REDUCTION OF HARMONICS IN POWER LINES USING FINITE IMPULSE RESPONSE FILTER

ABSTRACT

This work focused on reduction of harmonics in Power lines using finite impulse response filter. Distribution line network harmonic investigation has become an important issue in electric power systems since the increased use of power electronic devices and equipment sensitive to harmonics, which in turn, has increased the number of adverse harmonic-related events. Power quality problem and the means of keeping it under control is a growing concern. Due to the connection of nonlinear loads in the power distribution network, power quality issues have been raised and have resulted to widespread waveform distortion. This work made use of the bus bar voltage solutions obtained from a power flow study on the Electricity Distribution Company's power distribution network at Onitsha TCN work centre as the base data for the harmonic analysis. The focus of this work was on the application of active power filter in treating the harmonics distortion in Power distribution system by generating compensation signal by the active filter (APF) for the reduction of harmonic distortion and improving the system's Power Factor (PF). A system model to reduce harmonics in power line by using FIR filter to generate compensation signals and switching pulses for the active filter was modeled and the performance of the FIR filter using Matlab/Simulink environment was compared with the performance without filter. The simulation was achieved through the application of sending and receiving end bus bar voltages which was obtained from the power flow study. Harmonic results without filter and with filter were presented and it shows that the use of FIR active filter which has improved advantages over the conventional passive filters in mitigating harmonics problems was able to reduce the harmonics from 17.77% to 0.87% which is 16.9% (95% reduction) thereby improving the current, voltage and power factor (pf) of the system. Reduction of harmonics reduced disturbances that usually cause equipment overheating and deterioration of the performance of electronic equipment; hence the performances of the electronic equipment greatly improved leading to economic benefits.

KEYWORDS: Harmonics, filter, frequency, finte impulse, distortion

1.0 INTRODUCTION.

In recent years, the advancement in the technology, specifically the evolution of power electronics applications based on semiconductor switches (diode and thyristor rectifiers, electronic starters, UPS and HVDC systems, arc furnaces etc) have fetched many technical eases and economical profits, but it has concurrently introduced new challenges for power system operation. Electric energy has become the engine that drives industrialization, technological advancement and socio economic activities, which improve communication, provide sound healthcare delivery system and assist innovation in science and technology [1]. To appreciate the maximum asset utilization, secure and reliable operation needs to be maintained regarding various aspects of power system operation.
The electrical transmission system identifies devices such as power electronic circuitry used for power conversion as non-linear load [2]. A nonlinear element in a power system causes distortion due to their non- ideal characteristics. Nonlinear loads, including; uninterruptable power supply (UPS), variable frequency drives (VFD), adjustable speed drives (ASD), and switched mode power supplies, present a special challenge to successful delivery of high quality power under all operating conditions. With the increased number of power electronic systems connected to the mains, the systems have become more sensitive to supply voltage and current distortions [3].

Distorted voltages and currents have many harmful effects such as resonance problem that arises between the supply inductances and capacitances leading to over-currents and over-voltages. Distorted current increases the I^2Z heat losses in the transformer which promotes thermal and mechanical insulation stresses. Detrimental effects can also be seen in a system powering phase to neutral connected loads. For equipment where proper sequencing of operations depends on a zero crossing for timing, voltage distortion can cause mal-operation. Rapidly changing or varying industrial loads such as electric arc furnaces, welding machines, alternators, rolling mills and motors may also give rise to supply voltage fluctuations which might cause tripping of equipment [4].
Ideally, AC power systems are a pure sinusoidal wave, both voltage and current, but presence of non-linear loads modify the characteristics of voltage and current from the ideal sinusoidal wave. This deviation is reflected as Harmonics. *Harmonics* can simply be defined as the sinusoidal component of a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency.

To achieve better performance, to be able to control and to transfer more power over the power system, and to reduce the power consumption of the loads, currently many methods for elimination of harmonic pollution in the power system are developed and investigated. One of the main topics of special concern is the aspect of power quality which deals with, among others, voltage characteristics, current characteristics and most importantly control and prediction of harmonics

However, improvements in the power supply must be given the utmost priority because of the essential role electricity plays in our economic life. The purpose of an electrical power system is to generate electrical energy in ample volume at most suitable locality, transmit it in a bulk quality to a load centre, which is then distributed to the individual consumers [5]. Manufacturers have rightly complained that any interruption in electricity supply is bound to have negative effect on their output. Residential users of electricity have complained that power outages can affect their electrical/electronic appliances. Small- and medium-scale users of electricity have admitted that interrupted electricity is the bane of the smooth running of their businesses [6]. Initially, passive power filters (PPF) (combinations of capacitors and inductors) were normally used to mitigate the Power quality problems. These approaches were extensively used in high voltage DC transmission (HVDC) for filtering the harmonics on the AC and DC sides. However, this approach is unsuitable at the distribution level as PPF can only correct specific load conditions or a particular state of the power system. These filters are unable to follow the changing system conditions. Thus, the active power filter (APF) was introduced to compensate harmonics and reactive power [7].

This project is focused on the application of finite impulse response (FIR) filter in reducing the harmonics distortion in distribution system by determining low Total Harmonics Distortion (THD) value and improving the system's power factor (PF).

1.1 Harmonic (H) in Power Systems.

The harmonic problem is not a new phenomenon in Power System (PS). Years ago, the primary sources of harmonies were the transformers and the main problem was the inductive interference with open-wire telephone systems. Some early work on harmonic filtering in distribution feeders was performed around that time. In the recent time, there have been a big change in the use of non-linear loads. Due to this the value of harmonic non-sinusoidal currents and voltages has also increased up to a great extent in the system. These harmonic elements affect the overall PS as well as the client's equipment's also .So today the issue of maintaining the PQ is a big issue.

Harmonics are defined sinusoidal voltages or currents having frequencies that are whole multiples of the frequency at which the supply system is designed to operate (50 Hz or 60 Hz).Figures (1.1) and (1.2) shows that any periodic distorted waveform can be expressed as a sum of pure sinusoids. The harmonic number (h) usually specifies a harmonic component, which is the ratio of its frequency to the fundamental frequency [8].

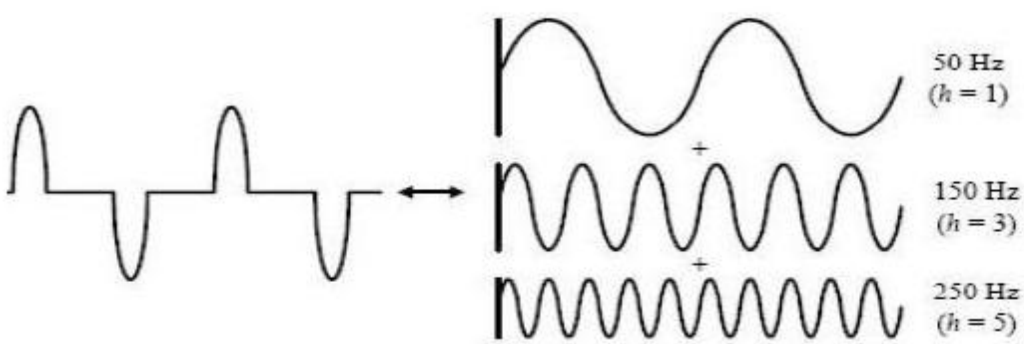

Fig. 1.1: Periodic distorted waveform [8].

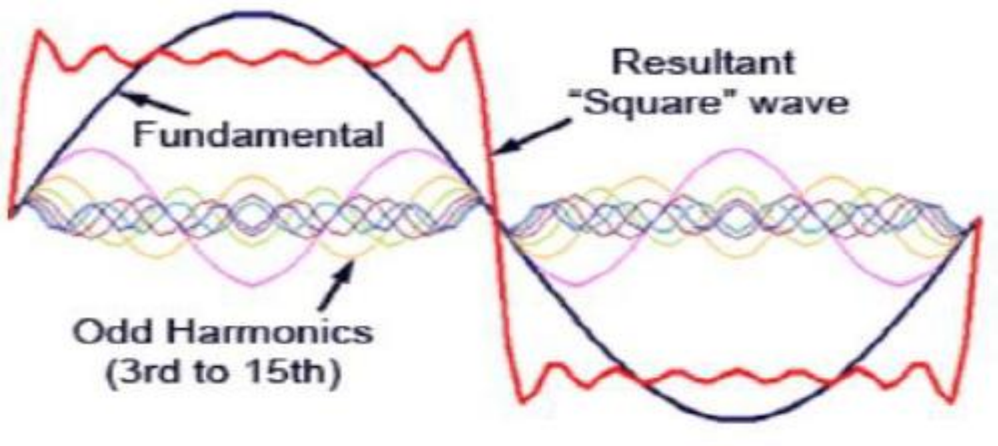

Fig. 1.2: Periodic distorted waveform with distortion.[8]

Harmonics have frequencies that are integer multiples of the waveform fundamental frequency. For example, given a 60 Hz fundamental waveform, the harmonic components will be at 120 Hz, 180 Hz, 240 Hz and 300 Hz respectively Thus, harmonic distortion is the degree to which a waveform deviates from its pure sinusoidal values as a result of the summation of all these harmonic elements. The ideal sine wave has zero harmonic components. In that case, there is nothing to distort this perfect wave [9].

1.2 Effect of Harmonics in Power Systems

Harmonics are a major cause of power supply pollution lowering the power factor and increasing electrical losses. The effect of harmonic results in premature equipment failure and also cause of requirement of equipment of high rating. The voltage distortion produced in the system is the major issue with the harmonics distribution. The electronics equipment used in the system usually generate harmonics more than one. In all type of harmonics the tripled harmonics are more severe example of triplet harmonics are 3rd 9th 15th [10].

These harmonics creates a big challenge for engineers because they pose more distortion in voltage. The effect of triplex harmonics come with overheating in wires, overheating in transformer units and also may become the cause of end user equipment failure. Triplex harmonics overheat the neutral conductor of 4 wire system. The neutral generally have no fundamental frequency or even harmonics but there may be existence of odd harmonics in system neutral conductor when there is a system that consist of triplex harmonics, it becomes additive. These triplex frequency impact on the system can be understood by the way that even under balanced load condition on the account of triplex frequency, neutral current magnitude reaches up to 1.75 times of average phase current [10]. Under above discussed case, if the load on the system increases, it may cause of failure of insulation of neutral conductor which further result in the breakdown of transformers winding. The important and major effect of Harmonics is further discussed as:

Effect on Transformer

Harmonics effect transformer losses and eddy current loss density [11]. Actually, the harmonic effects on transformer will not be noticed until actual failure occurs. It will occur when there has

been changes that are been made to the system like addition or replacement of new loads. Overheating of transformer is always been related with harmonics effects.
Harmonics produce addition losses in the transformer core as the higher frequency harmonic voltages set up hysteresis loops, which superimpose on the fundamental loop. Each loop represents higher magnetization power requirement and higher core losses.
Because of harmonics, the losses in conductor will increase. The resultant current will increase the distortion. Overheating also can occur when there is resistive skin effect and winding proximity effect [12].

Effect on Capacitor bank
In industrial load where a lot of motors are used, we need to improve power factor. For this purpose we connected capacitor banks near to the loads to improve it. Since harmonics create reactance, capacitor reactance will increase as the frequency decrease. Therefore, the linear loads served from a common feeder, which also serves nonlinear loads of some other consumers, may become susceptible to harmonic distortion. Moreover, a consumer's system which does not have harmonics can be subjected to harmonic pollution due to of other consumers in the system. The capacitors can be severely overloaded due to harmonics and can be damaged [11].

Neutral conductor over loading
In single phase PS, neutral play a very important role as they carry the return current and complete the circuit. But in case of harmonics it also becomes the return path for the harmonic current to transformer through neutral connection. For an unbalanced system the unbalanced currents are passed through the neutral and for this purpose we need to balance the system. The size of neutral cable is almost taken equal to its phase cable. Under environment of harmonics, the unbalanced current which is passed through the neutral produces a heat loss in the system which again affects the power quality of distribution system [13].

Effect on lines and cables
Harmonic distortion in a distribution system affects the system current significantly. These increased RMS currents produce additional heat losses in the system lines and cables. Harmonic distortion in cables increases the dielectric stress in the cables. This stress is proportional to the voltage crest factor which represents the crest value of voltage waveform to rms value of waveform. The effect of this increased stress is such that, the cable useful life is shortened, causing faults, which ultimately increases the system capital and maintenance cost [14]..

Thermal effect on rotating machine
Rotating machine are also affected by harmonics same as transformers. Resistance of rotating machine will go high if the frequency of system is high. For this, if there is harmonic present, the system will have a very high current value which tends to produce a heat loss in the rotating machine. This overall heat loss will again affect its life and thus increase maintenance problems.

Undesired operation of fuse
In the environment of harmonic the RMS value of voltage and current may increase. This tendency will lead the problem of unexpected operation of fuse in capacitor banks or other arrangements which are used in the system to make operation of nonlinear load. If the fuse of one connected phase is blown off then the other remaining fuse is in operation under a stress. In this condition the system become unbalanced and it will tends to produce the overvoltage in the

system. To summarize above discussion it is concluded that, the following problems arise due to harmonics (Adams, 2012).

i. Equipment overheating

ii. Equipment malfunction or operation failure of equipment

iii. Equipment failure

iv. Communications interference

v. Fuse and breaker operation failure

vi. Maintenance problem

To overcome such issues, there are various harmonic mitigation methods that we can use to address harmonics in the distribution system. They are valid solutions depending on circumstances, and have their pros and cons. One of the way out to resolve them using filters. The filters are widely used for reduction of PQ problems, with the increase of nonlinear loads in the PS more and more filters are required.(Das 2011).Other ways of removing harmonics in power lines out filtering are magnetic flux compensation, Harmonic current injection, DC ripple injection and pulse width modula

2.0 METHODOLOGY AND DESIGN

2.1. Processes of Achieving Harmonic Reduction

In this research work, finite impulse filter is implemented for removing signal harmonics using progressive strategies of shunt active performance filters with intention to compensate higher harmonic currents of non-linear load.

The methods used in achieving the harmonic reduction were the following steps.

1. The data collected from the harmonic measurements from a power quality analyzer that was installed at the source of the distribution feeders were fully studied and the maximum total harmonic distortion as percentage measurement of the fundamental voltage and current was compared for the fourteen day period.

2. The submodels for voltage sags and swell without filter were separately simulated since all three active power filters have same voltage sags swells mitigation sub model.

3.. The finite impulse filter model composed of sub models was simulated for harmonic compensation and power factor correction

4.. Matlab/Simulink was used to simulate the harmonic compensating sub models combined with power factor correction for the harmonic reduction analysis.

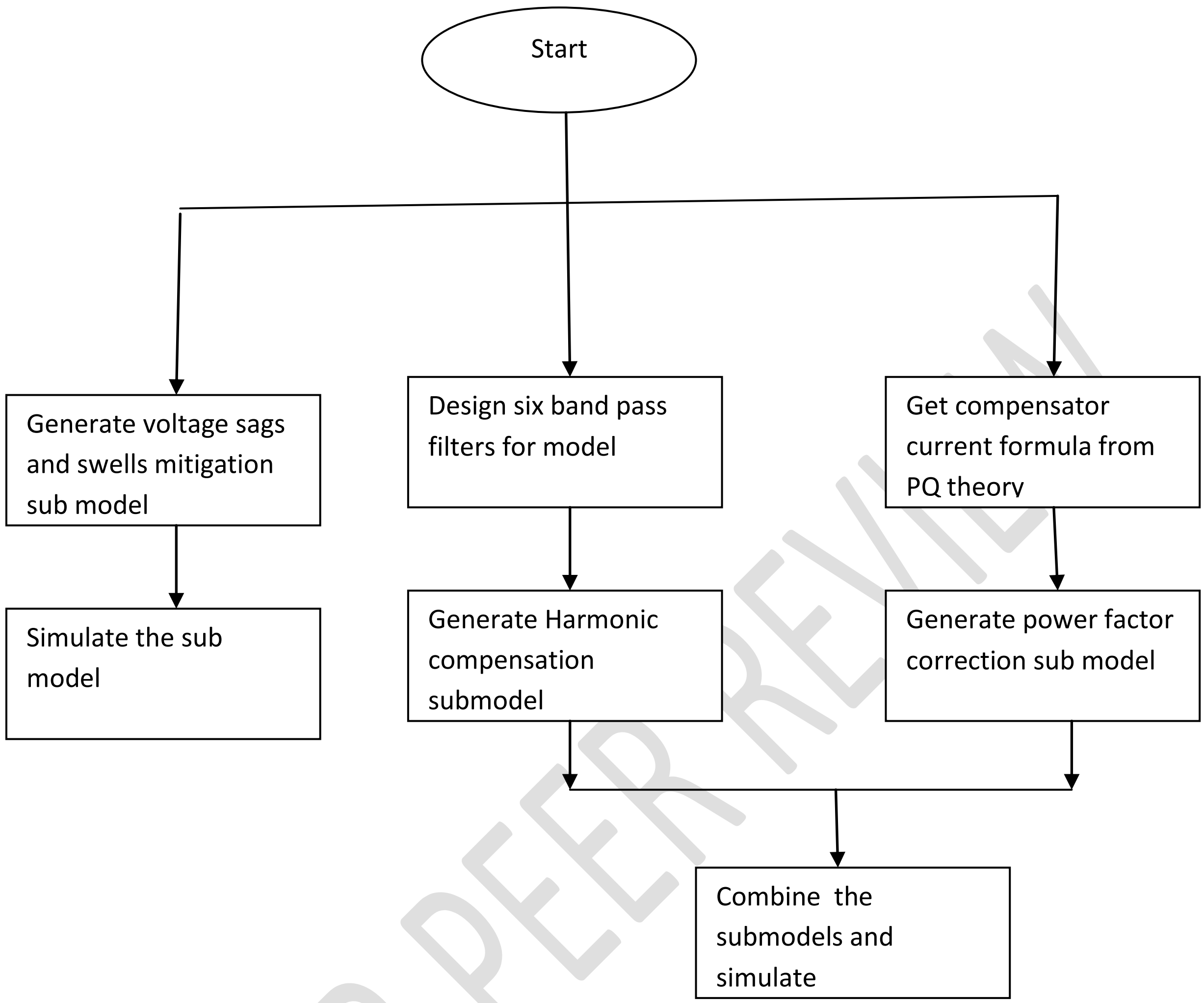

Figure.2.1. Simulation Process block diagram.

2.2. Characterized Power Sources at Awada TCN work centre.

Awada TCN Power network is made up of 330/132/33kv transmission station in Obosi, Anambra State. Okpai 330kv line from Okpai power station in Delta State is connected to Awada work centre. Awada work centre is connected to the national grid via the Benin 330kv line.The Okpai power station was built by AGIP Oil Company which is one of the private power stations presently hooked to the National grid.

The Benin 330kv line emanated from the interconnected systems of other generating stations tied together and controlled by the national control center (NCC), Oshogbo.

The Awada TCN primary station has eight(8) power transformers of two 330/132kv, 150MVA and one 330/132kv, 90MVA that were paralleled and stepped down to (i) 60MVA 132/33kv TR11 transformer feeding three 33kv lines of Obosi, 3-3 and Osamala (ii) 60MVA 132/33/11kv TRI 3 transformer feeding Nnewi,Nnewi industrial and Niccus 33kv feeders. (iii) 45MVA 132/33/11kv Mobitra 1 transformer feeding Umunya and Ogidi 33kv feeders with Woliwo and Nwaziki 11kv feeders; (iv) 40 MVA 132/33/11kv Mobitra 2 transformer feeding Army barracks and Awada 2, 33kv lines, and (v) 15MVA 132/11kv TRI2 transformer feeding PPI, IUNT and Ezeiweka 11kv lines.

The Awada TCN power network aside these power transformers at the TCN has twelve (12) 33/11kv injection substations which are Army Barracks 1x2, Umuoji, Awada 1x2, Akwudo, Oraifite, Uruagu, Atani, 3-3, Feggae and Ugwunwasike with associated 11kv feeders.

Army barrack injection substationhas has two 15MVA transformers with Ngbuka, Army, Minaj 1, Minaji 2, Omagba, GRA and Inland; Umuoji injection substation has a 7.5 MVA transformers with Avenco and Umuoji 11kv feeders; Awada 1x2 Injection Substations has two 15MVA transformers, one 15MVA 132/11kv transformer with Awada , Mgbemena, Okpoko , Nwaziki , Woliwo, PPI,IUNT and Ezeiweka 11kv feeders; Akwudo injection substation has one 15MVA and 7.5 MVA transformers with Mbanagu, Otolo and Nnewichi 11kv feeder ;Uruagu 7.5MVA Injection Substation has Uruagu 11kv feeder; Oraifite has 7.5 MVA transformer with Ibollo and Nkwoedo 11kv feeders ; Atani substation has two 15MVA transformers with Iweka, Water works, Industrial and Premier 11kv feeders; 3-3 Injection substation has a 15MVA and 7.5 MVA with Nsugbe, Housing and Nkwelle 11kv feeders;Feggae Injection Substation has Bida,Uga,market and housing and Ugwunwasike 15MVA Injection substation has Alben, Ogidi, Nkpor and Tollgate 11kv feeders. The line diagram of the distribution Power lines (33kv and 11kv) radiating from Awada work centre is shown in figure 2.2.

Harmonic data of the entire distribution network from power quality analyzer at Onitsha work center.

The results of data collected from a power quality Analyser (PQube) that was installed at the secondary side of the distribution lines at Awada work centre during the nationwide power quality Assessment programme targeted at major industrial feeders were used for the purpose of this study as was provided on request by the Awada TCN primary substation.

Two weeks data were retrieved from the PQube's Secure Digital (SD) memory card for the purpose of this study. The two weeks spanned between 1st and 16th February, 2020.

The line diagram of the distribution power lines from Awada work centreshowing the power distribution network is seen in fig 2.2. The total harmonic distortion data retrieved from the PQube's secure digital (SD) memory card that is used as a base data for harmonic analysis is seen in table 2.1. and 2.2 for current and voltage source respectively.

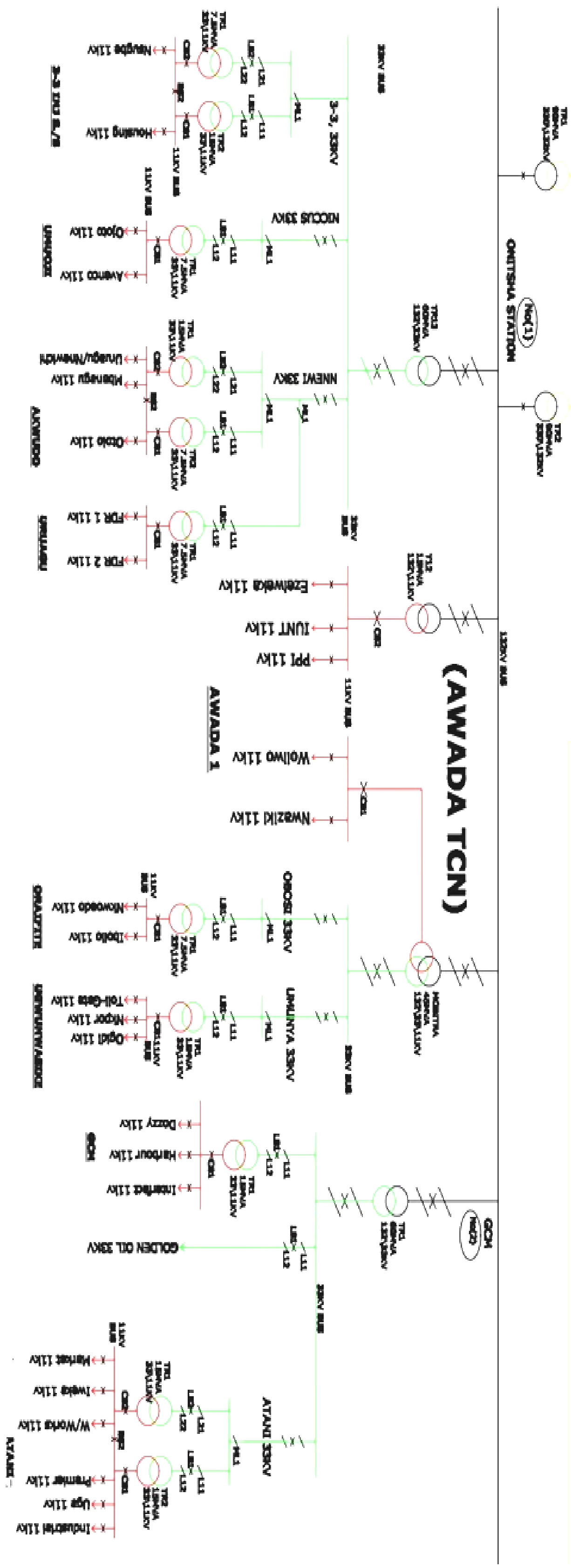

Figure 2.2: Line diagram of the Awada TCN network radiating the 33kv and 11kv outgoing feeders:(**source: TCN Onitsha work centre**)

Table 2.1: **VTHD showing the penetration of 3rd and 5th harmonics on the network using the current source**

Bus ID	VTHD	Harmonic Order
Obosi 33kv Bus	14.94	3.00
3-3 33kv Bus	13.15	3.00
Osamala 33kv Bus	13.41	3.00
Nnewi 33kv Bus	15.14	3.00
Nnewi Industrial 33kv Bus	13.43	3.00
Niccus 33kv Bus	5.23	3.00
Woliwo 11kv Bus	5.16	5.00
Nwaziki 11kv Bus	2.44	5.00
Army barracks 33kv Bus	4.57	5.00
Awada 1 33kv Bus	3.52	5.00
Awada 2 33kv Bus	7.13	5.00
PPI 11kv Bus	6.38	5.00
IUNT 11kv Bus	7.38	5.00
Ezeiweka 11kv Bus	6.57	5.00

Source: (Transmission Company of Nigeria, Onitsha Work Center.)

Table2.2. **VTHD Showing the Penetration of 3rd and 5th Harmonics on the Network Using the Voltage Source Model**

Bus ID	**VTHD**	**Harmonic Order**
Obosi 33kv Bus	14.94	3.00
3-3 33kv Bus	13.43	3.00
Osamala 33kv Bus	13.41	3.00
Nnewi 33kv Bus	13.14	3.00
Nnewi Industrial 33kv Bus	15.15	3.00
Niccus 33kv Bus	5.12	3.00
Woliwo 11kv Bus	5.16	5.00
Nwaziki 11kv Bus	2.82	5.00
Army barracks 33kv Bus	4.88	5.00
Awada 1 33kv Bus	2.51	5.00
Awada 2 33kv Bus	6.15	5.00
PPI 11kv Bus	7.29	5.00
IUNT 11kv Bus	7.30	5.00
Ezeiweka 11kv Bus	7.65	5.00

Source: (Transmission Company of Nigeria, Onitsha Work Center.)

2.3 Simulation of three phase shunt active power filter with FIR current control strategy in MATLAB/SIMULINK Environment

The system model was performed using the Matlab/Simulink software version 7.5. Simulink is an environment for multi domain simulation and model-based design for dynamic and embedded systems. It provides an interactive graphical environment and a customizable set of block libraries that let one design, simulate, implement and test a variety of time-varying systems including power, communications, controls, signal processing, e.t.c.

The performance of the proposed APF is studied using computer simulation with MATLAB. A model without FIR filter was simulated as shown in figures 2.3 and after that, three-Phase Harmonic Filter block to filter harmonic currents generated by a 12-pulse, 1000 MW, AC/DC converter in a 132/33kv, 60 Hz system as shown in figure 2.4. The filter set is made of the following four components providing a total of 600 Mvar:

1. One 150 Mvar C-type high-pass filter tuned to the 3rd harmonic (F1)
2. One 150 Mvar double-tuned filter tuned to the 11/13th (F2)
3. One 150 Mvar high-pass filter tuned to the 24th (F3)
4. One 150 Mvar capacitor bank

The key intentions of the research work is to propose intelligence based control approach based on AI techniques ,which is compared with the other control strategies, in order to improve the Performance of Shunt Active Filter. The performance of the Shunt Active Filter is evaluated through MATLAB / SIMULINK environment using Simlink power Systems toolbox and the results demonstrate the behavior of Shunt Active Filter using simple and flexible control methods to face the different operating conditions and disturbances inherent in power transmission and distribution system

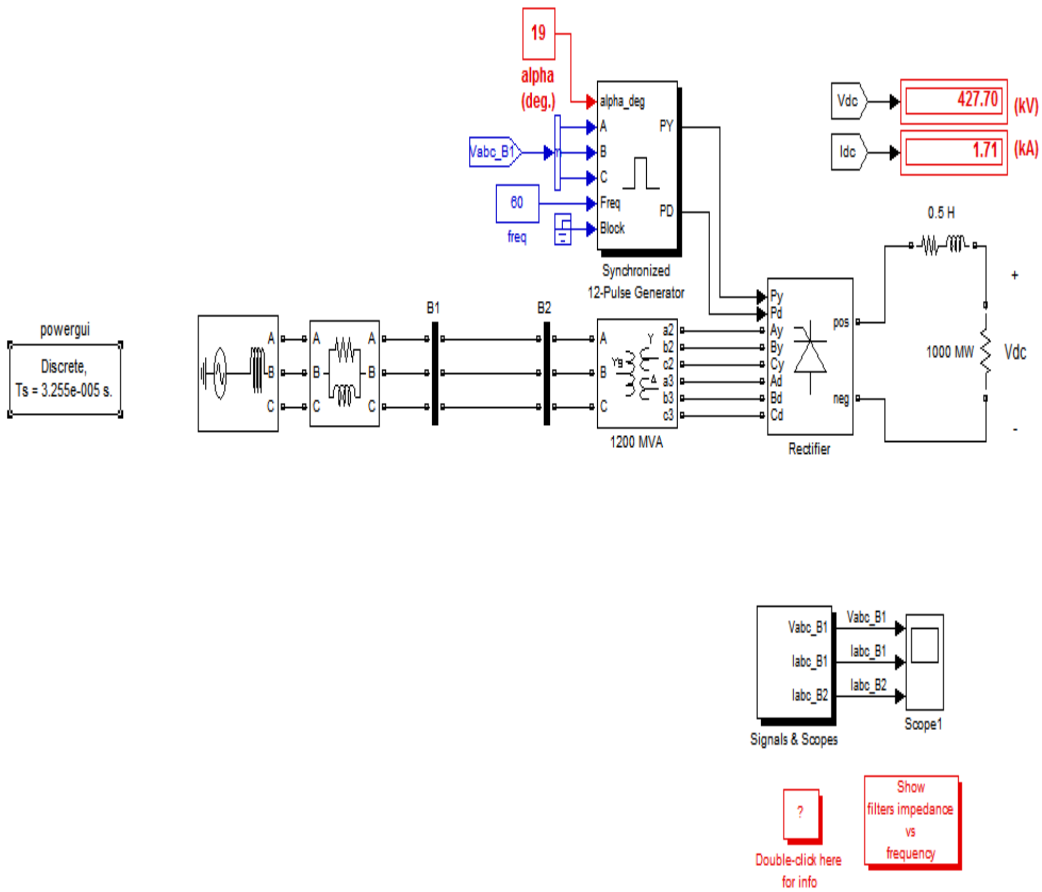

Fig. 2.3: Simulink model of a Power System Network without FIR filter

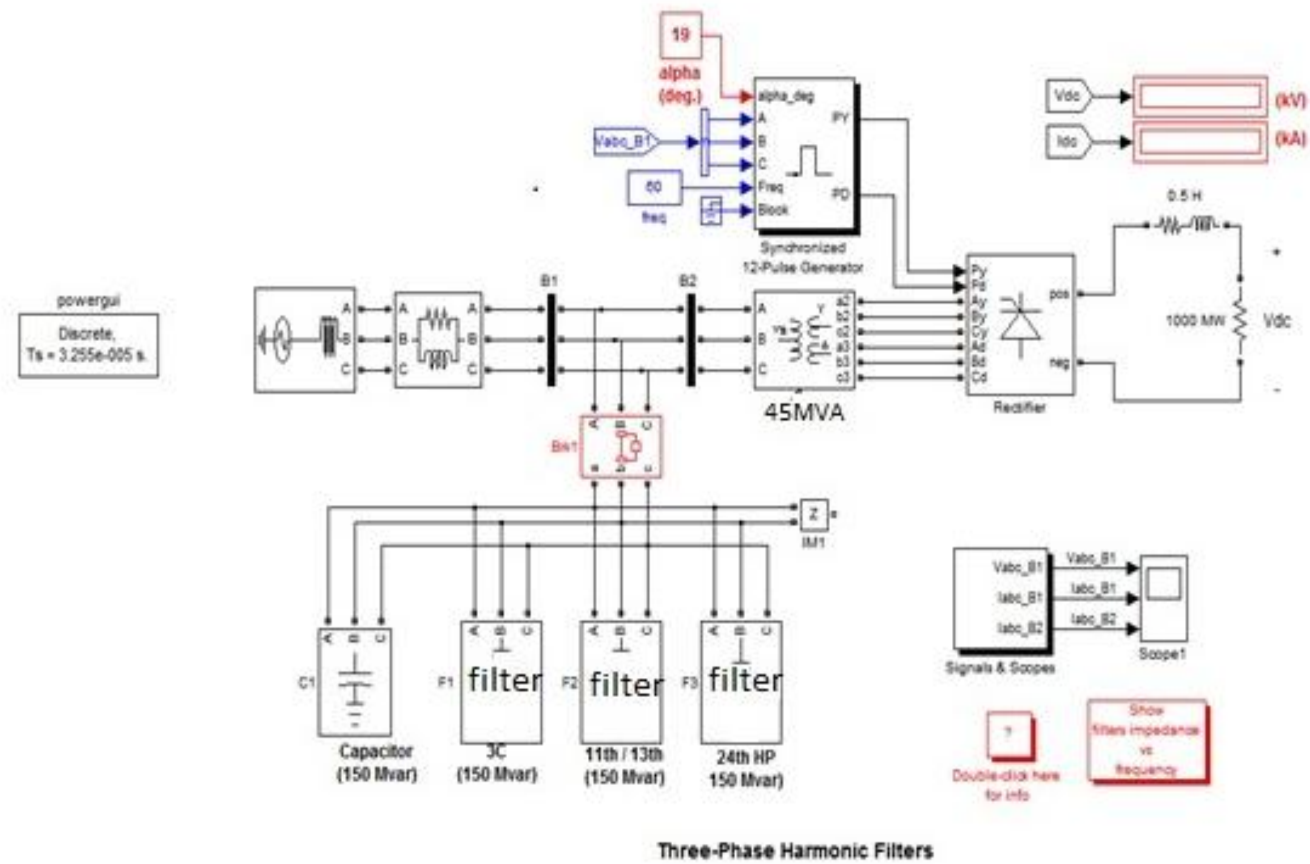

Figure 2.4: Simulink model of a Power System Network with Three-Phase Harmonic filter

The HVDC rectifier is built up from two 6-pulse thyristor bridges connected in series. The converter is connected to the system with a 45-MVA Three-Phase transformer (three windings). A 1000-MW resistive load is connected to the DC side through a 0.5 H smoothing reactor. The filters set are made of the following four components of the powerlib/Elements library:

1. one capacitor banks (C1) of 150 Mvar modeled by a "Three-Phase Series RLC Load",
2. three filters modeled using the "Three-Phase Harmonic Filter"

(1) One C-type high-pass filter tuned to the 3rd (F1) of 150 Mvar

(2) One double-tuned filter 11/13 th (F2) of 150 Mvar

(3) One high-pass filter tuned to the 24th (F3) of 150 Mvar

The total Mvar rating of the filters set is then 600 Mvar. A three-phase circuit breaker (Brk1) is used to connect the filters set on the AC bus.

The converter is open-loop controlled using the "Synchronized 12-Pulse Generator" of the Extras/Discrete Control library with a constant conduction angle alpha of 19 degrees.

3.0 Simulation Result

Simulation Result without FIR Filter

Three-phase voltage source and a nonlinear resistive load connected to the grid via a three-phase diode-bridge rectifier were chosen for the case study and simulation. At first the simulation is implemented without the FIR filter. The current which is drawn in harmonic load and one phase of the source is shown in Figure 3.1. The total harmonic distortion of the source is also shown in Figure.3.2.

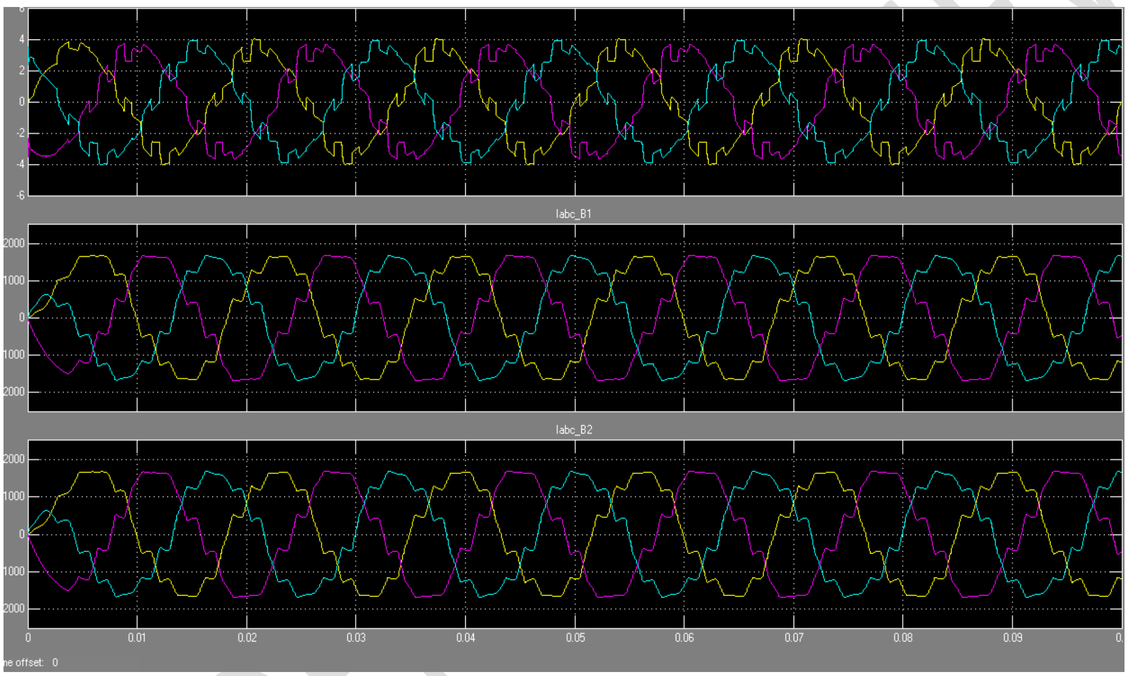

Fig. 3.1: Graph of Voltage and Current before compensation

Figure 3.1 shows the voltage (Vs) and current of the grid (Is) for the phase A, B and C. We observe that the current and voltage are in phase because all the reactive power of the load is compensated by the PV system. For a better readability of executed experiments was presented length of time window 0.1s. The waveforms of single phases are marked by different colors: phase A is blue, phase B is yellow and phase C is pink.

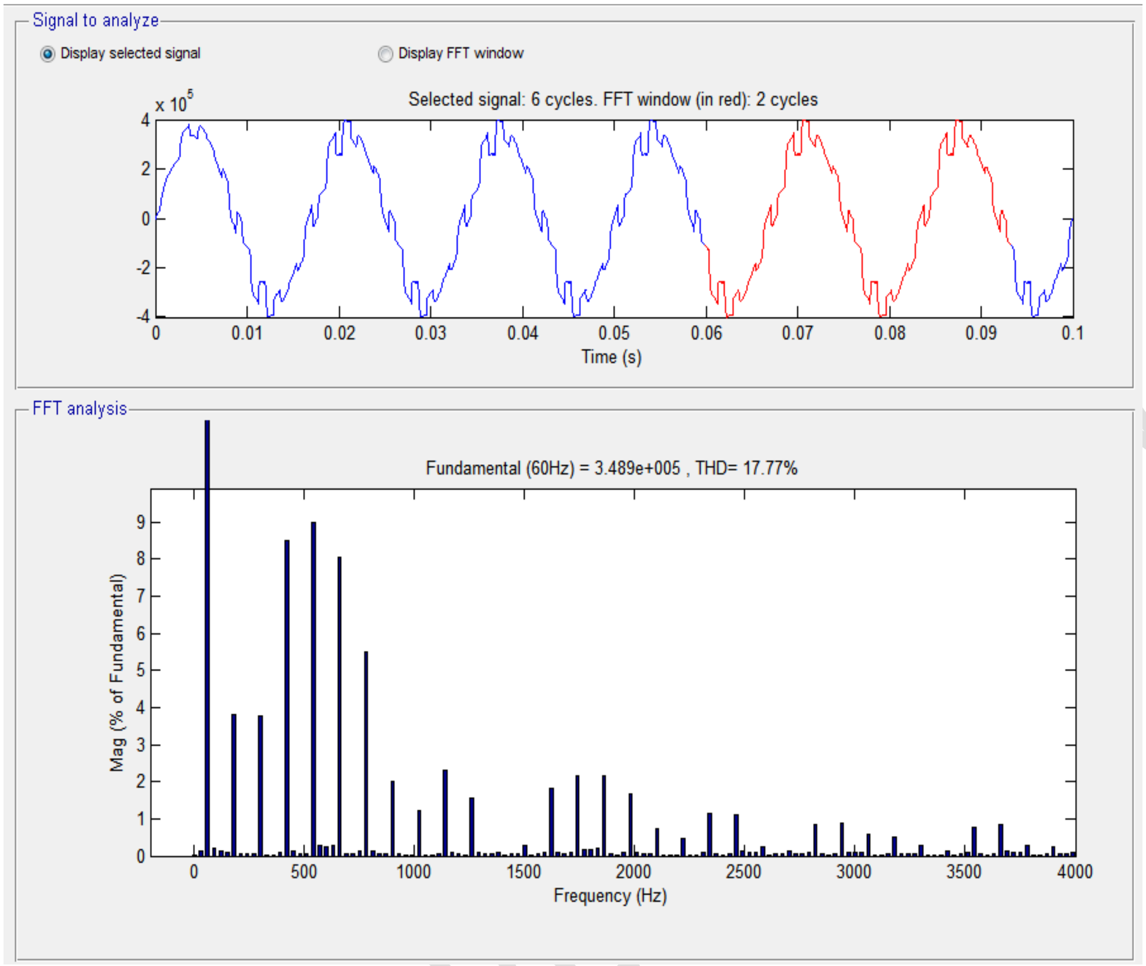

Fig. 3.2: Graph of FFT Analysis of the Current before compensation

The harmonic spectrum of the supply current before compensation is shown in figure 3.2.The THD (total harmonic distortion) is 17.77% before harmonic compensation in supply.

Simulation Result with FIR Filter

The three-phase three-wire system with a non-linear load is equipped with shunt active filter for mitigating the current harmonics. FIR is used to control the shunt active filter under balanced and unbalanced source voltage condition for normal load as well as increase load. Three-phase voltage source and a nonlinear resistive load connected to the grid via a three-phase diode-bridge rectifier were chosen for the case study and simulation. This time, the simulation is implemented using FIR filter. The current which is drawn in harmonic load and one phase of the source is shown in Figure 3.3. The total harmonic distortion of the source is also shown in Figure.3.4.

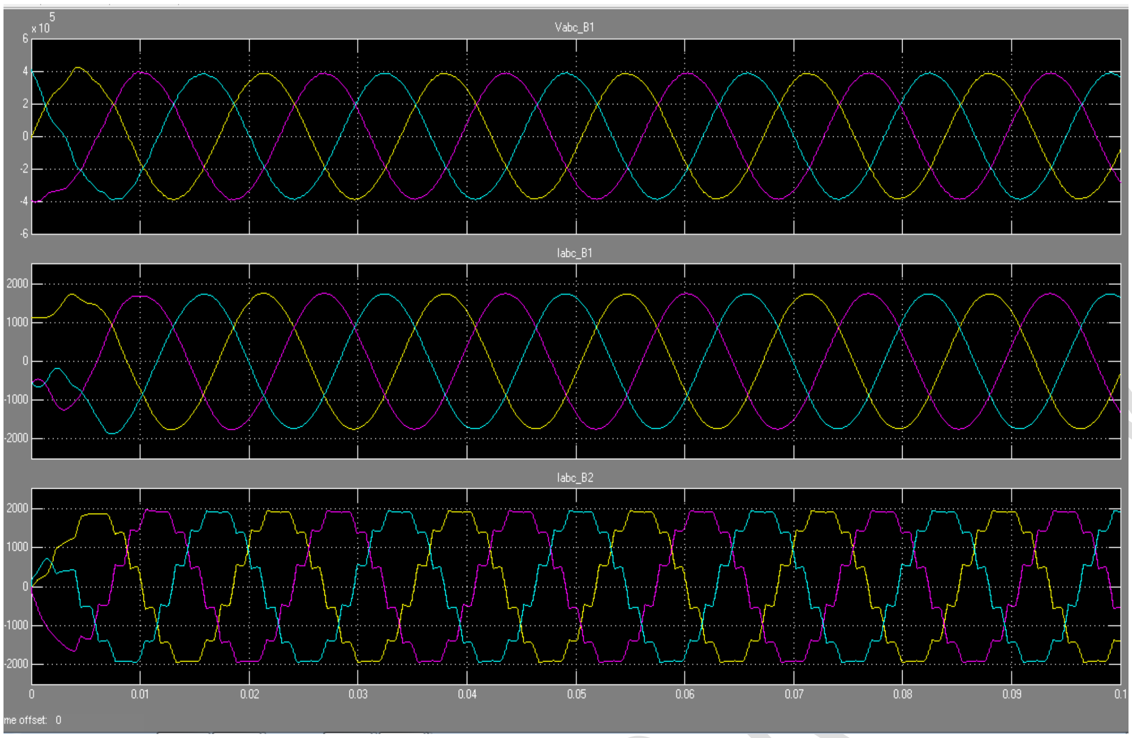

Fig. 3.3: Graph of Voltage and Current

Figure 3.3 shows the voltage (Vs) and current of the grid (Is) for the phase A, B and C. We observe that the current and voltage are in phase because all the reactive power of the load is compensated by the FIR filter system.

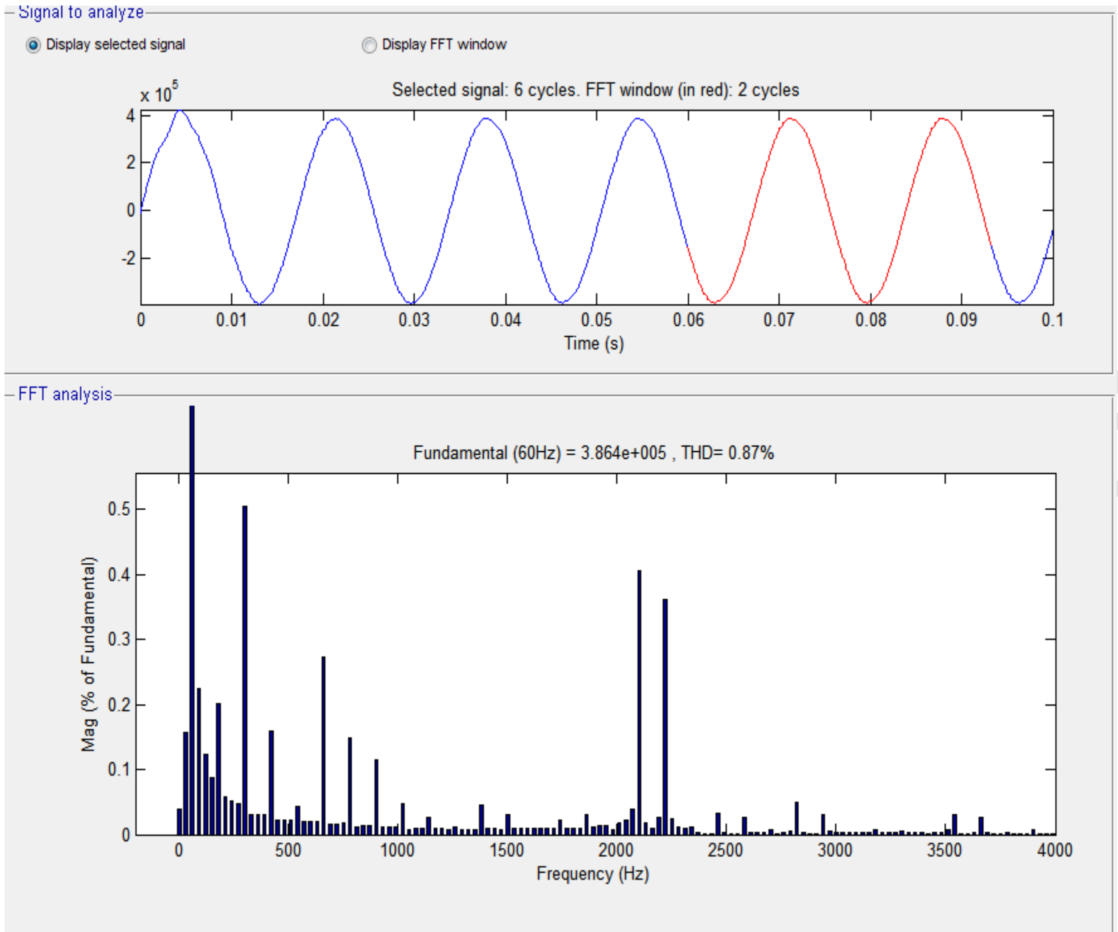

Fig. 3.4: Graph of FFT Analysis of the Current with FIR Filter

Using the FFT tool of the Powergui, you will find that the harmonic filters reduce the Total Harmonics Distortion (THD) value of the current injected in the system to 0.87% and improving the system's power factor (PF).

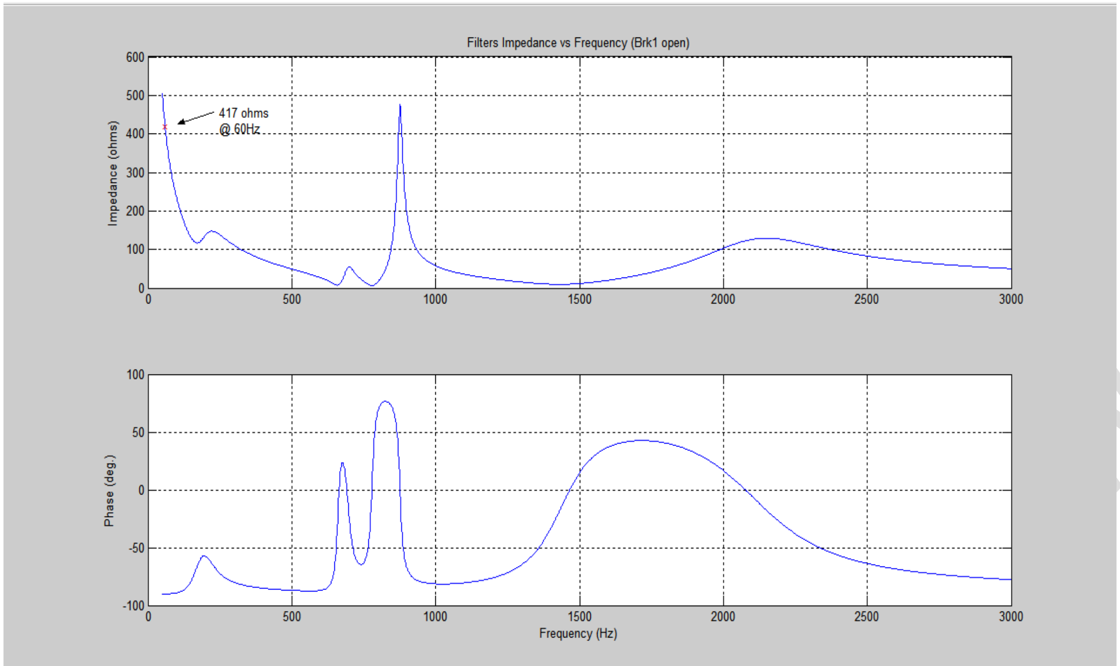

Fig. 3.5: Plot the impedance vs. frequency of the harmonic filters

From figure 3.5, you should find an impedance of 417 ohms capacitive (-90deg.) at 60 Hz. This value confirms that the total reactive power of the filters at 60 Hz is 600Mvar.

Table 3.1: **Total Harmonic Distortion of System with and without FIR filter**

System without FIR Filter	**System with FIR filter**
17.77%	0.87%

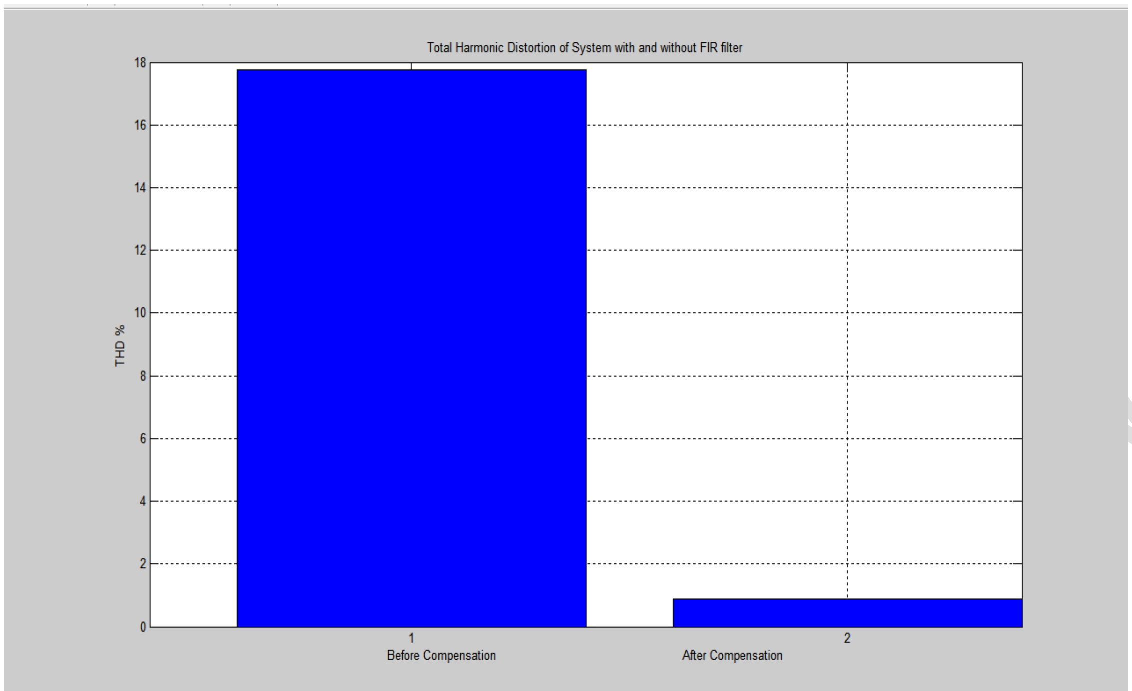

Fig. 3.6: Comparative Graphical analysis between System without and with Filter

The comparative analysis between system without FIR filter and with FIR filter using current control method based on FFT analysis is shown in table 3.2 Figure 3.6 shows the Total Harmonic Distortion (THD) of the system before and after using filter. As seen from the graph, the system with FIR filter gives the better result of 0.87% as compare to the system without filter with resulted in 17.77%.

Discussions

It clearly visible from the FFT analysis of the MATLAB/SIMULINK model of the circuit with and without FIR filter, that the harmonic component present in the source is compensated with the use of FIR filter. Further it is also seen that harmonic is compensated to a greater extent while using FIR filter i.e. the THD of source current is almost reduces drastically by more than 90%. The comparative analysis between system without FIR filter and with FIR filter using current control method based on FFT analysis is shown in table 3.2. Figure 3.6 shows the Total Harmonic Distortion (THD) of the system before and after using filter. As seen from the graph, the system with FIR filter gives the better result of 0.87% as compare to the system without filter with resulted in 17.77%.

Conclusion

The main goal of this project is control of active power and compensation of harmonics and reactive power of nonlinear loads and improvement of the power factor of the power system using FIR filter system. This function was done by using proper reference current generation, which is built by the instantaneous power theory (p-q). In this method, the system applies the grid with active power while compensating the reactive power of the load all the day. Simultaneously the power system was controlled to operate at the maximum power point. Simulation results showed that with the performance of proposed method the power system was controlled to operate at the maximum power point and the FIR filter can compensate the harmonics and reactive current. Also the THD amount of the current decreases significantly.

Based on the simulated results obtained in this research work it can conclude that Shunt Active Filter is a potential tool for the growing power quality problems for damping the harmonic resonance, reactive power compensation and load balancing. This work identifies the area of research for power filtering by employing the filter techniques, reduction in the transient time proposed FIR filter method.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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