reduces overshoot and derivative controller reduces rise time.[10]

7. Simulation Model in N-Network based MPPT Technique.

The first section of the simulated model is a PV array, in which temperature and solar irradiance are absorbed to generate electricity. The output of the PV array depends on two things: Temperature and Irradiance. Therefore current is generated at an output voltage of PV array. The current is needed two MPPT and current controlled source (c.c.s.) both. This leads to the charging of capacitor (DC Bus) and the output of the DC bus is fed to DC-to-DC Boost converter. In DC-to-DC boost converter, MOSFET is used as a switch whose GATE signal is controlled and given through Neural Network based maximum power point tracking (MPPT). All the circuit is similar to the previous simulated model only P&O based MPPT is replaced by Neural Network based MPPT.

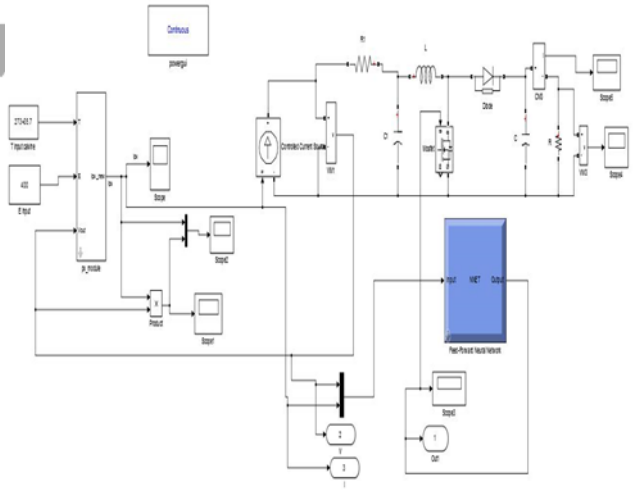

Figure 8:Simulation Model in Neural Network-Based MPPT Technique.

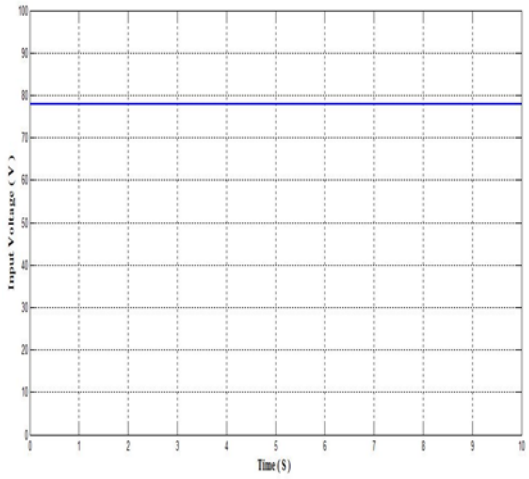

Figure 9: The Input Voltage Waveform of Neural Network Based MPPT Technique

The input voltage of the PV array obtained is 79 volt.

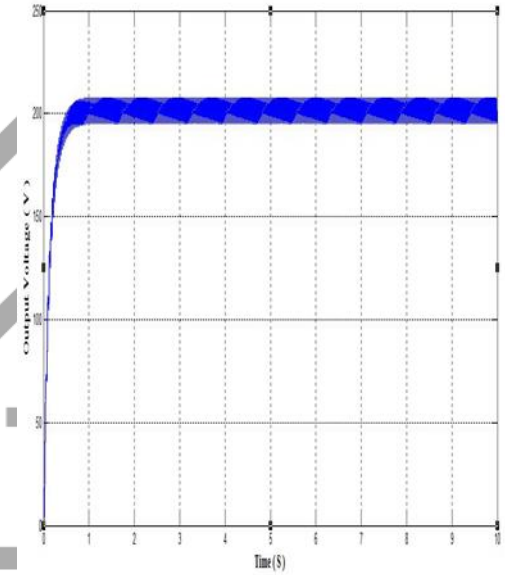

Figure10: The Output Voltage Waveform of Neural Network Based MPPT Technique

The Output voltage obtained is after using Neural Network based MPPT is 200 volt.

8. Conclusions

This work has displayed the demonstrating of PV module and the advancement of the MPPT strategies. Specifically, the exhibitions of the controllers are dissected in these three conditions with consistent illumination and temperature. The proposed framework is recreated by utilizing MATLAB-SIMULINK. We have considered in our present research work the recreation of three strategies for control: Perturb and Observe (P&O) and Neural Network based MPPT and Neural Network with PID based controller MPPT. They were connected on sunlight based photovoltaic Array to change over the voltage and current contribution to a fitting obligation cycle. We thought about the got reenactment results, by exposing the controlled framework to the equivalent ecological conditions. The reenactments have demonstrated that the utilization of neural system controller can improve the productivity of the general framework by limiting the vitality misfortunes when the difference in illumination is visit instead of the traditional strategy, for example, irritate and watch procedure.

REFERENCES

[1]. P. Kundur, “Power System Stability and Control”, McGraw-Hill, 1994.
[2]. K. R. Padiyar and A. L. Devi, “Control and simulation of static condenser,” in Proc. 9thAnnu. Applied Power Electronics Conf. Expo., Feb. 13-17, 1994
[3]. Y.H. Song and A.T. Johns, “Flexible ac transmission systems (FACTS)”, The Institute of Electrical Engineers, London, 1999.
[4]. N.G. Hingorani and L. Gyugyi, “Understanding FACTS: concepts and technology of flexible ac transmission systems”, IEEE Press, NY, 1999.
[5]. P. Rao, M.L. Crow and Z. Yang, “STATCOM Control for Power System Voltage Control Applications”, IEEE Transactions on Power Delivery, Vol. 16, pp. 18-23, 2000.

[6]. H. Saadat, “Power System Analysis”, McGraw-Hill, 2002.
[7]. K.R.Padiyar “FACTS Controllers in power transmission and distribution”, New Age international Publishers, 2007.
[8]. S.H. Hosseini, A. Ajami, "Transient stability enhancement of AC transmission system using STATCOM," TENCON '02.Proceedings. 2002 IEEE Region 10 Conference on Computers, Communications, Control and Power Engineering , vol.3, no., pp. 1809- 1812 vol.3, 28-31 Oct. 2002.
[9]. M.H. Haque, “Damping improvement using facts devices”. Electrical Power Syst. Res.Volume 76, Issues 9-10, June 2006.
[10]. P.Kumkratug;, "The Effect of STATCOM on Inter-Area Power System Stability Improvement," Computer Modeling and Simulation, 2008. EMS '08.Second UKSIM European Symposium on, vol., no., pp.359-363, 8-10 Sept. 2008.