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Implementation of Perturb & Observe Method in MPPT for enhanced output of PV System

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ABSTRACT

In this paper we have used the PV list of measurements provided. The PV output of the same members is connected to the Current Source Inverter. CSI contains an Insulated Gate Bipolar Transistor (IGBT) for conversion. The whole system simulates under two categories. One imitates the High Inductor (Ldc) value and the second is the low Inductor (Ldc) value with a Double Filter. The proposed system mimics the MATLAB / SIMULINK software 2.22.23 (2016a). This is well-known simulation software for analyzing electrical and electronic circuits. We can also imitate Mechanical Systems which are very useful to others.

Keywords: Double Tuned Resonant Filter, Current Source Inverter (CSI), Total Harmonic Distortion (THD)

1. INTRODUCTION

1.1 MAXIMUM POWER POINT TRACKING

The solar panel has a feature named p-v where there is a global total. This means that in a different area of the solar panel operation, different output power is available. To achieve maximum power the solar panel must operate at a voltage where the global magnitude of the p-v element is present. Therefore, in only one operating area, the maximum power output selects from the solar panel. This point in the p-v element is called Maximum Power Point (MPP). This MPP changes when the radiation and temperature change or when the solar panel is slightly shaded in rainy or cloudy weather.

1.1. 1 MPPT METHODS

I. Perturb & Observe method

II. Incremental Conductance method

III. Fractional Open-Circuit Voltage method

IV. Fractional Short-Circuit Current method

V. Fuzzy Logic Control method

VI. Neural Network method

1.2 PERTURB & OBSERVE METHOD

In the P&O method, the MPPT algorithm is based on the calculation of the output power of the PV and the power change by taking a sample of both current PV and voltage. The tracker works by increasing or decreasing solar energy. If a given disturbance leads to an increase (decrease) of the output of the PV output, then the following disturbance is produced in the same (opposite) manner. Therefore, the dc chopper activity cycle is changed and the process is repeated until the maximum power point is reached. In fact, the system is moving about MPP. Reducing the size of the disturbance step can reduce rotation. However, the small step size reduces the MPPT. To solve this problem, the magnitude of the variable fluid becomes smaller when you go to MPP. However, the P&O method can fail under rapidly changing atmospheric conditions. A number of research projects have been undertaken to develop traditional Hill-climbing and P&O methods. The reference suggests a three-point P&O method of weight comparison that compares the actual power point with the previous two points before a decision is made about the disturbance signal. The reference suggests a two-phase algorithm that provides faster tracking in the first phase and better tracking in the second phase.

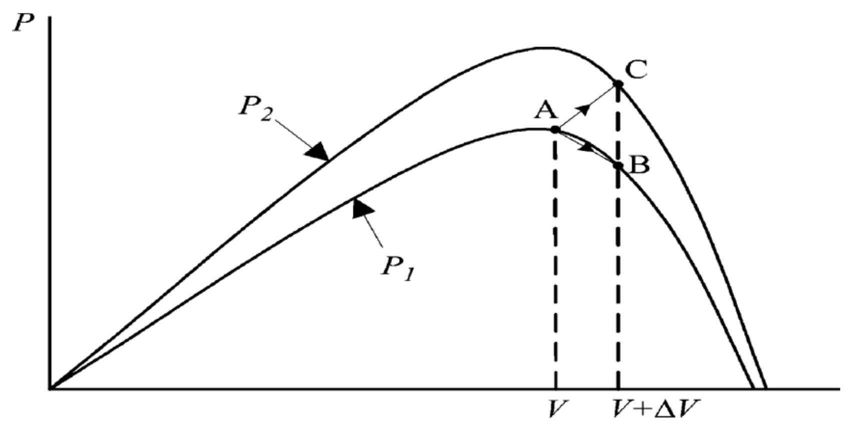

Fig. 1 Changes in Maximum Power Point

The figure shows that there is a rapidly changing situation at Maximum Power Point. From point A, if the atmospheric conditions remain constant, a disturbance in the PV voltage will bring the operating area to B and thus the disturbance will be reversed due to a decrease in power. However, if the irradiance increases and changes the power curve from P1 to P2 within one sample period, the working area will move from A to C and acquire a new curve. This represents an increase in power and distortion maintained in the same way. Therefore, the operating point varies from A to C in the picture above and will continue to vary as the irradiance gradually increases.

2. PULSE WIDTH MODULATION

Pulse Width Modulation is basically defined as the process of changing the pulse width of a driving train that is directly proportional to a small control signal. To detect a wide pulse we increase the value of the control voltage. Pulse Width Modulation (PWM) is a way to change how long a square wave stays "ON". In this way, a sine wave reference signal and a triangular network signal signal are used. .

2.1 DUTY CYCLE

In general terms, the Activity Cycle is considered to be the OPEN period of the switched signal. In other words the higher the level of the changed signal. It is usually measured in present. The diagram shows the VALIWE configuration and activity cycle. Figure 2 shows the TON and TOFF cycle. When the TON period is called the activity cycle.

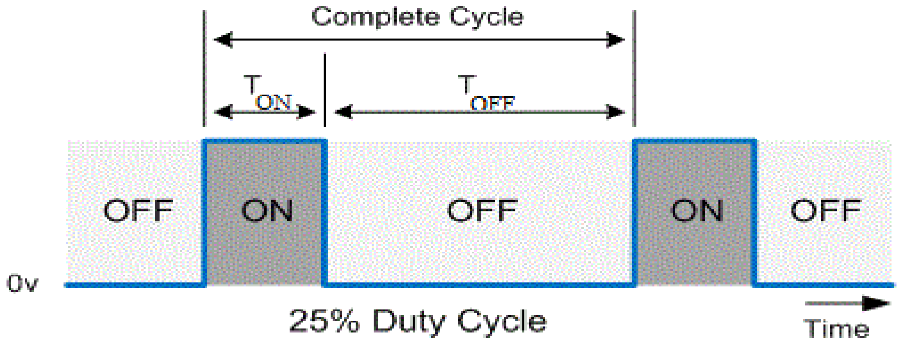

Fig. 2 Duty Cycle

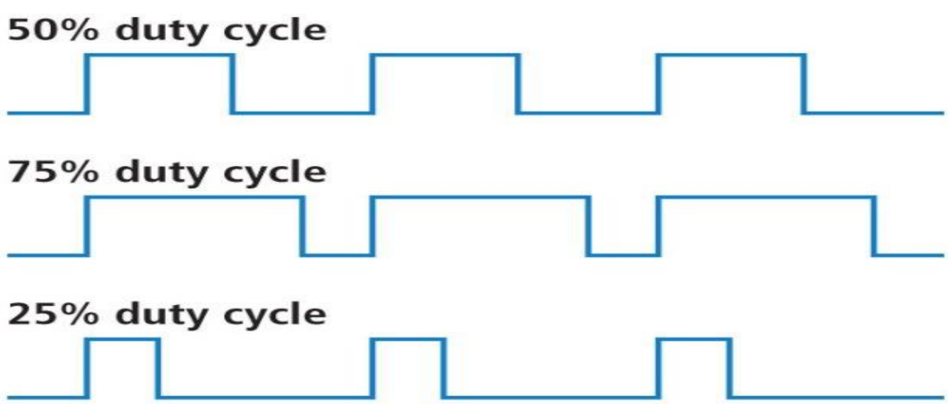

Fig. 3 Different strategy of Duty Cycle

3. TOTAL HARMONIC DISTORTION (THD)

Harmonic distortion is a change in the supply voltage waveform from a suitable sinusoidal waveform. It is caused by the interaction of reverse loads and the impedance of the supply network. Its worst effects are the heat of motor induction, transformers and capacitors and many other types of loads. It also causes excessive saturation. Figure 4. A sinusoidal waveform suitable for alternating current supply.

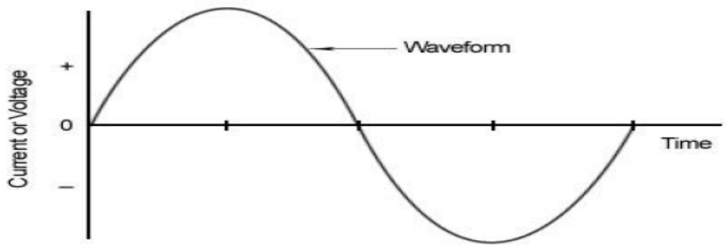

Fig. 4 Ideal Sinusoidal Waveform

3.1 LINEAR LOAD

A “line” load connected to an electrical system is defined as the load that draws current energy into a supply equal to the amount of electricity used (e.g., opposing lamps, incandescent lamps etc.). An example of the voltage and current waveforms of a line load is shown in Figure 5. For Line load, the current voltage and wavelengths are sinusoidal and phase.

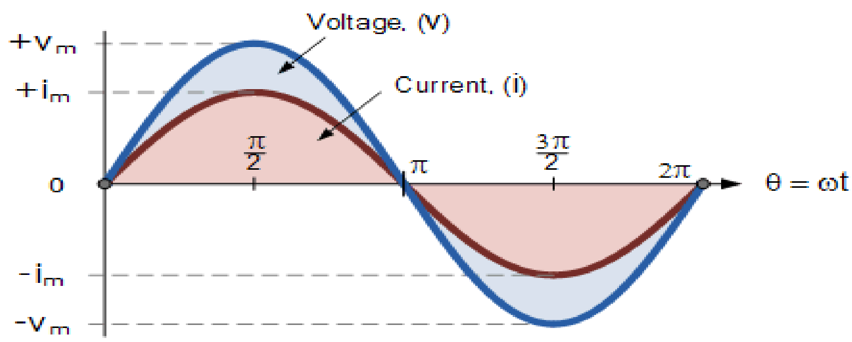

Fig.5 Linear Load

3.2 NON LINEAR LOAD

The load is considered "non-linear" when its impedance changes with the applied voltage. As a result of this flexible impact, the current being pulled by a non-linear load is also not a line i.e. non-sinusoidal environment, even if connected to a sinusoidal power source (e.g. computers, various drives, output light etc). An example of the voltage and current waveforms of non-linear load is shown in Figure 6. At Non-Line Loads, the current voltage and waves are not sinusoidal and are not phase. These non-sinusoidal waves contain harmonic currents that interact with the impedance of the energy distribution system to create distortion of electrical energy that can affect both the equipment of the distribution system and the loads connected to it.

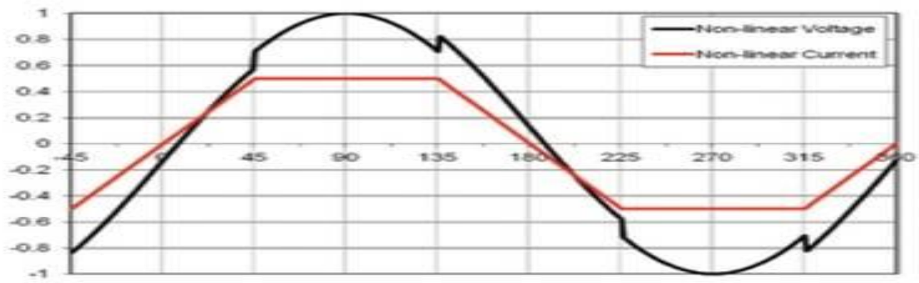

Fig. 6 Non Linear Load

4. CARRIER BASED PULSE WIDTH MODULATION (CPWM)

Due to some limitations of Sinusoidal Pulse Width Modulation, Modified Carrier Based Pulse Width Modulation was introduced. In Sinusoidal Pulse Width Modulation the pulses near the sine wave peak do not change much with the direction of rotation. The second thing is that the network company signal is used throughout the cycle. Climb no. of switching devices and increases switching losses. To overcome the situation above the Network Company Pulse Width Modulation was introduced. Provides continuous dc side current. There is one switch up or down that you must TURN on each switch. This can also be achieved in Sinusoidal Pulse Width Modulation (SPWM). In SPWM, due to time constraints. Allows continuous dc side current mode. Disruption time occurs when electrical devices change position. This duration is not enough to enable dc link inductor. This may be the result of an increase in Total Harmonic Distortion (THD). Thus introduced Carrier Based Sinusoidal Pulse Width Modulation (CBPWM). Here two carriers and one reference are used. In this network company frequency is used during the first 60º intervals and in each cycle. i.e. 0º to 60º and 120º to 180º.This is done in the same way in the negative half cycle. The network signal and reference signal of the Carrier based Pulse wide modulation are shown in Figure 7.

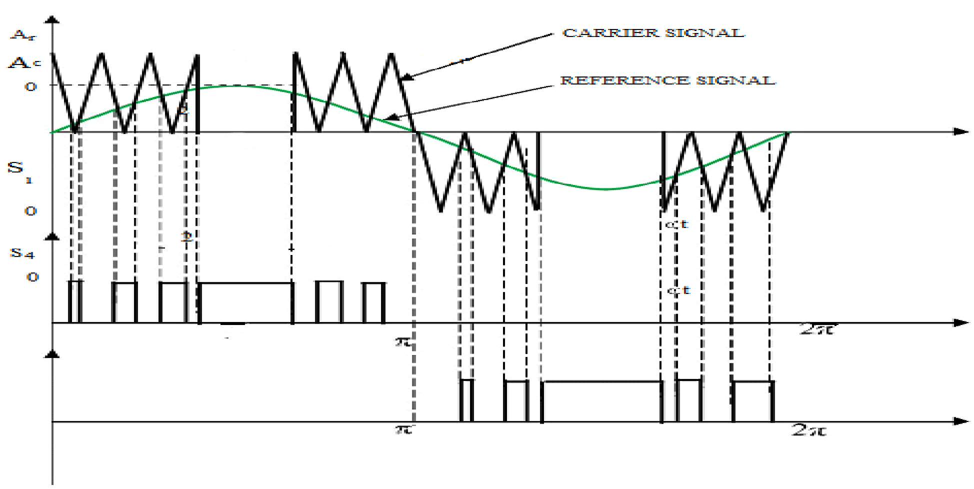

Fig. 7 Carrier Based Pulse Width Modulation

5. RESULTS

5.1 WITHOUT USE OF DOUBLE TUNED RESONANT FILTER

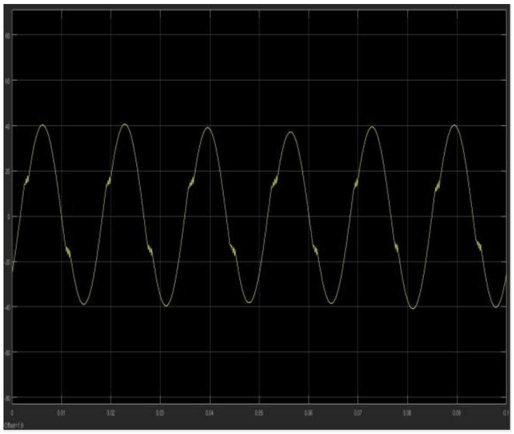

Fig. 8 CSI Output Current

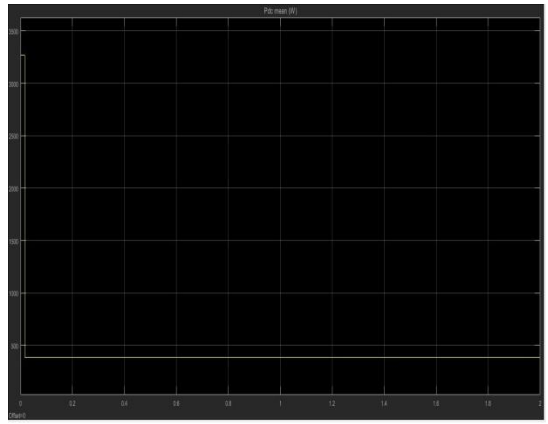

Fig. 9 PV Power

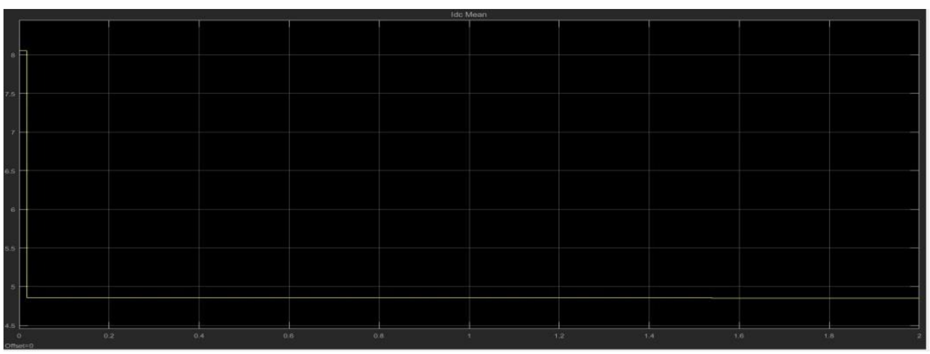

Fig. 10 PV Current

5.2 WITH USE OF DOUBLE TUNED RESONANT FILTER

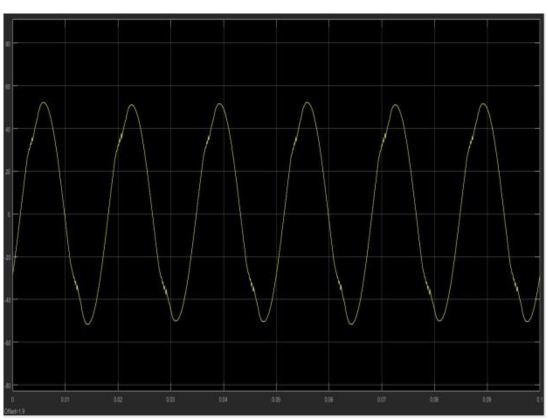

Fig. 11 CSI Output Current

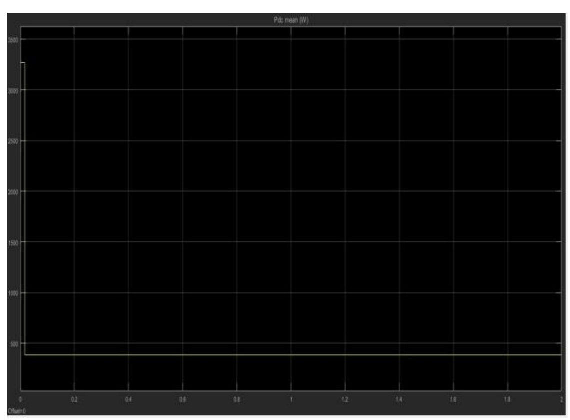

Fig. 12 PV Power

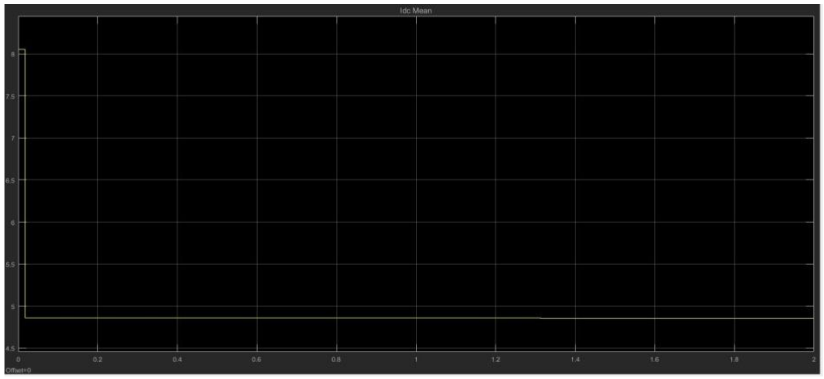

Fig. 13 PV Current

REFERENCES

1. W. Tsai-Fu, C. Chih-Hao, L. Li-Chiun, and K. Chia-Ling, "Power loss comparison of single- and two-stage grid-connected photovoltaic systems," IEEE Transaction on Energy Conversion, vol. 26, no. 2, pp. 707–715, Jun.2011.

2. S. B. Kjaer, J. K. Pedersen, and F. Blaabjerg, "A review of single-phase grid-connected inverters for photovoltaic modules," IEEE Trans. Ind. Appl., vol. 41, no. 5, pp. 1292–1306, Sep.–Oct. 2005.

3. G. Petrone, G. Spagnuolo, and M. Vitelli, "A multivariable perturb and observe maximum power point tracking technique applied to a single-stage photovoltaic inverter," IEEE Trans. Ind. Electron., vol. 58, no. 1, pp. 76–84, Jan. 2011.

4. E. Villanueva, P. Correa, J. Rodriguez, and M. Pacas, "Control of a single phase cascaded H-bridge multilevel inverter for grid-connected photovoltaic systems," IEEE Trans. Ind. Electron., vol. 56, no. 11, pp. 4399–4406, Nov. 2009.

5. C. Cecati, F. Ciancetta, and P. Siano, "A multilevel inverter for photovoltaic systems with fuzzy logic control," IEEE Trans. Ind. Electron., vol. 57,no. 12, pp. 4115–4125, Dec. 2010.

6. S. Busquets-Monge, J. Rocabert, P. Rodriguez, S. Alepuz, and J. Bordonau, "Multilevel diode-clamped converter for photovoltaic generators with independent voltage control of each solar array," IEEE Trans. Ind. Electron., vol. 55, no. 7, pp. 2713–2723, Jul. 2008.

7. N. A. Rahim, K. Chaniago, and J. Selvaraj, "Single-phase seven-level grid connected inverter for photovoltaic system," IEEE Trans. Ind. Electron., vol. 58, no. 6, pp. 2435–2443, Jun. 2011.

8. B. Sahan, S. V. Ara´ujo, C. N¨oding, and P. Zacharias, "Comparative evaluation of three-phase current source inverters for grid interfacing of distributed and renewable energy systems," IEEE Trans. Power Electron., vol. 26, no. 8, pp. 2304–2318, Aug. 2011.

9. B. Sahan, A.N. Vergara, N. Henze,A. Engler and P. Zacharias, "A single stage PV module integrated power converter based on a low power current source inverter", IEEE Transaction on Industrial electronics, vol.55 no.7,pp 2602-2609,Jul-2008.

10. P. P. Dash and M.Kazerani, "Dynamic modeling and performance analysis of a grid-connected current-source inverter-based photovoltaic system, "IEEE Trans. Sustainable Energy, vol. 2, no. 4, pp. 443–450, Oct. 2011.

11. S. Jain and V. Agarwal, "A single-stage grid connected inverter topology for solar PV systems with maximum power point tracking," IEEE Trans. Power Electron., vol. 22, no. 5, pp. 1928–1940, Sep. 2007.

12. A. Darwish, A. K. Abdelsalam, A. M. Massoud, and S. Ahmed, "Single phase grid connected curent source inverter: Mitigation of oscillating power effect on the grid current," in Proc. IET Conf. Renewable Power Generation, Sep. 2011, pp. 1–7.

13. R. T. H. Li, H. S.-H. Chung, and T. K. M. Chan, "An active modulation technique for single-phase grid-connected CSI," IEEE Trans. Power Electron., vol. 22, no. 4, pp. 1373–1382, Jul. 2007.

14. Katsuya Hirachi and Yasuharu Tomokuni, "A novel control strategy on single-phase PWM current source inverter incorporating pulse area modulation," Proceedings of Power Conversion Conf., vol. 1, pp. 289–294, Aug. 1997.

15. S. Nonaka, "A suitable single-phase PWM current source inverter for utility connected residential PV system," Sol. Energy Mater. Sol. Cells, vol. 35, pp. 437–444, Sep. 1994.

16. T. Esram, and Patrick L. C., "Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques", IEEE Trans. On Energy Conv., Vol. 22, No. 2, JUNE 2007 Pp 439-449

17.Chapter 6 Pulse Width Modulated Inverters and Chapter 8 Resonance Pulse Inverters and Chapter 4 Power transistor in Power Electronics Circuits, Devices and Applications By Muhammad H. Rashid Third Edition, PEARSON ©2014 Dorling Kindersley Pvt. Ltd.