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Power Quality Enhancement of Solar PV Interfaced Distribution System by Delta-Bar-Delta Neural Network

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Abstract: This project presents incremental conductance method for maximum power point tracker (MPPT). Main reason to develop solar photovoltaic energy source is to reduce deterioration in power. Power quality cannot be increases by the week distribution of grid. To increases the power of the grid solar energy conversion system paramount by implementation of a robust control technique. In this project we are we have control algorithm such as delta bar delta but neural network which is in control technique by this active power will be fed to the loads and remaining power to the grid as a function of distribution static compensator it has the capability of mitigating harmonics and balancing of loss and improving power factor. The delta bar delta neural network control algorithm has a capability to adjust weight adaptively in an independent manner and it offers alleviation in the model complexity predominant during an abnormal great conditions along with a reduction in complexion time. This model is efficient utilization accomplished with incremental conductance based on maximum power point tracking techniques for validating the behaviour of proposed system and we can expect this results in the simulation via MATLAB. The realization of MPPT controller can be based on different methods and algorithms. The results and technique include incremental conductance techniques due to the reduced oscillations while determining the Maximum PowerPoint is preferred here and it is also suitable for commercial purpose.

Keywords: Solar Energy, MPPT Mode, Voltage Source Converter, Ripple Filter, PWM,Neural Network.

I. INTRODUCTION

Energy makes a huge difference in our day-to-day lives and increasing technological development of the world during the past few years. The population increasing rapidly and depletion of fossil fuel taking place. Coming to the renewable energy sources are predominant and then an increasing population levels due to increasing the carbon footprint is one of the main factors The utilization of solar system can be grouped into single stage or double stage topologies. however the benefits of single stage topology, include reduction cost has the required number of components are less decreases in losses of the system due to the absence of boost converter and reduction in the overall complexity of the system there for enhancing the utilization of solar PV array which makes is preferable choice utilization of solar PV array which makes it preferable choice over the best age to these are represented by prototype the great cannot feed directly the with power arrived from the PV array does a power converter like voltage source converter (VSC) is essential for the DC to AC conversion process the combination of solar PV and VSC at the point of intersection with the utility grid can be used in the standalone and grid connected system in standalone system the requirement of additional storage systems is due to the conformity ready in time recording in solar PV output and the energy requirement of connected load.

That suffers from power quality problems of undervoltage, over voltage and harmonics due to a regular and nonlinear load this power quality issues leads to the financial losses equipment demands and losses of important data in order to evaluate in the power quality problems important data which performs the function of power factor improvement and harmonics mitigated through the optimal control technique there are numerous control techniques which exists in the literature involving. The control technique based on neural networks are gaining importance in recent times reducing computational burden and algorithm complexity have been achieved due to recent advancement in NN the energy based or control logarithms are being utilized for several applications including electrical machines Air craft landing control due to accuracy providing

A. Solar Energy

In today's climate of growing energy needs and increasing environmental concern, alternatives to the use of non-renewable and polluting fossil fuels have to be investigated. One such alternative is solar energy. Solar energy is quite simply the energy produced directly by the sun and collected elsewhere, normally the Earth. The sun creates its energy through a thermonuclear process that converts about 650,000,0001 tons of hydrogen to helium every second.

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The process creates heat and electromagnetic radiation. The heat remains in the sun and is instrumental in maintaining the thermonuclear reaction. The electromagnetic radiation (including visible light, infra-red light, and ultra-violet radiation) streams out into space in all directions. Only a very small fraction of the total radiation produced reaches the Earth.

Fig. 1. Solar Radiation falling on Panels

The radiation that does reach the Earth is the indirect source of nearly every type of energy used today. The exceptions are geothermal energy, and nuclear fission and fusion. Even fossil fuels owe their origins to the sun; they were once living plants and animals whose life was dependent upon the sun. Much of the world's required energy can be supplied directly by solar power. More still can be provided indirectly. The practicality of doing so will be examined, as well as the benefits and drawbacks. In addition, the uses solar energy is currently applied to will be noted.

B. Photovoltaic System

PV modules generate DC current and voltage. However, to feed the electricity to the grid, AC current and voltage are needed. Inverters are the equipment used to convert DC to AC. In addition, they can be in charge of keeping the operating point of the PV array at the MPP. This is usually done with computational MPP tracking algorithms. There is different inverter configurations depending on how the PV modules are connected to the inverter. The decision on what configuration should be used has to be made for each case depending on the environmental and financial requirements. If the modules are not identical or do not work under the same conditions, the MPP is different in each panel and the resulting voltage-power characteristic has multiple maxima, which constitutes a problem, because most MPPT algorithms converge to a local maximum depending on the starting point. If the operating point is not the MPP, not all the possible power is being fed to the grid. For these reasons each case has to be carefully studied to optimize the plant and obtain the maximum performance.

Fig. 2. Solar Photo Voltaic System

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C. Advantages of photovoltaic -PV- systems:

1) Photovoltaic (PV) systems provide green, renewable power by exploiting solar energy. We can use photovoltaic (PV) panels as an alternative energy source in place of electricity generated from conventional fossil fuels. Consequently, the more we use PV panels (or other renewable energy technologies) to cover for our energy needs, the more we help reduce our impact to the environment by reducing CO2 emissions into the atmosphere.
2) Photovoltaic (PV) panels constitute a reliable, industrially matured, green technology for the exploitation of solar energy. Photovoltaic (PV) companies give valuable warranties for PV panels in terms of both PV panel life span (years of PV life) and PV panels' efficiency levels across time. PV panels can last up to 25 years or more, some with a maximum efficiency loss of 18% only, even after 20 years of operation.
3) Unlike wind turbines, Photovoltaic (PV) panels operate autonomous without any noise generation as they do not incorporate any moving mechanical parts. In some cases, photovoltaic (PV) panels may be mounted on adjustable rotating basis which is mounted on a fixed pole and allows some movement for better and longer solar tuning – turning the solar panel to follow the sun. Even in this adjustable PV systems, the movements are very moderate, almost negligible, and do not generate any disturbances.

D. Disadvantages of Photovoltaic (PV) panels

1) Perhaps the biggest disadvantage of Photovoltaic (PV) panels is their limited efficiencylevels; compared to other renewable energy sources – such as solar thermal – PV systemshave a relatively low efficiency level ranging between 12-20%. Although there iscontinuous technological development in PV materials for improving existing systems'performances or creating new products, PV systems are still limited by the capabilities ofthe materials used in PV cells (thin-films PV, mono or polycrystalline cells etc.).
2) Another disadvantage of Photovoltaic PV panels is that they produce direct electric current which must be converted to alternating current (AC) before it can be used for consumption (either to be transferred to the power grid, or directly for own consumption). To convert DC to AC, PV panel systems use inverters, expensive electronic equipment and with certain technological limitations, adding to the overall system's cost especially at larger power sizes.
3) Although supply of solar energy is, usually, concurrent with peak energy demand (e.g. for cooling in hot summer days), one of Solar Photovoltaic (PV) panels' main disadvantage is that it delivers only in direct sunlight and it cannot store excess amounts of produced energy for later use. This is particularly important when energy is needed for the night when there is no sunlight or when weather conditions are fluctuating (e.g. sensitive to cloud shading) conditions under which PV efficiency is further decreased. Consequently, reduction in PV panel efficiency will result in a lower output (kwh) which greatly influences financial performance of your PV investment.

Block Diagram

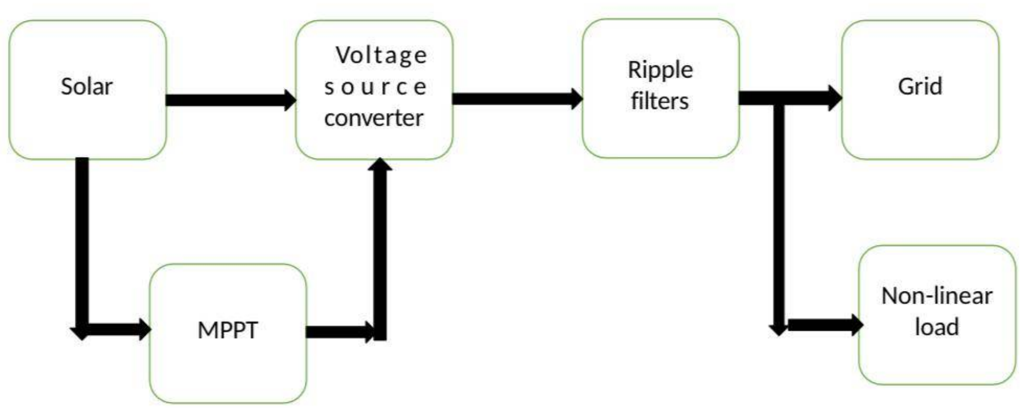

Fig.3. Block Diagram

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The above diagram shows over view of the simulation model in this way the systems are interconnected. The solar photovoltaic cell produces the power in the form of DC and the DC power is not much accurate because the temperature will not remain constant through the day. To maintain constant, we are using MPPT technique after that the power is converted to alternative form by IGBT switches. By non-linear loads, unbalancing of loads there will be harmonics that can create disturbance in waveform ripple factor is used to detect and control the harmonics. Active power fed to the grid and remaining unused power to the grid.

Circuit diagram

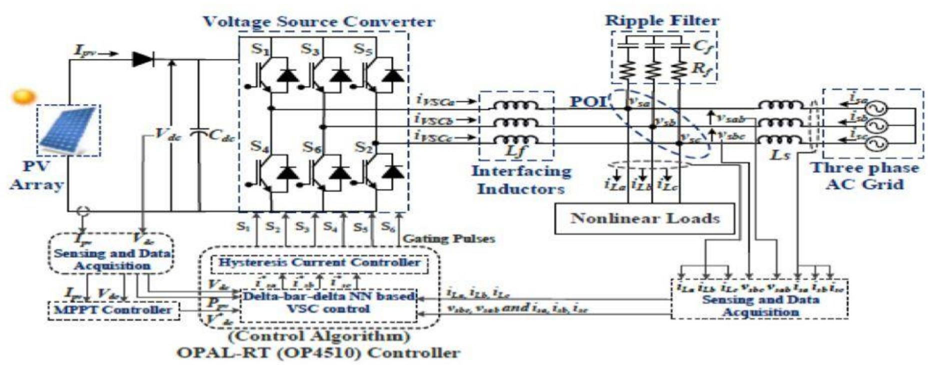

Fig.4. Circuit Diagram

The solar radiation is fall on pv array where the dc output coming from the array is here stored in the dc link capacitor. Here we use dc link capacitor because of low loss of storage is observed in it, and basically used for industrial purposes which have high life time and strong and safe terminating.

Then we use data sensing acquisition, where the process of sensing samples that measure the real world.

Then the MPPT determined through incremental conductance method in order to improve efficiency of pv array.

II. VOLTAGE SOURCE INVERTER

An inverter refers to a power electronic device that converts power in DC form to AC form at the required frequency and voltage output.

Inverters are classified into two main categories –

1) *Voltage Source Inverter VSI* – The voltage source inverter has stiff DC source voltage that is the DC voltage has limited or zero impedance at the inverter input terminals.
2) *Current Source Inverter CSI* – A current source inverter is supplied with a variable current from a DC source that has high impedance. The resulting current waves are not influenced by the load.

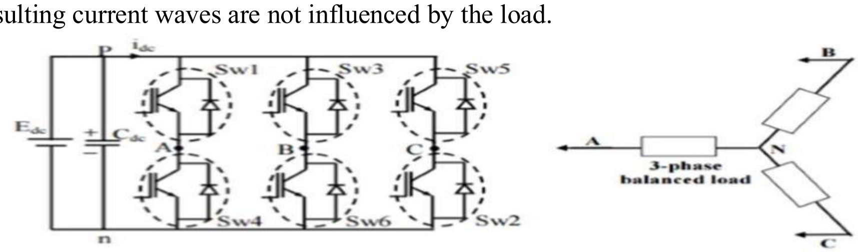

Fig.5. VSC

A three-phase inverter converts a DC input into a three-phase AC output.

Its three arms are normally delayed by an angle of 120° so as to generate a three- phase AC supply.

The inverter switches each has a ratio of 50% and switching occurs after every T/6 of the time T 60°angle interval.

The switches S1 and S4, the switches S2 and S5 and switches S3 and S6 complement each other.

The two types of inverters above have two modes of conduction – 180° mode of conduction and 120° mode of conduction.

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A. Neural Network

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by biological nervous systems. It is composed of a large number of highly interconnected processing elements called neurons. An ANN is configured for a specific application, such as pattern recognition or data classification.

B. Why to use Neural Networks

1) Ability to derive meaning from complicated or imprecise data
2) Extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques
3) Adaptive learning
4) Real Time Operation

III. MAXIMUM POWER POINT TRACKING ALGORITHMS

As was previously explained, MPPT algorithms are necessary in PV applications because the MPP of a solar panel varies with the irradiation and temperature, so the use of MPPT algorithms are required in order to obtain the maximum power from a solar array. Over the past decades many methods to find the MPP have been developed and published. These techniques differ in many aspects such as required sensors, complexity, cost, range of effectiveness, convergence speed, correct tracking when irradiation and/or temperature change, hardware needed for the implementation or popularity, among others. A complete review of 19 different MPPT algorithms can be found. Among these techniques, the P&O and the InCond algorithms are the most common. These techniques have the advantage of an easy implementation but they also have drawbacks, as will be shown later. Other techniques based on different principles are fuzzy logic control, neural network, fractional open circuit voltage or short circuit current, current sweep, etc. Most of these methods yield a local maximum and some, like the fractional open circuit voltage or short circuit current, give an approximated MPP, not the exact one. In normal conditions the V-P curve has only one maximum, so it is not a problem. However, if the PV array is partially shaded, there are multiple maxima in these curves. In order to relieve this problem, some algorithms have been implemented.

A. Hill-climbing Techniques

Both P&O and InCond algorithms are based on the "hill-climbing" principle, which consists of moving the operation point of the PV array in the direction in which power increases. Hill climbing techniques are the most popular MPPT methods due to their ease of implementation and good performance when the irradiation is constant. The advantages of both methods are the simplicity and low computational power they need. The shortcomings are also well-known: oscillations around the MPP and they can get lost and track the MPP in the wrong direction during rapidly changing atmospheric conditions.

B. Perturb and Observe

The P&O algorithm is also called "hill-climbing", but both names refer to the same algorithm depending on how it is implemented. Hill-climbing involves a perturbation on the duty cycle of the power converter and P&O a perturbation in the operating voltage of the DC link between the PV array and the power converter. In the case of the Hill-climbing, perturbing the duty cycle of the power converter implies modifying the voltage of the DC link between the PV array and the power converter, so both names refer to the same technique. In this method, the sign of the last perturbation and the sign of the last increment in the power are used to decide what the next perturbation should be.

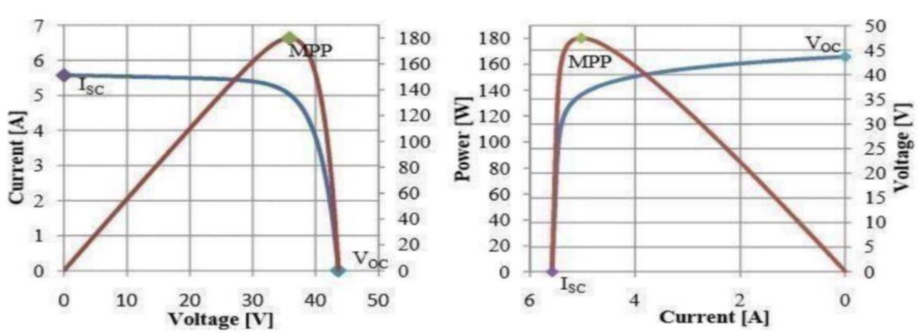

Fig.6 I-V & P-V Characteristics

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If there is an increment in the power, the perturbation should be kept in the same direction and if the power decreases, then the next perturbation should be in the opposite direction. Based on these facts, the algorithm is implemented. The process is repeated until the MPP is reached. Then the operating point oscillates around the MPP

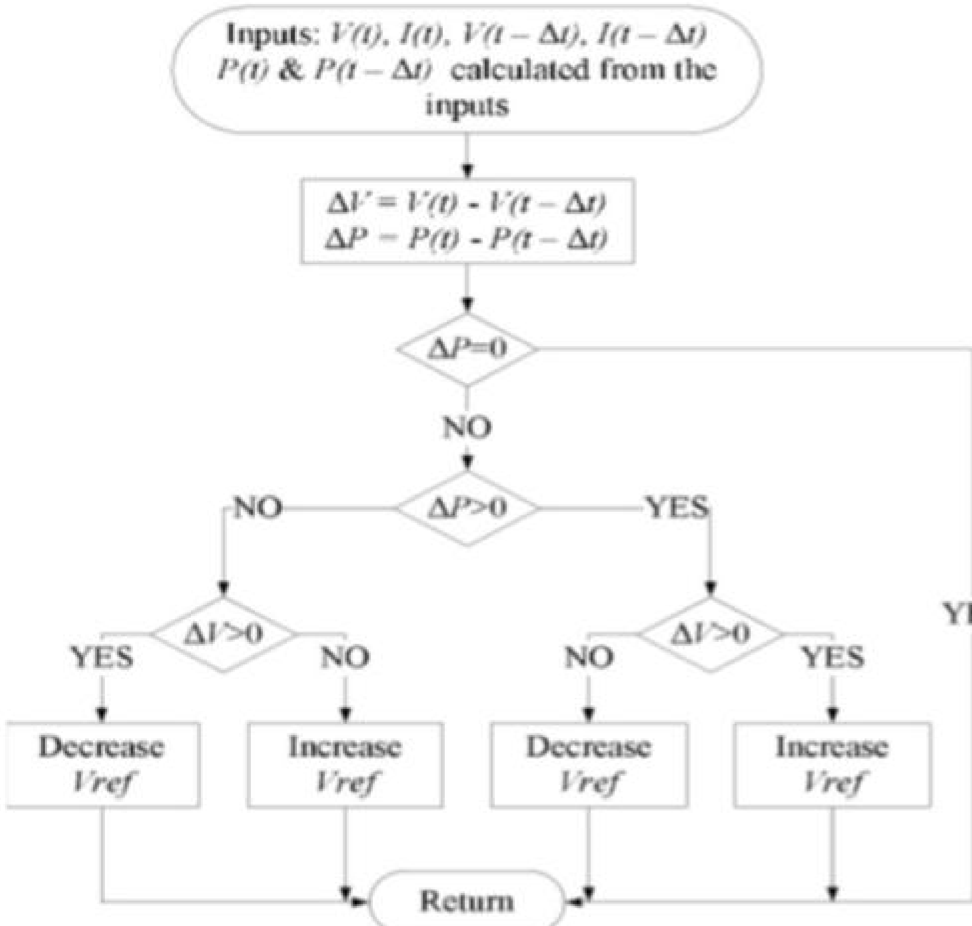

Fig 7. Perturb and observe technique algorithm

C. Computational Algorithm

1) *Incremental Conductance:* The incremental conductance algorithm is based on the fact that the slope of the curve power vs. voltage (current) of the PV module is zero at the MPP, positive (negative) on the left of it andnegative (positive) on the right.

- $\Delta V/\Delta P = 0$ ($\Delta I/\Delta P = 0$) at the MPP
- $\Delta V/\Delta P > 0$ ($\Delta I/\Delta P < 0$) on the left
- $\Delta V/\Delta P < 0$ ($\Delta I/\Delta P > 0$) on the right

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By comparing the increment of the power vs. the increment of the voltage (current) between twoconsecutives samples, the change in the MPP voltage can be determined. In both P&O and In Cond schemes, how fast the MPP is reached depends on the size of the increment of the reference voltage. The drawbacks of these techniques are mainly two. The first and main one is that they can easily lose track of the MPP if the irradiation changes rapidly. In case of step changes they track the MPP very well, because the change is instantaneous and the curve does not keep on changing.

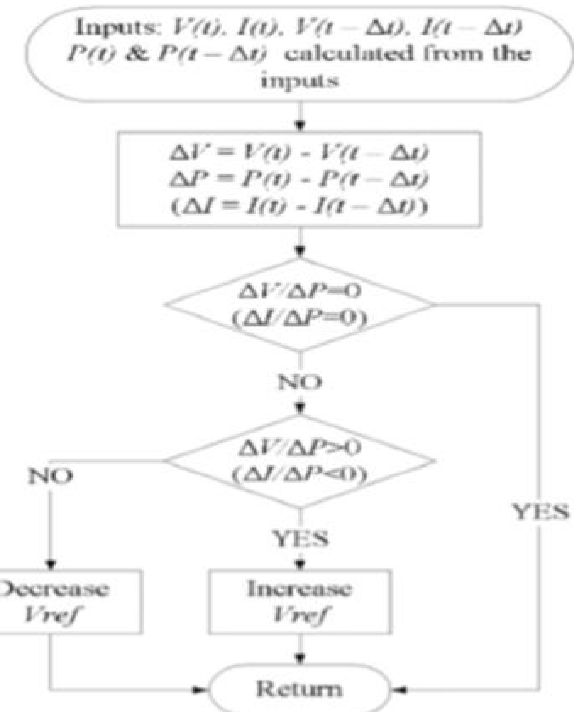

Fig 8 Incremental conductance algorithm

However, when the irradiation changes following a slope, the curve in which the algorithms are based changes continuously with the irradiation, so the changes in the voltage and current are not only due to the perturbation of the voltage. As a consequence, it is not possible for the algorithms to determine whether the change in the power is due to its own voltage increment or due to the change in the irradiation.

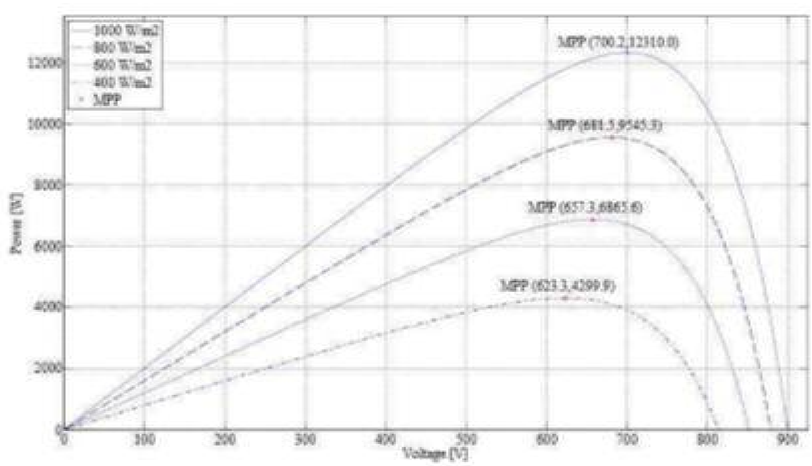

Fig. 9. MPPT power at different intervals

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D. PQ Theory

It is based on instantaneous values in three-phase power systems with or without neutral wire, and is valid for steady-state or transitory operations, as well as for generic voltage and current waveforms. The p-q theory consists of an algebraic transformation (Clarke transformation) of the three-phase voltages and currents in the a-b-c coordinates to the α-β-0 coordinates, followed by the calculation of the p-q theory instantaneous power components:

$$\begin{bmatrix} v_0 \\ v_\alpha \\ v_\beta \end{bmatrix} = \sqrt{\frac{2}{3}} \cdot \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} & 1/\sqrt{2} \\ 1 & -1/2 & -1/2 \\ 0 & \sqrt{3}/2 & -\sqrt{3}/2 \end{bmatrix} \cdot \begin{bmatrix} v_a \\ v_b \\ v_c \end{bmatrix} \qquad \begin{bmatrix} i_0 \\ i_\alpha \\ i_\beta \end{bmatrix} = \sqrt{\frac{2}{3}} \cdot \begin{bmatrix} 1/\sqrt{2} & 1/\sqrt{2} & 1/\sqrt{2} \\ 1 & -1/2 & -1/2 \\ 0 & \sqrt{3}/2 & -\sqrt{3}/2 \end{bmatrix} \cdot \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix}$$

$$p_0 = v_0 \cdot i_0 \qquad \text{instantaneous zero-sequence power}$$

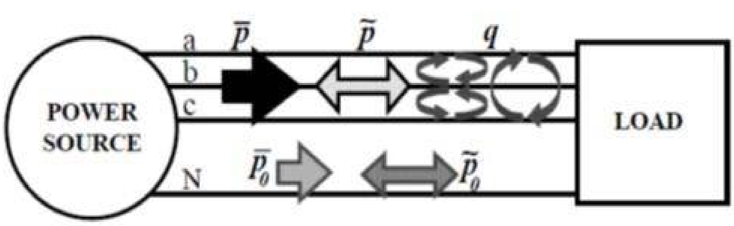
$$p = v_\alpha \cdot i_\alpha + v_\beta \cdot i_\beta \qquad \text{instantaneous real power}$$

$$q \equiv v_\alpha \cdot i_\beta - v_\beta \cdot i_\alpha \qquad \text{instantaneous imaginary power (by definition)}$$

The power components p and q are related to the same α-β voltages and currents, and can be written together.

$$\begin{bmatrix} p \\ q \end{bmatrix} = \begin{bmatrix} v_\alpha & v_\beta \\ -v_\beta & v_\alpha \end{bmatrix} \cdot \begin{bmatrix} i_\alpha \\ i_\beta \end{bmatrix}$$

These quantities are illustrated for an electrical system represented in a-b-c coordinates and have the following physical meaning: p0 = mean value of the instantaneous zero-sequence power – corresponds to the energy per time unity which is transferred from the power supply to the load through the zero-sequence components of voltage and current.
p0 ~ = alternated value of the instantaneous zero-sequence power – it means the energy per time unity that is exchanged between the power supply and the load through the zero-sequence components. The zero-sequence power only exists in three-phase systems with neutral wire.
Furthermore, the systems must have unbalanced voltages and currents and/or 3rd harmonics in both voltage and current of at least one phase.20 p = mean value of the instantaneous real power – corresponds to the energy per time unity which is transferred from the power supply to the load, through the a-b-c coordinates, in a balanced way (it is the desired power component). p~ = alternated value of the instantaneous real power – It is the energy per time unity that isexchanged between the power supply and the load, through the a-b-c coordinates.q = instantaneous imaginary power – corresponds to the power that is exchanged between thephases of the load. This component does not imply any transference or exchange of energy between the power supply and the load, but is responsible for the existence of undesirable currents, which circulate between the system phases. In the case of a balanced sinusoidal voltage supply and a balanced load, with or without harmonics, q (the mean value of the instantaneous imaginary power) is equal to the conventional reactive power (q = 3·V · I1 · sinφ1)



Power components of the p-q theory in *a-b-c* coordinates.

Fig. 10. PQ model

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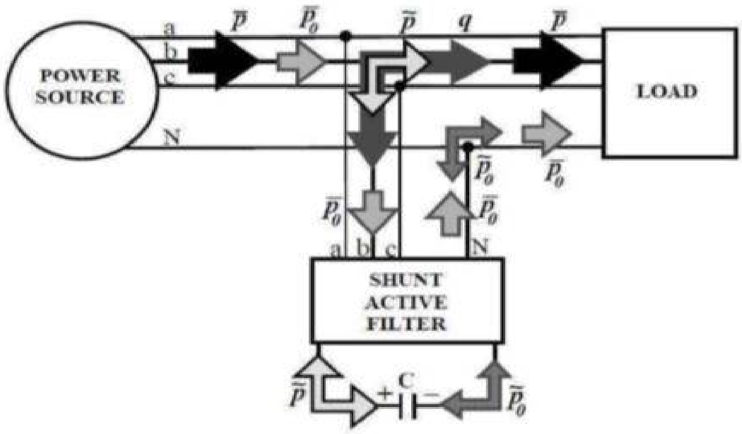
E. The P-Q Theory Applied To Shunt Active Filters

The p-q theory is one of several methods that can be used in the control active filters. It presents some interesting features, namely:

1) It is inherently a three-phase system theory;
2) It can be applied to any three-phase system (balanced or unbalanced, with or without harmonics in both voltages and currents);
3) It is based in instantaneous values, allowing excellent dynamic response;
4) Its calculations are relatively simple (it only includes algebraic expressions that can be implemented using standard processors);
5) It allows two control strategies: constant instantaneous supply power and sinusoidal supply current.

As seen before, p is usually the only desirable p-q theory power component. The other quantities can be compensated using a shunt active filter. This quantity is delivered from the power supply to the load, through the active filter. This means that the energy previously transferred from the source to the load through the zero-sequence components of voltage and current, is now delivered in a balanced way from the source phases. It is also possible to conclude from that the active filter capacitor is only necessary to compensate p~ and p0 ~, since these quantities must be stored in this component at one moment to be later delivered to the load. The instantaneous imaginary power (q), which includes the conventional reactive power, is compensated without the contribution of the capacitor. This means that, the size of the capacitor does not depend on the amount of reactive power to be compensated.



Compensation of power components $\tilde{p}$, q, $\bar{p}_0$ and $\tilde{p}_0$ in *a-b-c* coordinates.

Fig. 11.PQ to abc transformation

To calculate the reference compensation currents in the α-β coordinates, the expression (5) is inverted, and the powers to be compensated (0 p p ~ − and q) are used:

$$\begin{bmatrix} i_{c\alpha}{}^* \\ i_{c\beta}{}^* \end{bmatrix} = \frac{1}{v_\alpha{}^2 + v_\beta{}^2} \cdot \begin{bmatrix} v_\alpha & -v_\beta \\ v_\beta & v_\alpha \end{bmatrix} \cdot \begin{bmatrix} \tilde{p} - \bar{p}_0 \\ q \end{bmatrix}$$

Since the zero-sequence current must be compensated, the reference compensation current in the 0 coordinate is i0 itself:

ic0* = i0

In order to obtain the reference compensation currents in the a-b-c coordinates the inverse of the transformation given in expression (1) is applied.

$$\begin{bmatrix} i_{ca}{}^* \\ i_{cb}{}^* \\ i_{cc}{}^* \end{bmatrix} = \sqrt{\frac{2}{3}} \cdot \begin{bmatrix} 1/\sqrt{2} & 1 & 0 \\ 1/\sqrt{2} & -1/2 & \sqrt{3}/2 \\ 1/\sqrt{2} & -1/2 & -\sqrt{3}/2 \end{bmatrix} \cdot \begin{bmatrix} i_{c0}{}^* \\ i_{c\alpha}{}^* \\ i_{c\beta}{}^* \end{bmatrix}$$

$$i_{cn}{}^* = -(i_{ca}{}^* + i_{cb}{}^* + i_{cc}{}^*)$$

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The calculations presented so far are synthesized and correspond to a shunt active filter control strategy for constant instantaneous supply power. This approach, when applied to a three-phase system with balanced sinusoidal voltages, produces de following results:

1) The phase supply currents become sinusoidal, balanced, and in phase with the voltages. (in other words, the power supply "sees" the load as a purely resistive symmetrical load);
2) The neutral current is made equal to zero (even 3rd order current harmonics are compensated);
3) The total instantaneous power supplied, p3s (t) = va ·isa + vb ·isb + vc ·isc is made constant.

In the case of a non-sinusoidal or unbalanced supply voltage, the only difference is that the supply current will include harmonics (Fig 9), but in practical cases the distortion is negligible23

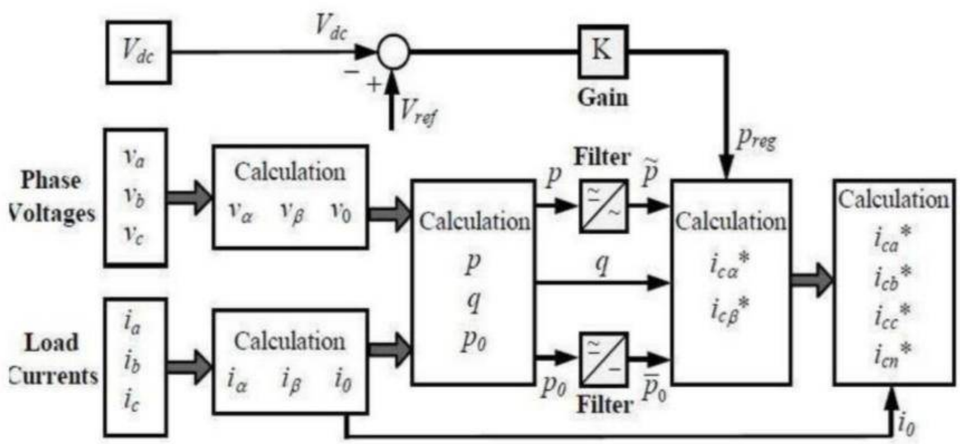

Fig. 12. Calculations for Constant instantaneous supply power control strategy.

The sinusoidal supply current control strategy must be used when the voltages are distorted or unbalanced and sinusoidal currents are desired.

F. Pulse Width Modulation (PWM)

The Pulse Width Modulation (PWM) is a technique which is characterized by the generation of constant amplitude pulse by modulating the pulse duration by modulating the duty cycle. Analog PWM control requires the generation of both reference and carrier signals that are feed into the comparator and based on some logical output, the final output is generated. The reference signals is the desired signal output maybe sinusoidal or square wave, while the carrier signal is either a saw tooth or triangular wave at a frequency significantly greater than the reference. There are various types of PWM techniques and so we get different output and the choice of the inverter depends on cost, noise and efficiency.

G. Sinusoidal Pulse Width Modulation

In this modulation technique are multiple numbers of output pulse per half cycle and pulses are of different width. The width of each pulse is varying in proportion to the amplitude of a sine wave evaluated at the centre of the same pulse. The gating signals are generated by comparing a sinusoidal reference with a high frequency triangular signal.

The rms ac output voltage,

$$V_o = V_s\sqrt{\frac{p\delta}{\pi}} \rightarrow V_s\sqrt{\sum_{m=1}^{2p}\frac{\delta_m}{\pi}}$$

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Where p=number of pulses and δ= pulse width.

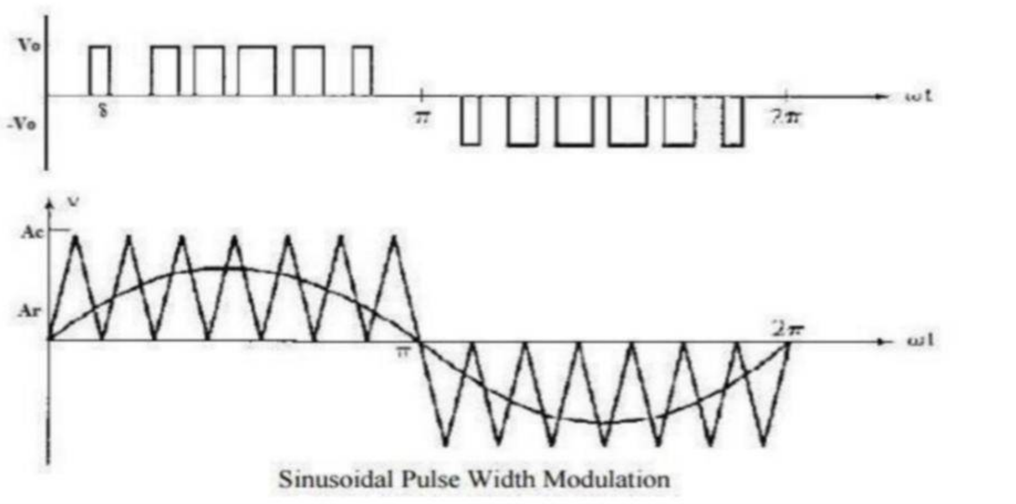

Fig. 13. PWM modulation

H. SPWM Harmonic Elimination

The SPWM waveform has harmonics of several orders in the phase voltage waveform, the dominant ones are the fundamental and other of order of n and n±2 where n=fc/fm. With the method of Selective Harmonic Elimination, only selected harmonics are eliminated with the smallest number of switching.

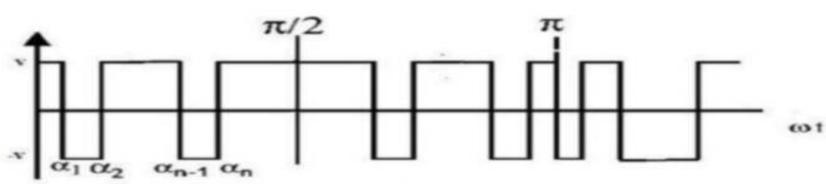

Fig. 14. Half wave symmetric graphs

The Fourier coefficients of the waveform shown in the above figure can be given by,

$$h_1 = \left(4\frac{V}{\pi}\right)[1 - 2\cos\alpha_1 + 2\cos\alpha_2 - 2\cos\alpha_3 + \ldots\ldots 2\cos\alpha_n]$$

$$h_3 = \left(4\frac{V}{3\pi}\right)[1 - 2\cos 3\alpha_1 + 2\cos 3\alpha_2 - 2\cos 3\alpha_3 + \ldots\ldots 2\cos 3\alpha_n]$$

$$.h_n = \left(4\frac{V}{n\pi}\right)[1 - 2n\cos\alpha_1 + 2n\cos\alpha_2 - 2n\cos\alpha_3 + \ldots\ldots 2n\cos\alpha_n]$$

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Where hn represents the magnitude of nth harmonic component and an is the primary switching angle, n is the no of chops. Fourier sine and cosine coefficients are,

$$a_o = \frac{1}{2\pi}\int_0^{2\pi} f(\theta)d\theta$$

$$a_k = \frac{1}{\pi}\int_0^{2\pi} f(k\theta)\cos(k\theta)d\theta$$

$$b_k = \frac{1}{\pi}\int_0^{2\pi} f(k\theta)\sin(k\theta)d\theta$$

Only odd no. harmonics exist due to half cycle symmetry of waveform. Using quarter cycle symmetry, the Fourier coefficients become,

$$b_k = 4\frac{V}{\pi}\left(\int_0^{\alpha 1}\sin(k\theta)d\theta - \int_{\alpha 1}^{\alpha 2}\sin(k\theta)d\theta + \int_{\alpha 2}^{\alpha 3}\sin(k\theta)d\theta - \ldots\ldots\int_0^{\frac{\pi}{2}}\sin(k\theta)d\theta\right)$$

$$= 4\frac{V}{n\pi}[1-2\cos\alpha_1 + 2\cos\alpha_2 - 2\cos\alpha_3 \ldots.. 2\cos k\alpha_n]$$

I. Advantages of SPWM

1) Low power consumption
2) High energy efficient
3) High power handling capability
4) No temperature variation-and ageing-caused drifting or degradation in linearity.
5) Easy to implement and control.
6) Compatible with today's digital microprocessors.

IV. SIMULATION AND RESULTS

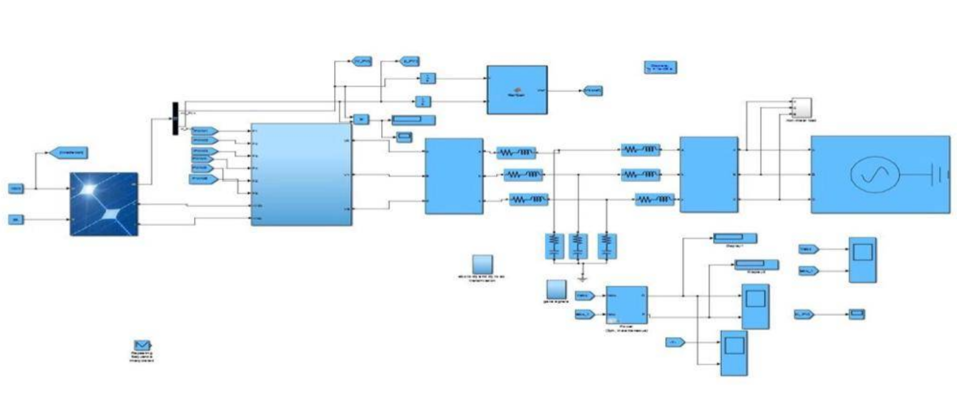

Fig. 15. Simulation

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A. Controller

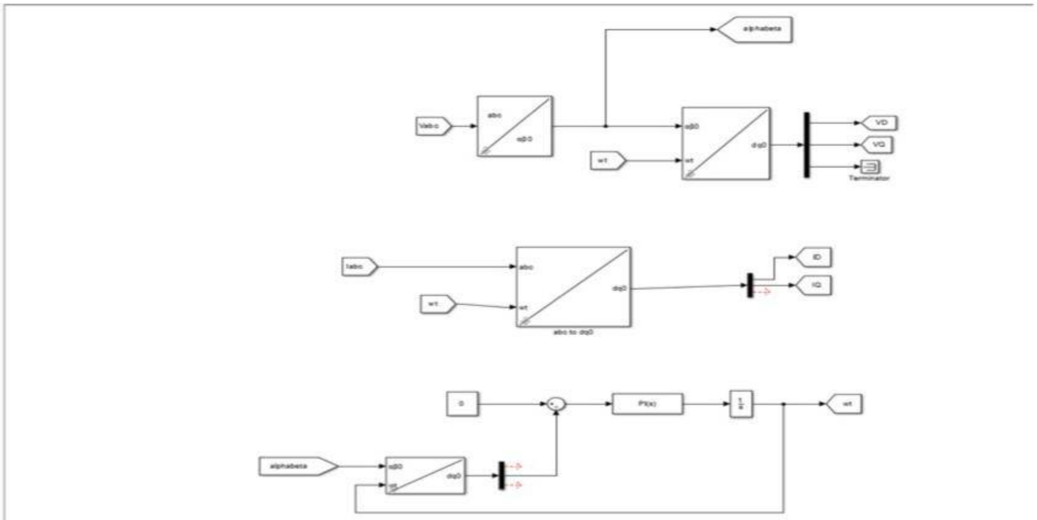

Fig. 16. PI controller

B. 3 Phase Inverter

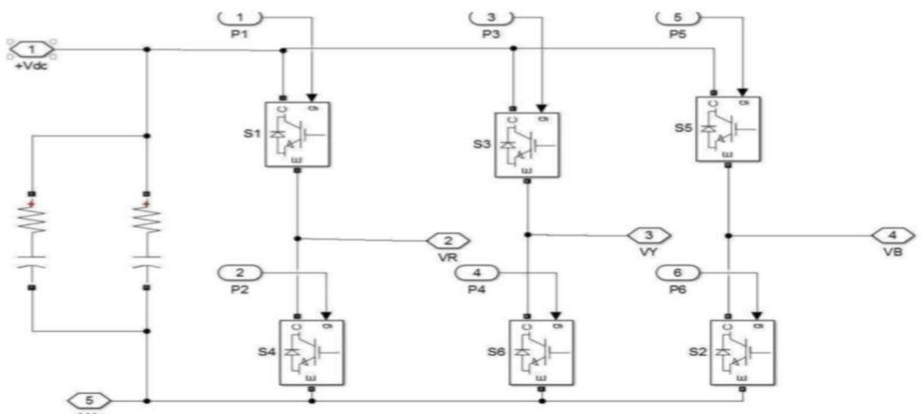

Fig. 17. voltage source inverter

C. Gate Signals Controlling

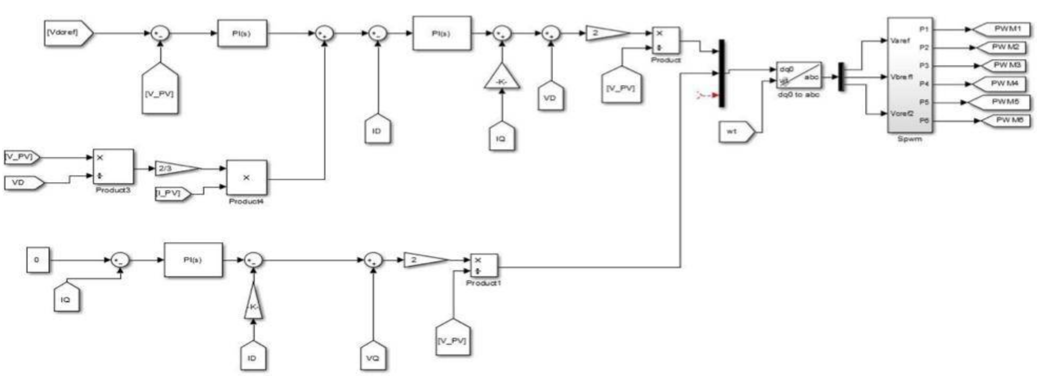

Fig. 18.Gate signal controller

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D. Solar Output Voltage

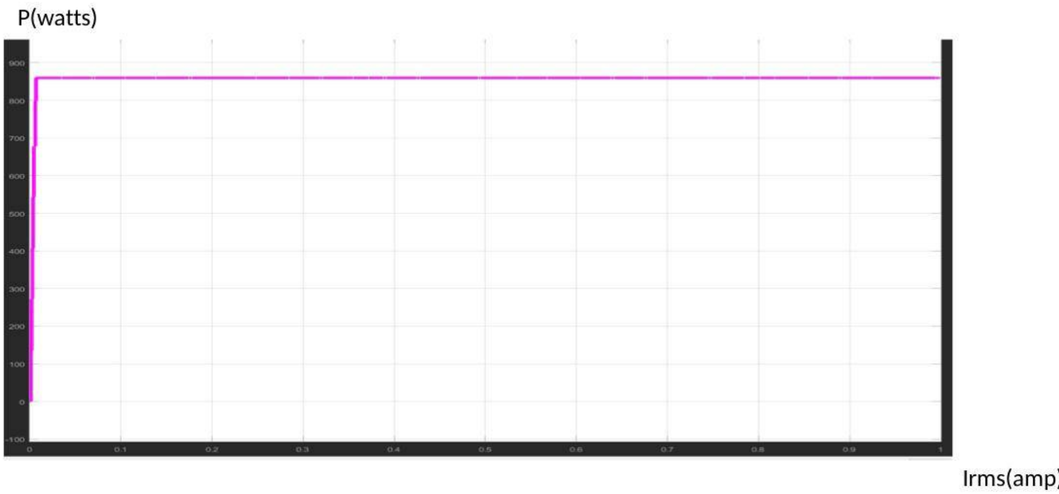

Fig.19. Solar output voltage

The decrease in solar insolation from 1000 W/m2 to 800W/m2 is presented by waveforms (a-e). There is no change observed in grid voltage (vsab), terminal voltage (Vt) due to the changing solar insolation conditions. The reference grid currents are reduced in magnitude as, which are generated by the control approach. In addition, shows a decrease in magnitude of the grid currents due to the decrease in insolation and a reduction in wpv and Ipv is also observed. In, the internal signals are observed with the decrease in solar insolation. As observed, Vdc is maintained almost constant by using a PI controller for satisfactory performance.

E. Non-linear Output Voltage

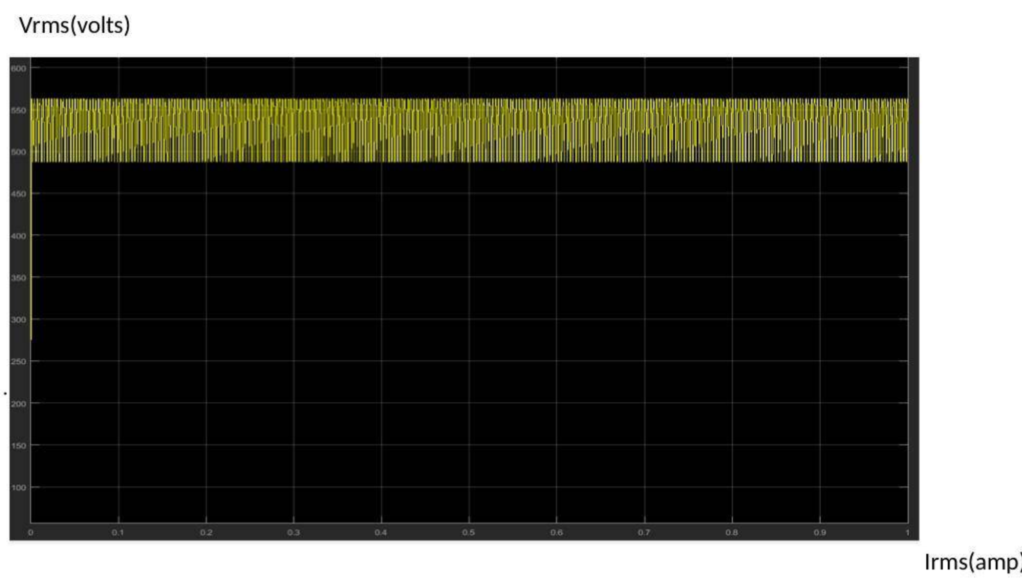

Fig. 20 non-linear voltage

By opening one of the load lines (phase ‘a’), the load disturbance condition is emulated, which emulates unbalanced load and causes reduction in the effective load. In Fig the phase ‘a’ load is disconnected at 0.5s in case of nonlinear load unbalanced condition. Therefore, as shown in Fig, the load current of phase ‘a’ is equal to zero. After load removal condition, an increase in the grid currents (isabc) is observed as the net power being fed to the grid increases. However, the grid currents are maintained sinusoidal in case of load unbalancing. Moreover, in ‘a’ phase VSC current (iVSC).

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F. Grid Side Current And Voltage

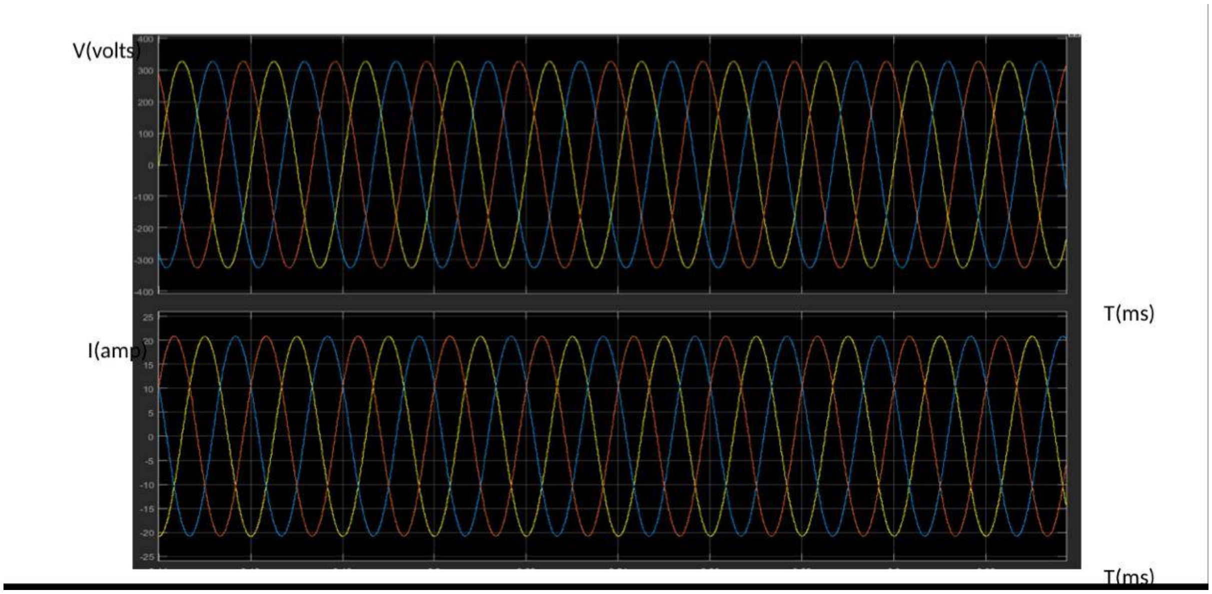

Fig. 21.grid side 3phase voltage

The operation under steady-state of the proposed system at nonlinear load. The grid current of 4.92A flows into the grid. The grid current total harmonic distortion (THD) is less than 5 %, which is observed to be within the limits . As the power is being absorbed by the grid, the grid power is observed with negative sign VSC current as 8.2A and VSC power is observed as 3.11kW . The solar PV array is responsible for delivering power to the grid and to the connected loads in the distribution system, which is refer to as VSC power. In, the load current and load power are observed, respectively. The THD of grid voltage (vsab) and it is observed.

G. Reactive Power And Active Power

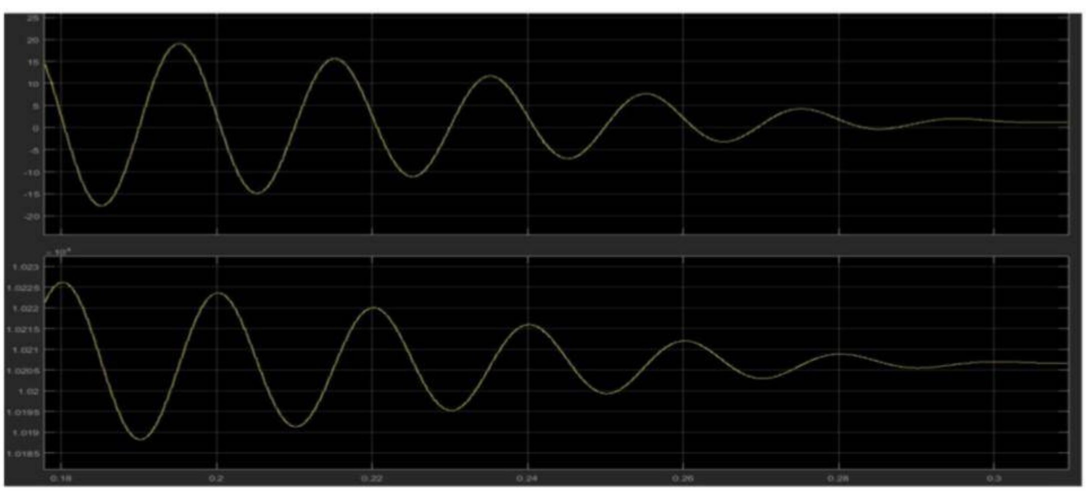

Fig. 22.reactive power and active power

Irregular dc wave from obtains because nonlinearity of the energy received . By means of capacitor and controller. The maximum energy stored in the capacitor, can be utilised by the controller Active power utilized by the loads and reactive circulates in the circuit to obtain initial voltage constant thus the voltage can be varied.

V. CONCLUSION

The delta bar delta neural network-based control technique has been proposed here for solar pv interfaced to the three-phase grid system. The incremental conductance based MPPT has been implemented in order to obtain maximum power from the solar pv array. Power quality of PV array module has been developed by a control algorithm and maximum power point technique is used for this project to obtain a maximum power from the solar PV array. This technique has given very efficient results in terms of nonlinear loads and abnormal condition in grid such as unbalancing of load, decreasing of solar insolation and voltage sag. The results obtained in steady state and dynamic condition based on experimental validation.

VI. FUTURE SCOPE

The Designing of MPPT controller, should be extended by tracking larger number of input parameters which are varying with respect to the time such as parameters variations of the system. In order to get accurate MPPT algorithms such as Z-infinity algorithms should be implemented. The work that has been carried out to the DC-DC converter is limited only by considering high switching frequency. But the output voltage THD values are not improved much so that the research should be carried out in this area, a filter circuits configuration should be improved. For the inverter circuits, the gird tied inverters are having the problem that if the gird fails, the customer will not get any supply even though there is power generation from the PV system. This should be considered as a serious problem and the research should be carried out in this area.

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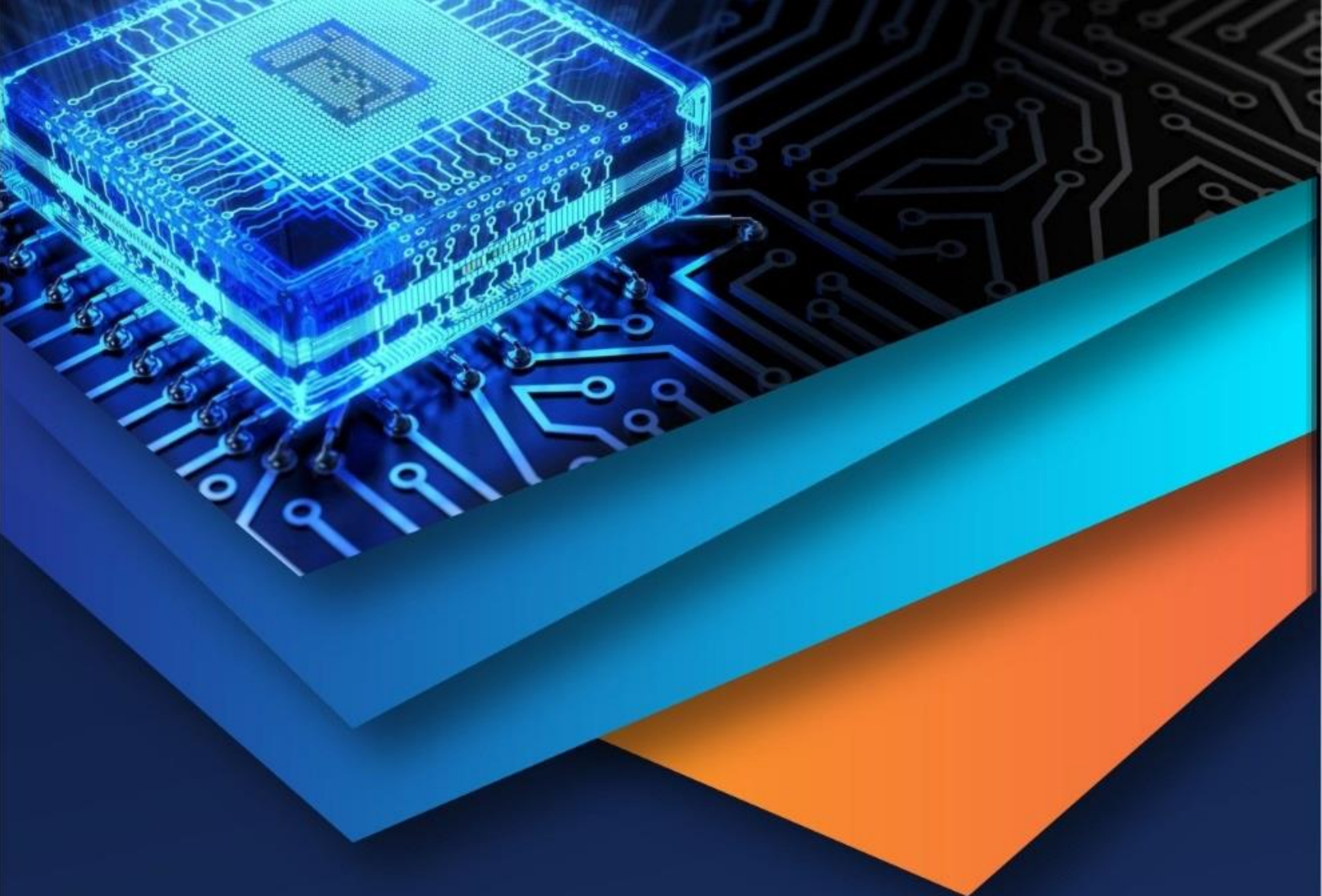

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