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# Analysis of Maximum power Point Tracking in Solar Photovoltaic System

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***Abstract—****This paper presents a grid synchronization technique based on adaptive notch twist for SPV (Solar Photovoltaic) system along with MPPT (Maximum Power Point Tracking) techniques. An efficient grid synchronization technique offers capable detection of various components of grid signal like phase and frequency. It also acts as a obstruction for harmonics and other turbulence in grid signal. A reference phase signal synchronized with the grid voltage is provided by the grid synchronization technique to standardize the system with grid codes and power quality standards. Hence, grid synchronization unit plays important role for grid connected SPV systems. As the output of the PV array is variable in nature with the meteorological parameters like irradiance, temperature and wind etc. In order to maintain a constant DC voltage at VSC (Voltage Source Converter) input, MPPT control is required to track the maximum power point from PV array. In this work, a variable step size P & O (Perturb and Observe) MPPT technique with DC/DC boost converter has been used at first stage of the system.*

***Keywords— MPPT algorithms, solar energy, Review.***

## I. INTRODUCTION

Electricity is one the most essential needs for humans in the present. Conversion of solar energy into electricity not only improves generation of electricity but also reduces pollution due to fossil fuels. The output power of solar panel depends on solar irradiance, temperature and the load impedance. As the load impedance is depends on application, a dc-dc converter is used for improving the concert of solar panel. The solar irradiance and temperature are dynamic. Hence an online algorithm which dynamically computes the working point of the solar panel is required. The efficient conversion of solar energy is possible with Maximum Power Point Tracking (MPPT) algorithm. There are various MPPT algorithms such as agitate and Observe, Incremental Conductance etc. The various algorithms in MPPT and their topology is discussed in this paper. The comparison between these algorithms is also given in this paper.[1]

## II. PV ARRAY MODELLING AND CHARACTERISTICS

The power that one module can produce is seldom enough to meet requirements of a home or a business, so the modules are linked collectively to form an *array*. Most PV arrays use an Inverter to convert the DC power produced by the modules into broken current that can power lights, motors, and other loads. The modules in a PV array are usually first connected in series to obtain the desired voltage; the individual strings are then connected in parallel to allow the system to produce more current The PV array is made up of number of PV modules connected in series called thread and number of such strings connected in parallel to achieve desired voltage and current. The PV module used for simulation study consists of series connected polycrystalline cells. [3]

*A. PV Model*

The electrical equivalent circuit model of PV cell consists of a current source in parallel with a diode as shown in Fig. 1

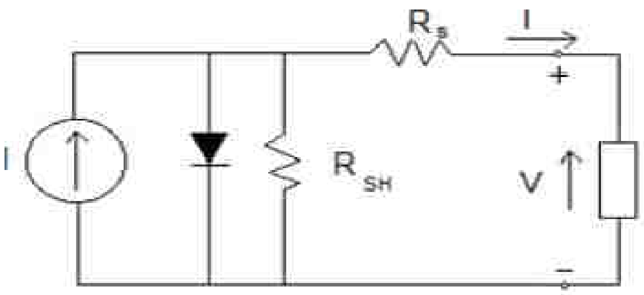


*Fig.1: Electrical Equivalent Circuit Model of PV Cell*

***Maximum Power Point Tracking***

There are number of MPPT techniques available in the literature to track the maximum power point. These techniques includes trouble and observe, incremental conductance, constant voltage, open circuit voltage, short circuit current, extremism seeking control and hybrid etc. Some techniques based on artificial neural networks, fuzzy logic, genetic algorithms are also available in the literature. Variable step size Perturb and Observe method for tracking the maximum power point of solar PV array is implemented in This work. After the application of perturbation the output Power is compare with the previous perturbation cycle power output. If the power increases then the increment in voltage or current remains incessant in same direction. If power decreases then the variation in voltage or current in reverse direction. This algorithm divide the dPpv/dVpv curve of PV panel into three separate zones i.e. zone 0, zone 1 and zone 2. A fine value of tracking step size is used in zone 0 while zone 1 and zone 2 require a large value of step size in order to obtain a high tracking speed. Operation of algorithm can be explained further by using flowchart given in Fig. 3

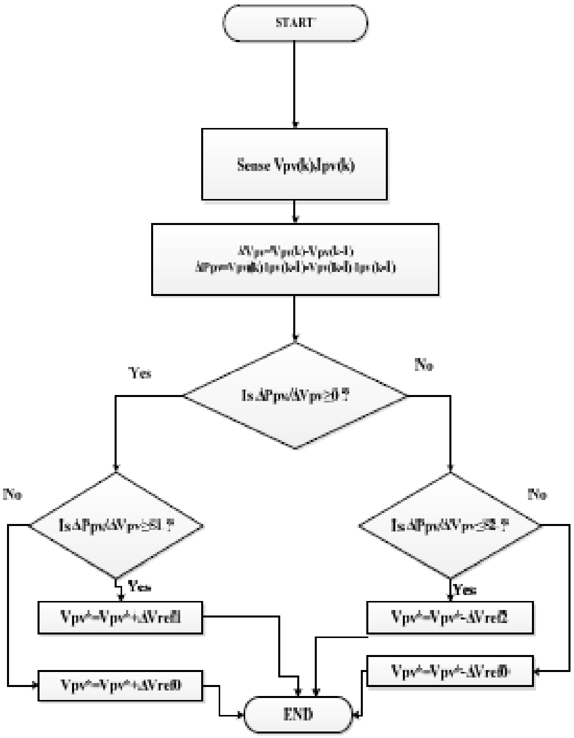


*Fig.2: Flowchart of P&O algorithm*

. Δvref0, Δvref1 and Δvref2 represent different step sizes in zone 0, zone 1 and zone 2 respectively, k denotes the iteration count. Δvref0, Δvref1 and Δvref2 is taken as 0.1 V, 0.3 V and 0.3 V respectively [4]

***DC/DC Converter***

Output of PV array is highly affected by the meteorological Parameters similar to irradiance, temperature and keeps on changing. A control technique named as MPPT (maximum power point tracking) is essential to continuously track the maximum power point of PV array. A power converter is required to implement the MPPT control and to step up the There are other three techniques revised in [8] that can be grouped with the algorithms: *ripple correlation control* (RCC), *dP/dV* or *dP/dI* Feedback control and slide control. RCC uses the ripple imposed by the power converter on the PV array to track the MPP. It correlates *dp/dt* with *di/dt* or *dv/dt*, to drive the power gradient to zero, which happens when the MPP is reached. According to are positive to the left of the MPP, negative to the right and zero at the MPP. Actually the same criteria is used by the InCond algorithm but expressed in a different form, thus it will suffer the same problems. In fact, it has been only tested with irradiation steps, which are not 28 appropriate to test the dynamic performance. Besides, it needs low switching frequencies to have enough ripple so the correct decisions can be made and it is an analog technique. On the contrary, inverters are nowadays controlled digitally with DSPs, so this method does not show any advantage to the P&O or In-Cond. *dP/dV* or *dP/dI* Feedback control is a technique which computes the slope of the P-V or P-I distinctive curve and feeds it back to the controller in order to drive it to zero, as they are zero at the MPPT. Again this is another implementation of the In-Con algorithm, so it has the same recompense and disadvantages.

Finally, in the slide control, the switching function used is again *dP/dV*, thus the same problems as with the In-Cond algorithm can be expected under changing irradiation. To summary, the last three MPPT methods are based on the same ideology as the P&O and the InCond algorithms, so they have the same advantages and disadvantages. All hill-climbing MPPT methods depend on the PV array's V-P or I-P characteristics, which vary with temperature and irradiation, therefore these MPPT methods can be confused when the irradiation or temperature are changing, as it is explained in [15].

Finally, the other hill-climbing MPPT methods do not offer any improvement to the original P&O and In-Cond algorithms.

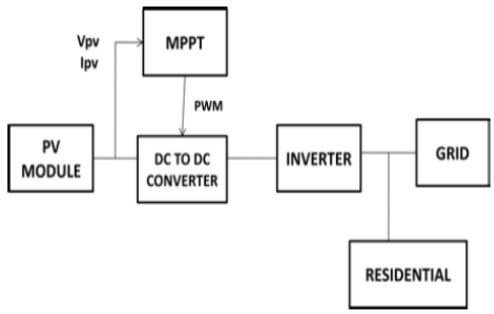


*Fig.3:Block diagram of grid connected PV system*

## III. SIMULATION

Simulink is a software package for model, simulate, and analyze dynamical systems. It supports linear and nonlinear systems, modeled in uninterrupted time, sample time, or a hybrid of the two. Since MATLAB and Stimulant are integrated, the simulation, analyzation, and the revision of models are done in either environment at any point. Figure 4 shows the overall simulation diagram. The simulation model for MPPT is shown in Fig4 The photovoltaic model circuit is implemented with a help of MATLAB/SIMULINK

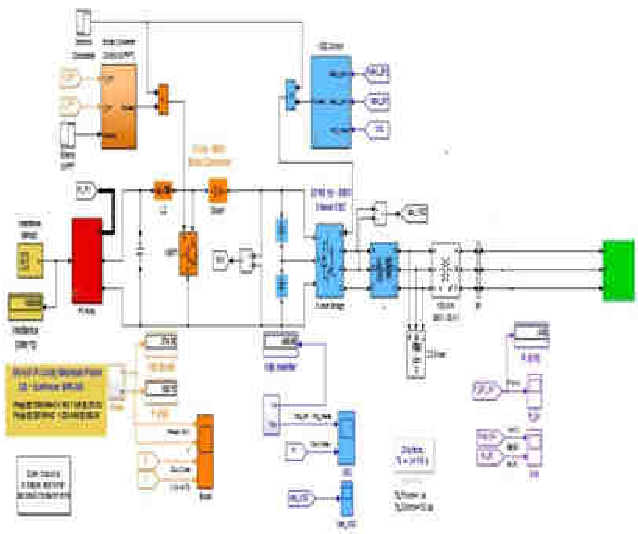

*Fig.4: PV system with grid Synchronization*

## IV. RESULT AND DISCUSSION

The output of the PV array depends on temperature and irradiation. In this paper the temperature an irradiation is designed as 280.15 degree Celsius and 200w/m2 in that order. Output of the solar panel is 163w. The output current and voltage is 2.45 A and 20kV respectively When the generated power from the PV array is not enough then the power from the EB is harmonized with the solar output. The synchronized voltage and current waveform. In this paper the output power from the solar array is considered as 170W.When the load is increased above this level the remaining power is synchronized with it from the EB. The deviation of solar alone and synchronized voltage is shown in the same output i.e., up to 0.02s the solar output is connected to the load after that the synchronized power is connected to the load.

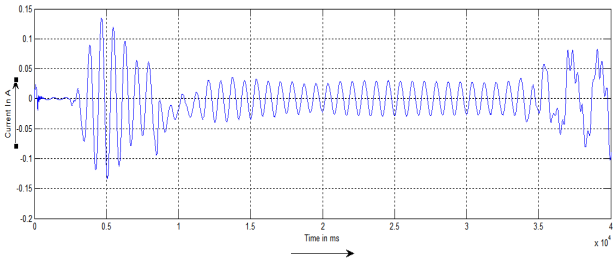


*Fig.4: Synchronized Current Waveform*

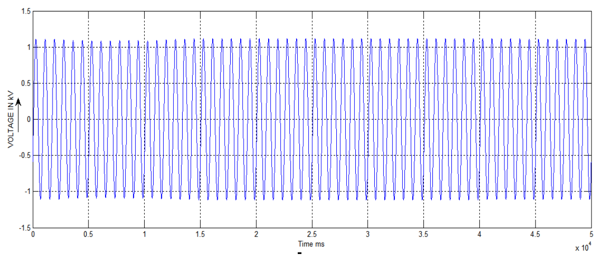


*Fig.5: Synchronized Voltage Waveform*

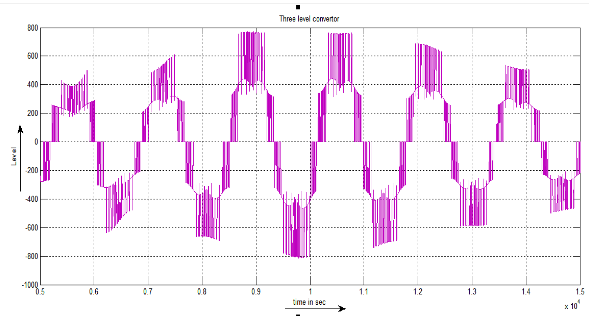


*Fig.6: Synchronized Voltage Sources convertor*

The photovoltaic (PV) module is an all-electrical device that converts sunlight into electrical DC power. Solid-state power electronic inverters have been used to connect PV modules to the AC utility grid since the early seventies. The inverter has two major tasks: to inject a sinusoidal current into the grid, and to optimize the working point of the PV modules, to capture the maximum amount of energy. Large, Megawatt, PV systems were connected to the grid in the eighties, but the trend is now to connect smaller systems to the grid, in order to overcome certain problems, like non-flexible designs, mismatch losses between the PV modules, etc. These systems are either based on the string-concept, with multiple modules associated in series, or on a single PV module

## REFERENCES

[1] Faete Filho, Yue Cao, Leon M. Tolbert, ―11-level Cascaded H-bridge Grid-tied Inverter Interface with Solar Panels,‖ *IEEE* Trans pp. 968-972, June 2010.

[2] A. J. Morrison, ―Global Demand Projections for Renewable Energy Resources,‖ *IEEE Canada Electrical Power Conference*, 25-26 Oct. 2007, pp 537-542.

[3] J. Rodriguez, S. Bernet, Bin Wu, J. O. Pontt, S. Kouro, ―Multilevel Voltage-Source-Converter Topologies for Industrial Medium-Voltage Drives, ‖ *IEEE Transactions on Industrial Electronics*, vol. 54, no. 6, pp. 2930-2945, Dec. 2007.

[4] L. M. Tolbert, F. Z. Peng, ―Multilevel Converters as Utility Interface for Renewable Energy Systems,‖ *IEEE Power Engineering Society Summer Meeting*, Seattle, Washington, July 15-20, 2000, pp. 1271- 1274.

[5] S. Khomfoi, L. M. Tolbert, ―Multilevel Power Converters,‖ *Power Electronics Handbook*, 2nd Edition Elsevier, 2007, ISBN 978-0-12- 088479-7, Chapter 17, pp. 451-482.

[6] S. Busquets-Monge, J. Rocabert, P. Rodriguez, S. Alepuz, J. Bordonau, ―Multilevel Diode-clamped Converter for Photovoltaic Generators with Independent Voltage Control of Each Solar Array,‖ *IEEE Transactions on Industrial Electronics*, vol. 55, July 2008, pp. 2713-2723.

[7] E. Ozdemir, S. Ozdemir, L. M. Tolbert, B. Ozpineci, ―Fundamental Frequency Modulated Multilevel Inverter for Three-phase Stand-alone Photovoltaic Application,‖ *IEEE Applied Power Electronics Conference and Exposition*, Feb. 24-28, 2008, pp. 148-153.