Research Result

Bypass Dynamic Power Filters with Unsure Fuzzy Logic Controller

Aditya Marmat[1] and Vijay Anand Bharti[2]

[1]M.Tech (Power Electronics), Department of Electrical & Electronics, Mital Institute Bhopal (M.P.), INDIA
[2]Assistant Professor, Department of Electrical & Electronics, Mital Institute Bhopal (M.P.), INDIA

ABSTRACT

An effective shunt power filter with invisible control is discussed in this paper. This is due to the increased presence in the indirect asset network; they create a source of harmonic network pollution, which causes a lot of disruption, and disrupts the efficiency of electrical equipment. In this work, we propose a solution to eliminate the harmonics presented by indirect loads. This paper introduces a review of the three-phase active filter (APF) that compensates for harmonic power and active energy created by low and medium energy loads in a stable and temporary environment. Harmonics pollution is a major and dangerous problem for energy systems. Effective power filtering makes one of the proposed solutions the most effective. An effective shunt energy filter that achieves harmonic distortion of low current value, active energy compensation, and power adjustment. The topology is based on the IGBT voltage inverter, which is intended to alleviate the harmonics produced by the diode modifier. A major contribution of the paper is the use of a notch filtering method, which includes only two serial band-pass filters, counting reference currents, and the use of a vague concept to control better filter accuracy. Entry signals are made with a company-based PWM strategy. Simulated model simulation activities, using SIMULINK under the MATLAB software, have produced satisfactory results in temporary and stable environments.

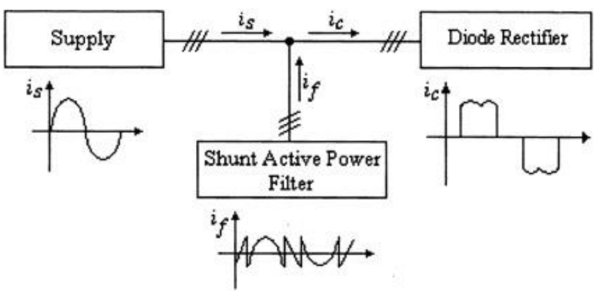
KEYWORDS

Active Power Filters, Harmonics, fuzzy logic controller.

1. INTRODUCTION

Modern electrical systems, due to the widespread proliferation of power conversion units and electrical appliances, cause the disruption associated with the growing waves of ac pipes. Power (PQ) is an important measure of a power system. The term PQ means to maintain the current state of the sinusoidal wave in a phase in the form of a sinusoidal voltage wave. The energy produced by a naturally occurring station is sinusoidal. Deterioration of electrical quality is mainly due to current harmonics and voltage due to the wide distribution of. electrical equipment based on electrical equipment including convertible drives, electrical equipment, DC car drivers, battery chargers, electric ballasts are responsible for increased power-related problems [1] [2], [3]. These indirect loads absorb non-sinusoidal currents and usually consume active energy. Harmonic currents are generated by indirect loads and incorporated into a power distribution system using a common point of contact. Normal PI voltage and current controls were used to control harmonic current and dc voltage shunt.

APF. However, a standard PI controller requires an accurate mathematical model of the system line, which is difficult to detect under parameter variability, line inconsistencies, and load distortions. In recent years, sensible controls have made a huge impression on some applications. The advantages of unambiguous controls are: durability, no need for an accurate mathematical model, can work with nonlinear input, and can control line inconsistencies. In this paper, sophisticated mind control schemes for the corresponding current power supply and inverter dc are proposed to improve each of the three levels of APF shunt levels. The performance of the blur control is tested with computer simulations under strict conditions. The results obtained showed that, the proposed active filter control provided sinusoidal supply current with low harmonic distortion and phase and line voltage. APF performance is explained in detail by harmonic current (reference current) and dc voltage of the inverter control systems. Development and implementation of a sensible control system made in this paper.



2. LITERATURE REVIEW

Integrated power quality conditioners (UPQC's), intended for the integration of efficient and effective shunt filters.

The main objective of the UPQC is to compensate for voltage flicker / imbalances, operating power, negative current sequences, and harmonics. In other words, UPQC has the potential to improve energy quality in the area of incorporation into energy distribution systems or industrial energy systems. UPQC data. The test results obtained from the 20 kVA laboratory model, as well as theoretical analysis, were presented to confirm the effectiveness and efficiency of the UPQC. [1]

Shunt active power filters are used to eliminate current harmonics and to improve the power factor in line load systems. Currently, there are various ways to control active energy filters. Some of them are based on the idea of saving energy quickly [I] while others are based on a consistent reference framework using Park modification [2j. The purpose of this paper is to introduce a new control method for active shunt power filters in unbalanced systems, both in load waves, and in AC voltage, with a high content of harmonics. The method is based on the time domain analysis by P. Filipski. With this method of control one can make a set of indirect loads and the shunt power filter behave consistently as a resistor, UPF (with uninity power factor), or that the current absorbed by the set is completely sinusoidal, simply by operation. by trade. The system is made up of different loads and lines. Line waves are displayed, with their corresponding deviation content. [2]

How to reduce the volume to increase the capacity of active power filters (APFs). The rated capacity combines the active force with the current deviation size provided by the APFs. Under volume limit control m + 1 APFs provide an effective loading capacity of m APFs that provide their limited power and one APF provides a fraction of its estimated value. Similarly, n + 1 APFs provide a harmonic current load and n APFs provide a current distortion of the total length and a single APF that provides part of its limited range. The advantages of this proposed method include high flexibility to increase system capacity, high reliability due to offline control, reduced APF power requirement, high modem due to uniform APFs, stable operating capacity and consistent current sharing and performance regardless of variable parameter. of APFs, less expensive due to modularization, etc. Three 1KVA single phase APFs are designed and implemented. Performance is shown by other test results. [3]

Comparison of three different techniques used for the production of current reference in active shunt power filters. Three different strategies are evaluated and compared in terms of compensation performance under stable and temporary operating conditions, start-up requirements, and compensation for four-wire power distribution systems, with one unequal category of indirect load. The three revised strategies are the Instantaneous Reactive Power Theory (PQ Theory), the Synchronous Reference Frame Theory (SRF) and the Peak Detection Method (PDM). Technical testing is performed by considering the intensity of the work with an uneven and distorted feed voltage, uneven load currents, signal condition control and processing delays presented

The comparison is based on theoretical analysis and corrective effects obtained from MATLAB. What is important is that the effectiveness of compensation for different strategies is the same under favorable conditions, but under the absence of inequalities and distortions of power, compensation performance is very different, and not all reference methods allow full compensation. Synchronous Reference Frame algorithm introduces excellent performance for different working environments. [4].

How to control the active filter of active shunt novels using SVPWM is introduced. In the proposed control mode, a VF voltage reference Vector is generated instead of the current reference, and the required electrical power of the APF is generated by a vacuum switch. The control algorithm is simple and can be seen with a less expensive controller. An effective power filter based on the proposed method can eliminate harmonics, compensate for active power and load asymmetry load. A 10kVA APF laboratory prototype is being developed. This model adopts the power source converter as the primary power and low-cost DSP ADMC326 as the control context. The simulations and test results confirm the validity of the analysis and feasibility of the APF with the proposed regulatory framework. [5]

The current novel acquisition algorithm based on the timeline of three-phase shunt Functional Filters (APF) to eliminate harmonics, and / or correct power factor, and / or measurement load estimates are analyzed in this paper. First, an overview of the basics and performance testing of the three existing algorithms for obtaining active power filters is presented. Depending on the complexity of the power issues and the different objectives of compensation, the current novel acquisition algorithm is then proposed. Compared to existing algorithms, this algorithm has a shorter delay and a clearer body definition. Current compensation indicators can be obtained accurately and easily using the proposed algorithm. It ensures that the shunt APF can achieve different compensation purposes. In addition, it is very easy to use this algorithm in Digital Signal Processor (DSP). The simulation results obtained with MATLAB and the test results for the APF shunt test were presented to it.

3. HARMONICS AND SHUNT ACTIVE FILTER

Harmonics is the cause where one of the main problems in the energy system. Harmonics provides distortion in current and voltage waves following the corrosion of the entire power system. The first step in evaluating harmonic harmonics comes from indirect loads. The result of such an analysis lasts for many years; great importance is given to the approach to learning and managing harmonics. Harmonics is present in the energy system and has inconsistent repetition of the total number of critical frequencies and has a medium wave formation. Harmonics produces in the energy system from two types of loads. [1]

One is listed as line load. The time loads of the fixed line are characterized by the fact that the application of the sinusoidal voltage effect to the current sinusoidal flow. A continuous impedance is observed from these loads during active sinusoidal voltage. As the voltage and current compared to others, if the voltage is increased it will also produce an increase in power. The case for such a load is incandescent light. However, if the flux signal in the air shaft of a rotating machine is not sinusoidal, under normal load loading conditions and rotating machines meet well with this definition. Also, the current transformer contains unusual harmonics that calculate the fraction of dc. Excessive use of magnetic circuits over time can be very common and can lead to the production of harmonics. In power systems, synchronous generators generate sinusoidal voltages and loads attract sinusoidal currents. In this case, harmonic distortions are formed due to the types of direct sinusoidal voltage loads being smaller.

Line loads are considered one of the loads. All of these devices are named as indirect loads and are sources of harmonics. The purpose of the sinusoidal voltage does not cause the sinusoidal flow to apply sinusoidal voltage to non-linear devices. Non-linear loads indicate a potential wave. Harmonic current is removed using a different harmonic filter to protect electrical equipment from damage due to the distortion of the harmonic voltage. They can also be used to capture the energy element. Special unsafe and dangerous effects of harmonic distortion can be manifested in many different ways such as loss of electronics, increased temperature effect on electrical objects, capacitor overload, etc. Here are two types of filters that are used to reduce harmonic. reverse active filters and passive filters.

Active harmonic filters are electrical components that remove unwanted harmonics from the network by inserting harmful harmonics into the network. Active filters are usually introduced on a low voltage network. Active filters include active devices such as IGBT-transistors and remove many unusual harmonic waves. The signal type can be single phase AC, three AC phase. On the other hand, idle harmonic filters include a vacuum system such as resistors, inductors and capacitors. to separate functional filters used for low voltage only, passive filters are commonly used and are available at different power levels.

A. Basic Active Power Filter

Figure 1a shows the basic principle of compensation for the active power of the shunt. It is controlled to draw or give compensation of the current ic from or in the service, to cancel the current harmonics on the ac side. Figure 2 shows the different waves. Curse A is the current load and curve B is the current required man. Curve C shows the current compensatory power injected by a functional filter that contains all the harmonics, making the mains current sinusoidal. In this way an effective shunt energy filter can be used to eliminate current harmonics and active energy compensation [5]. from Fig. 1a fast currents can be labeled;

$$i_s(t) = i_L(t) - i_c(t)$$

The source voltage is given by

$$v_s(t) = V_m \sin \omega t$$

if a nonlinear load is applied, then the load current will have a fundamental component, and the harmonic components can be represented as;

$$i_L(t) = \sum_{n=1}^{\infty} I_n \sin(n\omega t + \phi_n)$$

$$i_L(t) = I_1 \sin(\omega t + \phi_1) + \sum_{n=2}^{\infty} I_n \sin(n\omega t + \phi_n)$$

Instantaneous load power can be given as

$$p_L(t) = v_s(t) * i_L(t)$$

$$p_L(t) = V_m I_1 \sin^2 \omega t * \cos\phi_1 + V_m I_1 \sin \omega t * \cos \omega t * \sin \phi_1$$
$$+ V_m \sin \omega t * \sum_{n=2}^{\infty} I_n \sin(n\omega t + \phi_n)$$

$$p_L(t) = p_f(t) + p_r(t) + p_h(t)$$

From equation (4) real (Fundamental) power is drawn by the load

$$p_f(t) = V_m I_1 \sin^2 \omega t * \cos\phi_1 = v_s(t) * i_s(t)$$

From equation (6) the source current supplied by the source, after compensation

$$i_s(t) = \frac{p_f(t)}{v_s(t)} = I_1 \cos\phi_1 \sin \omega t = I_{sm} \sin \omega t$$

Also, there are some switching losses in the PWM converter. Hence, the utility must supply a small overhead for the capacitor leaking and converter switching losses in addition to the real power of the load.

Hence, total peak current supplied by the source.

$$I_{sp} = I_{sm} + I_{sL}$$

If the active filter provides the total reactive and harmonic power then i_s (t) will be in phase with the utility voltage and pure sinusoidal. At this time the active filter must provide the following compensation current:

$$i_c(t) = i_L(t) - i_s(t)$$

Hence for the accurate and instantaneous compensation of reactive and harmonic power, it is necessary to calculate is (t), the fundamental component of load current, as the reference current

B. Estimation of Reference Source Current

The peak value of the reference current I_{sp} can be estimated by controlling the dc side capacitor voltage. The ideal compensation requires the main current to be sinusoidal and in phase with the source voltage irrespective of the load's current nature. The desired source currents after compensation can be given as

$$i_{sa}^* = I_{sp} \sin \omega t,$$
$$i_{sb}^* = I_{sp} \sin(\omega t - 120^o),$$
$$i_{cb}^* = I_{sp} \sin(\omega t + 120^o),$$

Where $I_{sp} = I_1 \cos\phi_1 + I_{sL}$ is the amplitude of the current source you want, while the phase angles can be obtained from the source voltage? Therefore, the waveform and wavelength categories are known only for the wave size that needs to be determined.

The maximum value of the current reference is limited by controlling the dc side capacitor voltage of the PWM converter. This voltage of the capacitor is compared to the reference value and the error is processed in the PI control. The output of the PI controller is considered to be the maximum current source of the desired source, and the reference currents are measured by multiplying the maximum value per unit vector unit in the power source.

4. ROLE OF DC SIDE CAPACITOR

The dc side capacitor serves two main purposes (1) maintains a dc voltage with a small ripple in a stable position, and (2) acts as a power storage to provide real power difference between load and source in a short period of time. In the case of stability, the actual power supplied to the source should be equal to the actual need for load capacity and minimum capacity to compensate for the loss of the active filter. Therefore, the voltage of the dc capacitor can be maintained at a reference value. However, when the load condition changes, the actual power balance between the source and the load will be disturbed. This actual power difference will be compensated by the dc capacitor. This changes the dc capacitor voltage away from the reference voltage. In order to maintain the efficiency of the active filter, the maximum current reference value must be adjusted to match the actual power taken from the source. This real power is charged or discharged by a capacitor to compensate for the actual power used by the load. When the dc capacitor voltage is detected and reaches the reference voltage, the actual power supplied to the source must be equal to that used by the load again.

Therefore, in this way the maximum value of the current reference source can be obtained by controlling the voltage rating of the dc capacitor. A smaller voltage dc capacitor than a reference voltage means that the actual power supplied to the source is insufficient to supply the load requirement. Therefore, the current source (i.e. the actual power taken from the source) needs to be increased; while a greater voltage of the dc capacitor than the reference voltage attempts to reduce the current reference source. This change in capacitor voltage is confirmed in the simulation results shown in Figure 10. The actual active power injection may cause the ripple voltage of the dc capacitor. A low pass filter is often used to filter these ripples which bring a limited delay. To avoid the use of this low pass, filter the capacitor voltage is taken as a sample where the zero voltage falls. The current dynamic reference makes compensation move slower over time. This voltage is therefore taken as a sample when it falls to the egg in one of the phase power waves. These speeds up compensation. Taking only two samples per cycle compared to six times per cycle provides a very high dc capacitor voltage or drip in a short time, but the processing time is short. Here is a demonstration of how harmonic termination is performed in the Inverter by Pulse Width Modulation process by solving indirect calculations. Statistics are used to determine the switching angles of the Inverter. Changing angles plays an important role in producing the desired output by removing selected harmonics.

To create a set of calculations, the basic component is given the required amount of output and all other harmonics are measured in zero. In my simulation I find the changing angles of the 5th, 7th and 11th harmonics.

The equation based on Total Harmonic distortion of the output voltage and current of the inverter is used to reduce the harmonics generated in the inverter. The percentage of total Harmonic deviation is given in the following formula [15].

$$\%THD = \left[\frac{1}{a_1^2} \sum_{n=5}^{\infty} (a_n^2) \right] \times 100$$

Where n = 6i ± 1(i = 1, 2, 3….)

5. FUZZY LOGIC CONTROLLER

In the last few decades, the application of an abstract set theory, or abstract thinking, in control systems has gained widespread popularity, especially in Japan. Since the mid-1970's, Japanese scientists have been instrumental in transforming the theory of abstract thinking into technological phenomena. Today, obscure mind-based control systems, or obscure logic controls (FLCs), can be found in a growing number of products, from washing machines to speedboats, from air conditioning units to automatic focus cameras. The calibration engine is the heart of the incomprehensible controller (and any incomprehensible rules system) to operate. Its actual performance can be divided into three steps (Figure 1):

i) Fuzzification – actual inputs are fuzzified and fuzzy inputs are obtained.

ii) Fuzzy processing – processing fuzzy inputs according to the rules set and producing fuzzy outputs.

iii) Defuzzification – producing a crisp real value for a fuzzy output.

6. SIMULINK MODEL AND RESULTS

6.1 Three Phase circuit with linear load: -

It is MATLAB/Simulink model of three phase circuit with linear load, it gives the source side and load side voltage and current waveform which follow the Ohm's law and purely sinusoidal in nature.

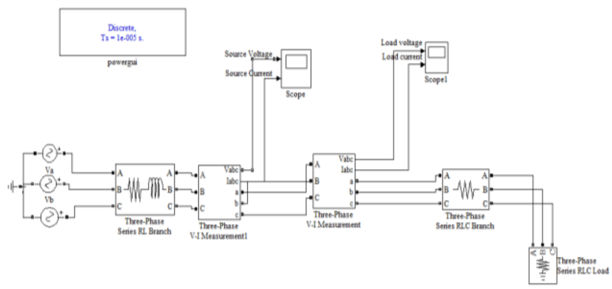


Figure 6.1 MATLAB/Simulink model of three phase circuit with linear load

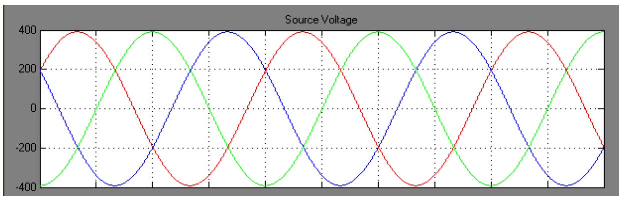


Figure 6.2 Source side voltage waveform of linear load circuit

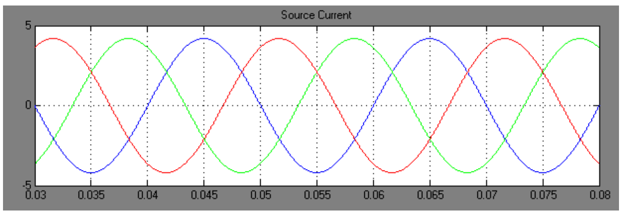


Figure 6.3 Source side current waveform of linear load circuit

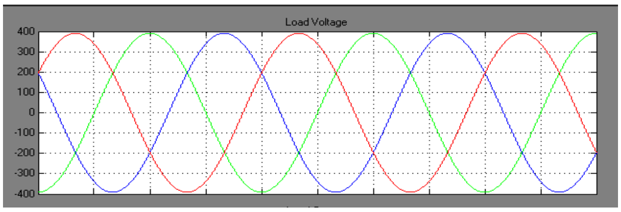


Figure 6.4 Load side voltage waveform of linear load circuit

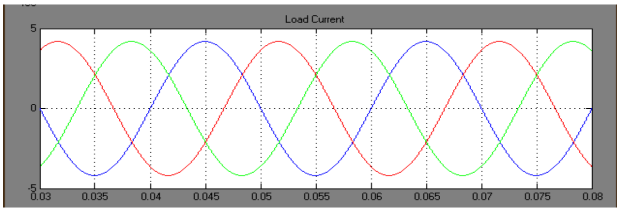


Figure 6.5 Load side current waveform of Linear load circuit

6.1.1 FFT analysis of current waveform of linear load circuit

It is the Fast Fourier Transform analysis of the current waveform of linear load which give the total harmonics distortion of current 0.00% it means there is no harmonics presents. When we use linear load. It is also shown in figure 6.3 that current is linear (Sinusoidal).

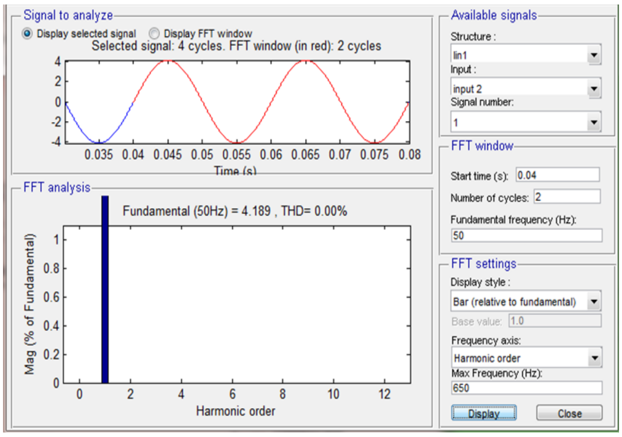


Figure 6.6 FFT analysis of current waveform of linear load circuit

6.2 Three Phase circuit with nonlinear load:-

It is Matlab Simulink model of three phase circuit with Non linear load, it gives the source side and load side voltage and current waveform which do not follow the Ohm's law and waveform of current is distorted in nature.

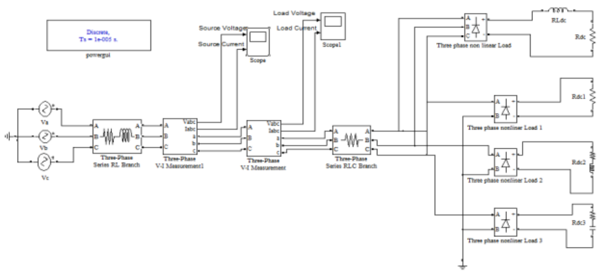


Figure 6.7 MATLAB simulink model of three phase circuit with nonlinear load

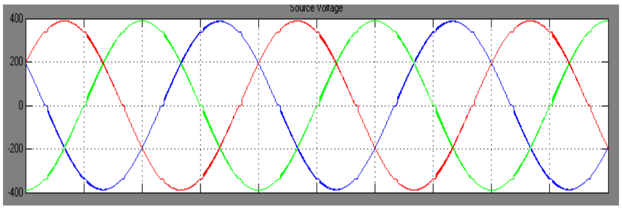


Figure 6.8 Source side voltage waveform of Non-linear load circuit

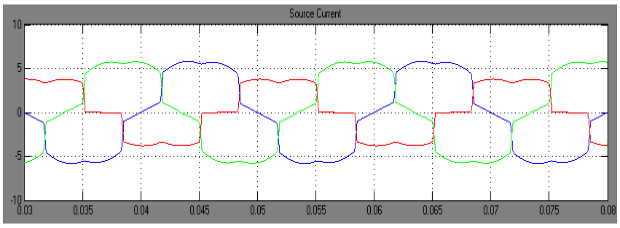


Figure 6.9 Source side current waveform of Non linear load circuit

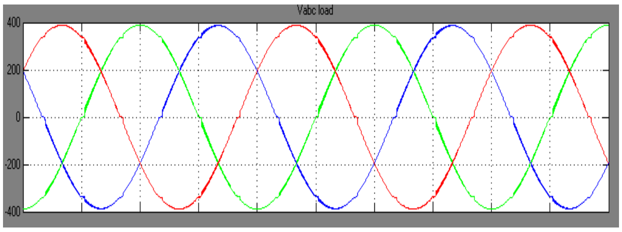


Figure 6.10 Load side voltage waveform of Non linear load circuit

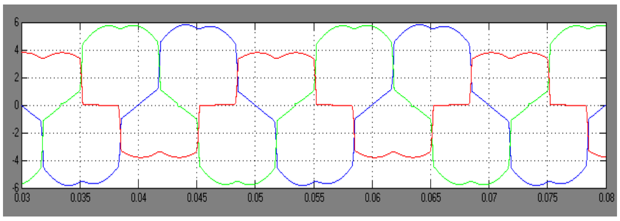


Figure 6.11 Load side current waveform of non-linear load circuit

6.2.1 FFT analysis of current waveform of Non linear load circuit:-

It is the Fast Fourier Transform analysis of the current waveform of Non Linear load which give the total harmonics distortion of current 18.50 % it means there is harmonics presents. when we use Non linear load. It is also shown in figure 6.9 that current is distorted.

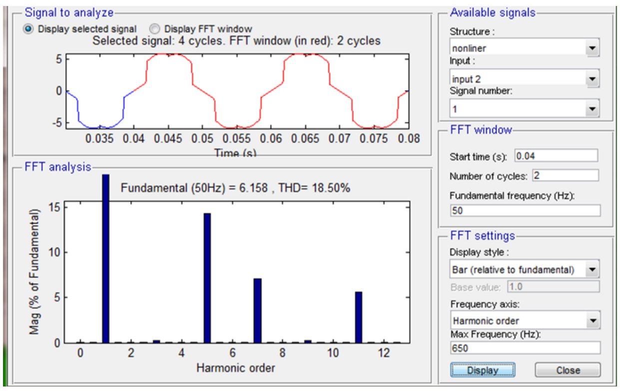


Figure 6.12 FFT analysis of current waveform of non liner load circuit

6.3 Three Phase circuit using shunt active power filter with fuzzy logic controller: -

It is MATLAB/Simulink model of three phase circuit with Non linear load using Fuzzy Logic Controller, it gives the source side and load side voltage and current waveform, which is liner and purely sinusoidal in nature which can be done with the shunt active filter.

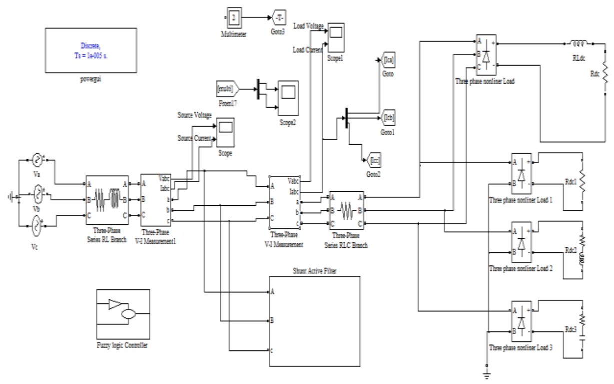


Figure 6.13 MATLAB simulink model of three phase circuit with nonlinear load circuit with shunt active filter

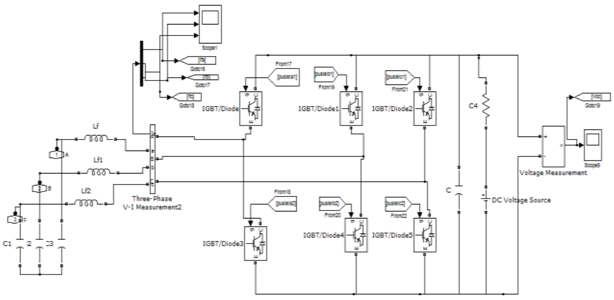


Figure 6.14 Inverter circuit for shunt active power filter

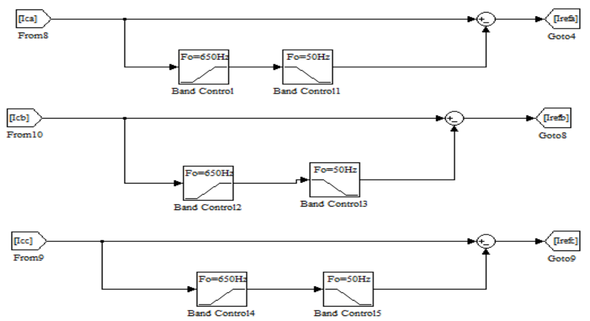


Figure 6.15 Bandwidth control for shunt active power filter

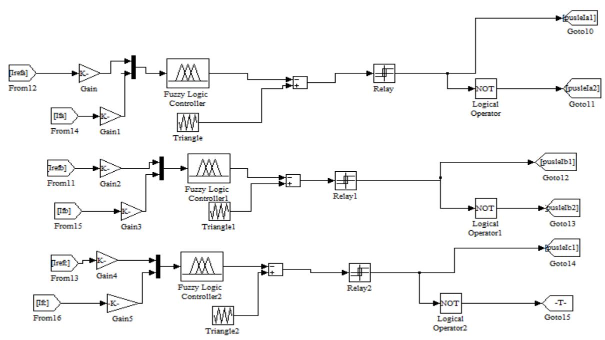


Figure 6.16 Fuzzy logic controllers

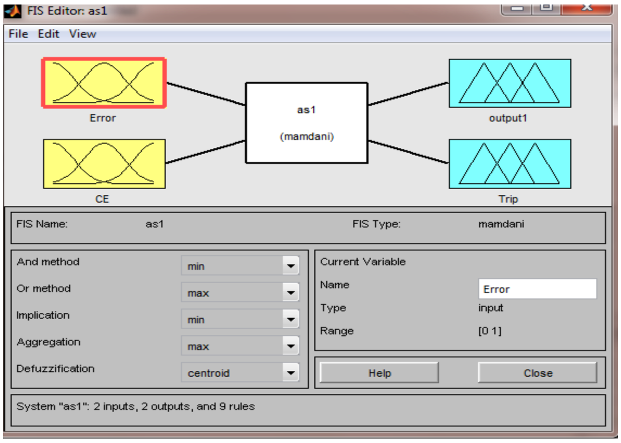


Figure 6.17 FIS window for fuzzy logic controller

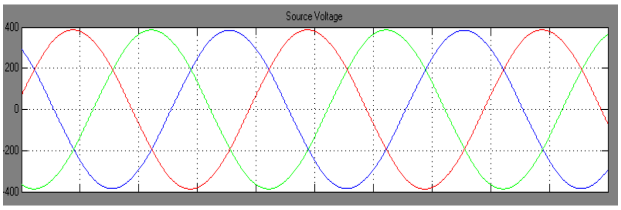


Figure 6.18 Source side voltage waveform of non linear load circuit with shunt active filter

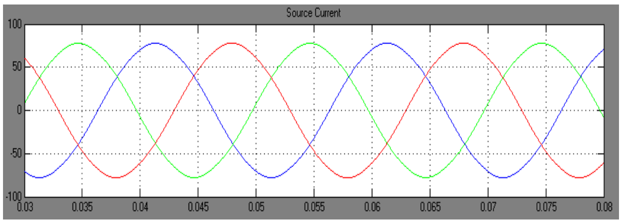


Figure 6.19 Source side current waveform of non linear load circuit with shunt active filter

Figure 6.20 Load side voltage waveform of non linear load circuit with shunt active filter

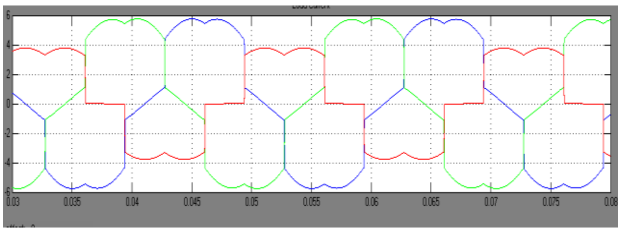


Figure 6.21 Load side Current waveform of non-linear load circuit with shunt active filter

6.3.1 FFT analysis of current waveform of Non-linear load with shunt active filter: -

It is the Fast Fourier Transform analysis of the current waveform of Non-Linear load which give the total harmonics distortion of current 0.68 % and harmonics are reduced with the help of Shunt active Filter It is also shown in figure 6.19 that current is Sinusoidal.

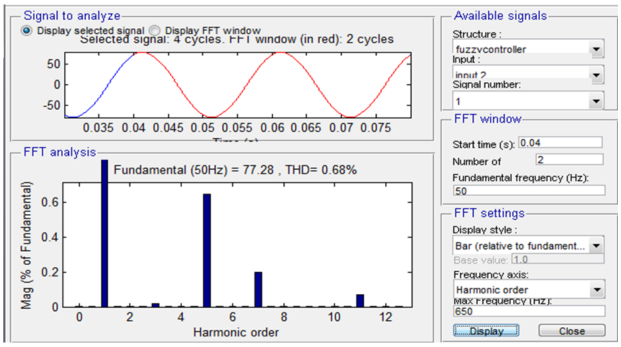


Figure 6.22 FFT analysis of current waveform of non liner load circuit with shunt active filter

7. CONCLUSION

Electronic power tools lead to increased harmonic pollution in power transmission or distribution systems. Review Many researchers from the field of energy systems and automation have searched for different ways to solve a problem. Another approach was opened by introducing harmonic compensation through active Shunt filters. In this thesis we describe the harmonics of the power system, the inverter circuit and the active shunt filter of the third phase circuit imitates and the limited THD ensures the reduction of the active harmonics shunt filter. The Shunt AF is able to compensate for the currents of the non-horizontal and horizontal load of the four-wire system with a central cable connected to a central capacitor.

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