International Journal on Future Revolution in Computer Science & Communication Engineering
Volume: 4 Issue: 1
ISSN: 2454-4248
41 – 43

Simulation Studies of Single Axis Elevated Solar Tracking System; At Different Angle Implemented on Simulink Platform

Neeraj Tiwari[1]
Professor, Department of Electrical Engineering
Poornima College of Engineering, Jaipur
neerajtiwari.1407@gmail.com

Dagur Krishna Shivsingh[2]
Department of Electrical Engineering
Poornima College of Engineering, Jaipur
Krishsingh64@gmail.com

Arun Singh Kashmir[3]
Department of Electrical Engineering
Poornima College of Engineering
2015pceeearun029@poornima.org

Devesh Gotan[4]
Department of Electrical Engineering
Poornima College of Engineering
2015pceeedevesh@poornima.org

***Abstract*—** This paper presents the simulation results of improved effeciency due to elevated single axis solar tracking system over the static SPV system. All the models such as a static PV system, sun model, tracking PV system, control circuit, LDR sensor are developed in Simulink plaform. Comparative study shows that the improved efficiency of SPV system due to elevated is 14 %. In this simulation study the real irradiance and temperature data are considered. The irradiance and temperature data are taken with the help of pyroheliometer and temperature sensor. The data were recorded in different seasons.

Keywords— *Static PV system, photo voltaic system, Tracking PV system, Control circuit.*

NOMENCLATURE.

SPV	Solar Photovoltaic
PV	Photo Voltaic.

*****

I. INTRODUCTION

In the recent year as the demand of energy increases. The amount of SPV power plant increase because it is the best energy sources among the present renewable energy sources. There are many advantages of SPV system such as pollution free, abundant in nature, long life. But the main drawback associated with this energy source is the low conversion efficiency of PV cells. The PV cells present in the market are mono-crytalline, polycrystalline, and amorphous. The comparative chart for their efficiency are presented in table 1 [1]. Generally crystalline cells have higher efficiency compared to thin film cells.

Table 1: Comperative study of different cells.

Cell material	**Module efficiency**	**The area required for 1 kW_p**
Monocrystalline Si	15-18 %	07-09 m^2
Polly crystalline Si	13-16 %	08-09 m^2
Micromoph tandem	6-9 %	09-12 m^2
Thin film copper indium diselenide (CIS)	10-12 %	09-11 m^2
Thin film cadmium telluride (CdTe)	9-11 %	11-13 m^2
Thin film Amorphous Si (a-Si)	6- 8 %	13-20 m^2

Therefore the initial installation cost of SPV system is high. Many research has been done towards the increase in efficiency of SPV system. Secondly the power generation by PV array depends on load, irradiance and temperature. solar cell produces the solar power changes according to change in solar radiation and temperature [2]. As irradiation and temperature level changes rapidly, the voltage produced fluctuates and become inconstant. There are three ways to increase the efficiency of a solar photovoltaic system [3]. As the irradiance values increase the output current of SPV system increases means The photo current is directly proportional to solar radiations [4]. Therefore, by implementing the tracking system, the efficiency of SPV system Can be increased. The main function of tracking system to track the exact sun position. There are different tracking system suggested by authors (1) Active tracking system (2) Passive tracking system (3) Chronological Tracker. Active tracker consists of motors, gear train and a photodiode. These light sensing diode senses the light intensity and give the signal to motor whenever the light intensity on both sensors are same. Passive Trackers use a low boiling point compressed gas, fluid that is driven to one side or the other (by solar heat creating gas pressure) to cause the tracker to move in response to an

 ISSN: 2454-4248
41 – 43

imbalance. Chronological Tracker counteracts the earth's rotation by turning at an equal rate as the earth, but in the opposite direction. Actually the rates aren't quite equal, because as the earth goes around the sun, the position of the sun changes with respect to the earth by 360° every year or 365.24 days [5].

II. Developed Solar Tracking System.

This section starts with the developed solar tracking system as shown in figure 1. This designed tracking system comprises with many parts. The design and construction of it could be divided into following main parts.

Figure 1: Developed Solar Tracing System

1. Selection of Tracking system mount concept
2. Framing structure of tracker on which SPV array mounted.
3. Designing of the motor control driving circuit.
4. Selection of LDR sensor and sensor control circuit
5. Data acquisition and interface card

For smooth tracking of the sun these five main parts would work together harmoniously. The most commonly used tracking is azimuthal tracking (tracking of the sun from east to west) due to simple in construction and economical. By azimuthal tracking we got 47 % more energy compare to the static SPV system. While the second type of single axis tracking is elevated (North to South). By this tracking technique the efficiency SPV system can be increased 14 % compared to the static SPV system.

III. Characteristics Of PV Cell

Modeling concepts of single diode PV cell without emphasis given on physics of how to pv cell transforms the solar photon into electrical power. To estimate the performance of a PV cell, under all weather conditions. We cannot ignore the effect of solar radiation cell temperature. The photo current is directly proportional to solar radiations [6] also shown in figure 2. The variation of the saturation current as a function of temperature is described by [7]. The PV array must operate electrically at a certain voltage that corresponds to the maximum power point under the influence of given operating conditions like temperature and solar radiation. In the PV array simulation all modules are considered to be identical and to work under identical temperature and solar radiation conditions. Figure:2 current vs voltage characteristics for four temperature levels and Figure:3 shows the power-voltage characteristics of pv cell.

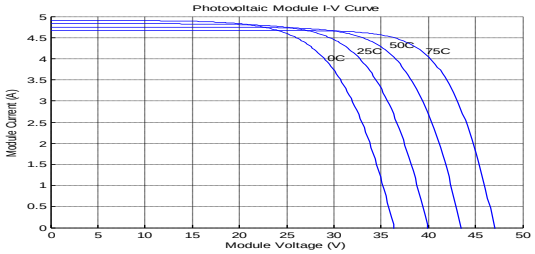

Figure 2: I– V Characteristics for four temperatures level.

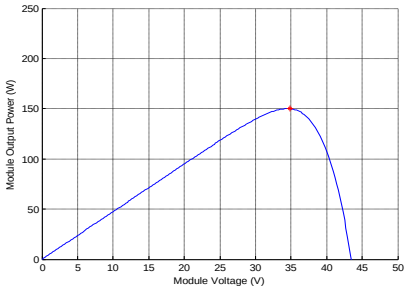

Figure 3: P– V characteristics for a PV cell.

IV. Simulink Block Diagram

For the simulation we used real time, temperature and radiation values are taken which was recorded on date 13-08-2017. The variation in temperature and radiation value for this date is shown in figure 4 and 5. This data was discrete in nature for getting continuous curve for simulation purpose cubic spline curve was fitted.

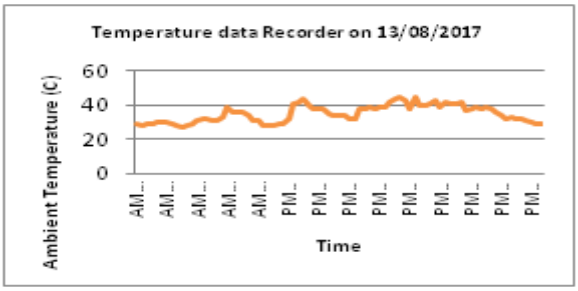

Figure 4: variation in temperature on dated-13-08-2017.

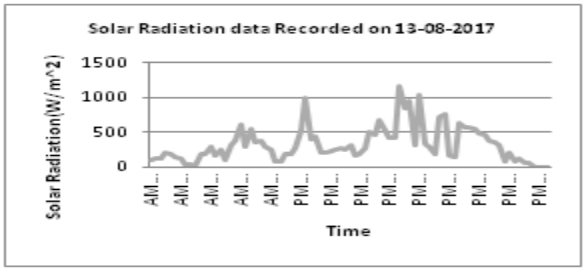

Figure 5: variation in temperature on dated-13-08-2017

The model developed on SIMULINK platform for the comparative study of tracking system has been presented in figure 6.

 ISSN: 2454-4248
41 – 43

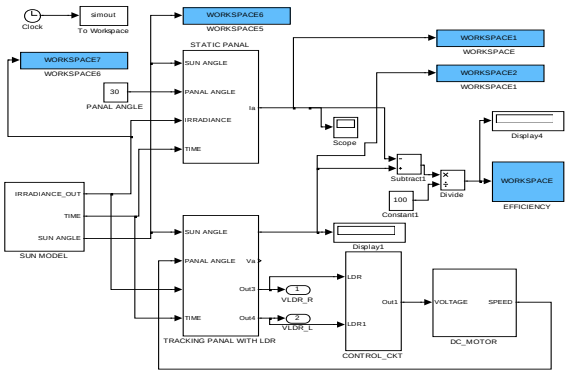

Figure 6: SIMULINK model for comparative study.

V. SIMULATION RESULTS AND DISCUSSION

Elevated Tracking Results

Figure 7,8 and 9 shows the simulation results obtained due to variation in the sun path in the elevated direction (North-South). The static panel was fixed at 29^0 towards south for getting the maximum irradiance from the sun. Here we neglected the effect of azimuthal tracking (E-W). Figure 8, shows simulation results between tracker panel current and static panel current assume that a static panel was tilted at different angle like 30^0 degree, 60^0 and 90^0 south facing. the comperative results are shown in different colours. and bold green line presented the results obtained from tracking system. there is gain of energy 14% as compared to static power plants. The sun changes its position 47^0 in whole year. therefore static SPV system are tilted app. 22^0 degree to wards south facing. this titation angle depends on geographical region.

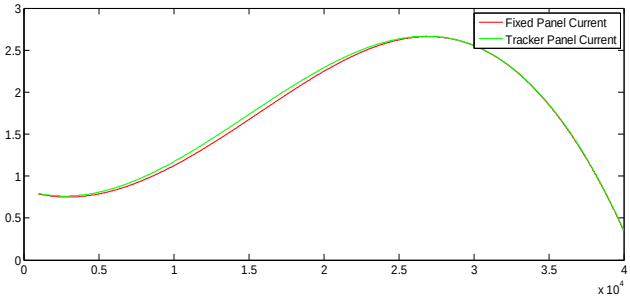

Figure 7. Comparative studies between tracker panel current and static panel current.

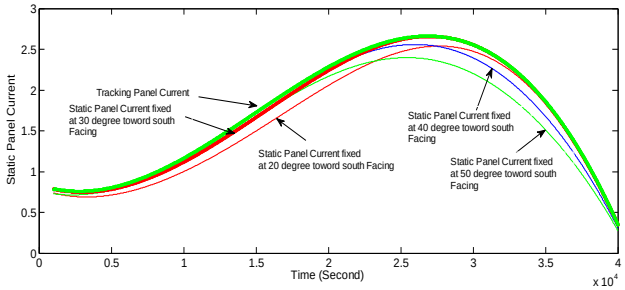

Figure 8 Variation in static current due to change in the angular positiono fixed panel.

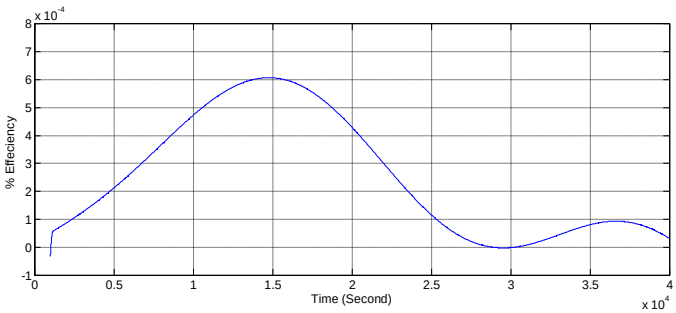

Figure 9 Variation in instantaneous tracker panel efficiency compared to fixed panel.

Figure 9 shows the efficiency of tracker current is maximum at 12:00 PM after that it starts to decrease due to change the position of the SUN results decrease in Irradiance value. The increase in efficiency due to solar tracker PV System is 14 % to elevated tracking.

VI. CONCLUSION

The simulation results shows that the tracking SPV system can produce 14% more energy as compared to the static SPV system. Here results claims only for elevated tracking system assume that azimuthal tracking system is fixed. there is small increase in energy because The sun changes its position in elevated direction is about 47^0 with in a year.

REFERENCES

[1] http://www.eai.in/ref/ae/sol/technology_options.html

[2] E.Koutroulis, K.Kalaitzakis, and Nicholas C. Voulgaries, 2001. ” Dvelopment of a microcontroller based photovoltaic maximum power point tracking control system ”IEEE Trans. Power Electronics , vol. 16,no 1,pp.46-54.

[3] Piao,Z.G., Park,J.M. Kim,J.H. Cho,G.B. Baek,H.L.,”A Study on the tracking photovoltaic system by program type,”Electrical machines and systems,2005.ICEMS 2005.Proceedings of the Eight International Conference on, 27-29 sept.2005, page(s):971-973 Vol.2.

[4] T. F. Wu, C. L. Shen, H. S. Nein, and G. F. Li, “A single-phase 3 W Inverter with grid connection and active power filtering based on Nonlinear programming and fast-zero-phase detection algorithms”, IEEE Transactions on Power Electronics, vol. 20, pp. 218-226, 2005.

[5] “Solar Tracker Drive Types” http://en.wikipedia.org/wiki/Solar_tracker

[6] S. Saha, and V. P. Sundarsingh, “Novel grid-connected photovoltaic inverter”, in IEE proc. On Generation, Transmission and Distribution,vol. 143, pp. 219-224, 1996.

[7] M. G. Villalva, E. Ruppert F., “Analysis and simulation of the P&O MPPT algorithm using a linearized photovoltaic array model”, In:Proc.35th Annual Conference of the IEEE Industrial Electronics Society, IECON, p. 231-236, 2009.