ISSN 2277 – 5528
Impact Factor- 4.015

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

DIFFERENT TECHNIQUES FOR MAXIMUM POWER POINT TRACKING FOR PV SYSTEM

Md Naqui Akhtar*[1], Md Abu Shahma Razmi[2], Jitendra Narayan[3]
*[1]Lecturer, Dept of Electrical Engineering, Government Polytechnic, Latehar, Jharkhand, India.
[2]Engineer,Visvesvaraya Technological University, Belgaum, Karnataka,India
[3]Principal, Dept of Mechanical Engineering, Government Polytechnic, Latehar, Jharkhand, India

ABSTRACT

Solar energy is clean, renewable and is available approximately well at the scattered state of the zones with low density of population. The cost of electricity from the solar array system is more expensive than the electricity from the utility grid. So, it is necessary to operate the Photovoltaic system at maximum efficiency by tracking maximum power point at any environmental condition. Photovoltaic (PV) generation is becoming increasingly important as a renewable source since it offers many advantages such as incurring no fuel costs, no polluting, requiring little maintenance, and emitting no noise. PV modules still have relatively low conversion efficiency. So it is essential for controlling maximum power point tracking (MPPT) for the solar array in PV system. The Maximum Power Point Tracking (MPPT) is a technique used in power electronic circuits to extract maximum energy from the Photovoltaic (PV) Systems. To improve the energy efficiency, it is important to operate PV system always at its maximum power point. Maximum power point Tracking (MPPT) techniques for obtaining MPP are discussed in this paper

Keywords: Photovoltaic system (PV-system), Solar Energy, Maximum Power Point Tracking (MPPT)

I. INTRODUCTION

Renewable sources of energy acquire growing importance due to its enormous consumption and rapid exhausting of fossil fuel. The world is experiencing a great need for additional energy resources so as to reduce dependency on conventional energy sources, and renewal energy could be an answer to that need. Renewable energy becomes an essential source for many applications in the last four decades.

Solar energy is the most available source of energy and it is free. Energy supplied by the sun in one hour is equal to the amount of energy required by the human in one year. It is difficult to supply electrical energy to small applications in remote areas from the utility grid or from small generators. Energy generated by Photo voltaic systems can be used in many applications such as water pumping, street lighting in rural town, battery charging and grid connected PV system. In addition, solar energy is clean, renewable and its decentralized character is appropriate well even at low populated areas around the globe. Consequently, it can contribute to the environmental protection and can be regarded as an alternative in future to conventional energies. There are two ways to generate electricity from sun; through photovoltaic (PV) and solar thermal systems. Generally, PV systems can be divided into three categories; stand-alone, grid-connection and hybrid systems. For places that are far from a conventional power generation system, stand-alone PV power supply system has become a good alternative. Stand alone photovoltaic (PV) systems are the best solutions in many small electrical energy demand applications such as communication systems, water pumping and low power appliances in remote area.

The characteristics of the PV module clearly indicate that the operating point of the module is not same as the maximum power point of the module. The electrical characteristics of PV module depend on the intensity of solar radiation and operating temperature. Increased radiation with reduced temperature results in higher output. The aim of the tracker is to derive maximum power against the variations in sunlight, varying atmosphere and temperature and local surface reflectivity. The electrical characteristic of PV module depends on the intensity of solar radiation and operating temperature. Increased radiation with reduced temperature results in higher module output.

The maximum power point tracker is used with PV modules to extract maximum energy from the Sun. The maximum operating point of solar photovoltaic (PV) panels changes with environmental conditions. The maximum

ISSN 2277 – 5528
Impact Factor- 4.015

power point (MPP) of a PV system depends on cell temperature and solar irradiation, so it is necessary to continually track the MPP of the solar array.

II. EQUIVALENT CIRCUIT OF PV CELL

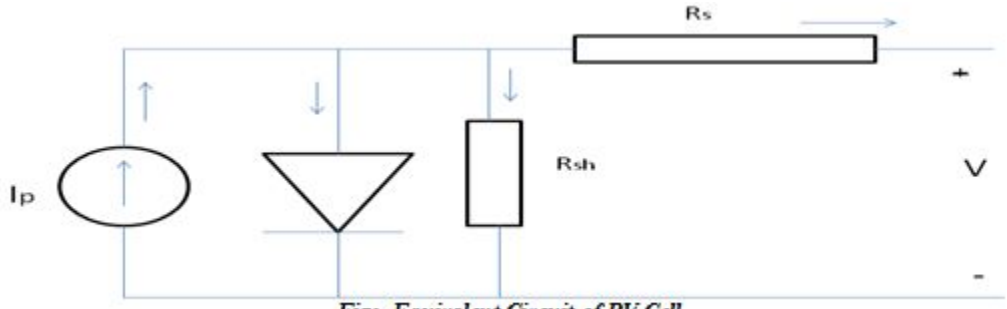

Fig:- Equivalent Circuit of PV Cell

Different Techniques for Tracking Maximum Power Point for PV Systems

Perturb and Observe

This is a trial and error method. This method searches the maximum power point by changing the photovoltaic voltage or current and detects the change in photovoltaic power output. Here power is measured by the adjustment of voltage and current. If the power increases the process is repeated again. This continues till the power stop increasing. It is referred to as hill climbing method also. The power with respect to the voltage increases and after reaching the maximum point power starts decreasing. In this method continuous oscillation occurs around the operating point. It is an intrinsic problem of this method.

1. ***Incremental Conductance Method***
   In this method the derivative of PV output power with respect to its output voltage (**dP/dV**) if found out. The maximum PV output power can be achieved when it **dP/dV** approaches zero. The equation based for this process is **dI/dV = -I/V or dP/dV = 0.** This occur rarely in rapid changing environment.

2. ***Voltage Based Peak Power Tracking***
   The open circuit voltage is the simplest MPPT control method. This Technique is also known as constant voltage method. V_{OC} is the open circuit voltage of the PV panel. V_{OC} depends on the property of the solar cells. A commonly used V_{MPP}/V_{oc} value is 76% This relationship is described by equation

   $$\mathbf{V_{MPP} = K_1 * V_{oc}}$$

   Factor $\mathbf{K_1}$ is always less than unity whose value varies from 0.71 to 0.8.

   The open circuit Voltage basically based on peak power tracking method is also known as 'constant voltage' method or 'open voltage' method. This open circuit voltage varies with temperature.

3. ***Current Based Peak Power Tracking***
   The Short Circuit Current algorithm is the simplest MPPT control method. This technique is also known as constant current method. $\mathbf{I_{SC}}$ is the Short circuit current of the PV panel. $\mathbf{I_{SC}}$ depends on the property of the solar cells.This relationship can be described by the equation

   $$\mathbf{I_{MPP} = K_2 * I_{SC}}$$

   The factor $\mathbf{K_2}$is always less than 1. $\mathbf{K_2}$ varies from 0.78 to 0.92. When the PV array output current is approximately 90% of the short circuit current, solar module operates at its MPP.

ISSN 2277 – 5528
Impact Factor- 4.015

The current based peak power tracking method is based on measured terminal current of PV arrays. The maximum power point is determined by the short circuit current of the PV array. The peak power is found to be at 0.9 times of the short circuit current of the module.

Maximum Power Point Tracker using Booster Maximum Power Point Tracking can be achieved using DC / DC booster. By this technique maximum power can be drawn from the PV system by overcoming the undesired effects and by using DC / DC convertor.

Maximum Power Point Tracker using PI (Proportional-Integral) Controller
Maximum Power Point of PV system is obtained by using Proportional Integral controller along with DC / Dc booster to acquire maximum power from PV system.

1. Artificial Intelligence Method

The artificial intelligence methods are mainly based on fuzzy logic controller and artificial neural networks. Fuzzy logic controllers use the expert knowledge for the establishment of rules and inferences. On the other hand, the artificial neural networks are based on neural structure of the brain. Neural Network can be used to find the position of the maximum power point with reduced number of iterations and oscillations.

a. Artificial Intelligent Technique or Artificial Neural Network
This technique is based on Artificial Neural Network. It reduces the noise and oscillation generated by classical method. Artificial Neural Network is a mathematical model of biological brain. With the help of feed forward neural network MPP is being tracked. In this method neurons are trained by using back propagation method.

b. Tracking of MPP using Fuzzy logic controller
This method reduces the PV array area and increases the output. It is basically helpful for stand-alone PV system and cost effective.

c. Neuro-Fuzzy Controller (NFC)
This method is the combination of fuzzy-logic controller and the learning capability of neural network. Information is developed by gradient estimator which is based on radial basis function. Radial basis function neural network (RBFNN) is designed to develop Neuro-Fuzzy Controller with gradient information.

d. Adaptive Neuro-Fuzzy Inference System (ANFIS)
It is designed with the combination of Fuzzy model and Neural network. Developed Fuzzy logic controller (FLC) utilizes the ANFIS output voltage to track MPP. This technique gives high efficiency and low fluctuation.

e. Modeling of Photo Voltaic Power supply System (PVPS - System)
This technique will work under different climatic conditions. It proposes new model for PV system such as ANFIS based PV-array, battery and regulator. It provides better results compared to neural network. It also develops better results for (i) the optimal configuration of PV system (ii) Control of PV system (iii) performance of PV system.

III. CONCLUSION

In this work various techniques for tracking maximum power point are discussed. It support effective (economic) cost for tracking MPP

ISSN 2277 – 5528
Impact Factor- 4.015

REFERENCES

1) *J Surya Kumari, Ch Sai Babu et.al, "An Enhancement of Static Performance of Multilevel Inverter for Single Phase Grid Connected Photovoltaic modules", International journal of Recent Trends in Engineering, Academy Publishers, Finland, Vol. 3, No. 3, May 2010, pp.20-24.*
2) *J Surya Kumari, Ch Sai Babu et.al, " Design and Investigation of Short Circuit Current Based Maximum Power Point Tracking for Photovoltaic System" International Journal of Research and Reviews in Electrical and Computer Engineering (IJRRECE) Vol. 1, No. 2, June 2011 ISSN: 2046-5149.*
3) *J Surya Kumari, Ch Sai Babu et.al, Mathematical Model of Photovoltaic System with Maximum Power Point Tracking (MPPT) International Conference on Advances in Engineering and Technology, (ICAET-2011), May 27-28, 2011.*
4) *Balakrishna S, Thansoe, Nabil A, Rajamohan G, Kenneth A.S., Ling C. J.', "The Study AndEvaluation Of Maximum Power Point Tracking Systems", Proceedings Of International Conference On Energy And Environment 2006 (ICEE 2006), Organized by University TenagaNasional, Bangi, Selangor, Malaysia; 28-30 August 2006, pp.17-22.*
5) *Jawad Ahmad, "A Fractional Open Circuit Voltage Based Maximum Power Point Tracker forPhotovoltaic Arrays", Proceedings of 2nd IEEE International Conference on Software Technology and Engineering, ICSTE 2010, pp. 287-250.*
6) *R. Faranda, S. Leva, V. Maugeri, "MPPT techniques for PV systems: energetic and costcomparison." Proceedings of IEEE Power and Energy Society General Meeting- Conversionand Delivery of Electrical Energy in the 21st Century, 2008, pp-1-6.*
7) *V. Salas, E. Olias, A. Barrado and A. Lazaro, "Review of themaximum power point tracking algorithms for stand-alonephotovoltaic systems", Solar Energy Materials & Solar Cells 90(2006), pp. 1555-1578.*
8) *M. Salhi and R. El-Bachtiri, " Maximum Power Point TrackingController for PV systems using a PI regulator with Boost DC/DCconverter", ICGST-ACSE journal ISSN 1687-4811,Vol.8, issueiii, January 2009, pp. 21-27.*
9) *M. Hatti, A. Mcharrar, M. Tiourci, " Novel approach of Maximum Power Point Tracking for Photovoltaic Module Neural Network Based", International Symposium on Environment friendlyEnergies in Electrical Applications EFEEA'10, 2-4 November 2010, Ghardaia, Algeria, pp.1-6.*
10) *A. Mellit, M. Benghanme, A. Hadj and A. Guessoum, " Control of Stand-Alone Photovoltaic System Using Controller", Proc. Of Fourteenth Symposium on Improving Systems in Hot and Humid Climates, TX May 17-20, 2004.*
11) *LI Chun, ZHU Xin, SUI Sheng and HU Wan, "Maximum Power Point Tracking of a photovoltaic Energy System Using Neural Fuzzy Techniques", J Shanghai Univ (Engl Ed), 2009, 13(1), pp.29-36.*
12) *Abdulaziz M, S. Aldobhani and Robert John, " Maximum Power Point Tracking of PV System Using ANFIS Prediction and Fuzzy Tracking", Procs. Of the Inter. Multi Conf. of engineers and Computer Scientists 2008, vol. II, IMECS 2008, 19-21 March, Hong Kong*