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"Comparative Study of Time Domain Based Control Techniques for Shunt Active Power Filter MATLAB/Simulink"

Chetan Haribhau Kidile [1], Prof. Rajendra M. Bhombhe [2], Prof. Praful Kumbhare[3]

[1]Post Graduate Student
Gurunanak Instituete of Engineering & Technology,
Nagpur, Maharashtra, India
[2,3]Assistant Professor
Gurunanak Instituete of Engineering & Technology,
Nagpur, Maharashtra,India

Abstract – *Use of nonlinear load increasing day by day thereby increases the harmonic contents in power system. The removal of harmonics is important issue and effective way to compensate harmonics is Shunt Active Power Filter (SAPF). Heart of SAPF is reference current generation technique. Number of control algorithms for reference current generation has been developed. This paper presents three different reference current generation techniques viz. Synchronous Reference Frame Method (SRF), Perfect Harmonic cancelation strategy (PHC), Unity Power Factor system (UPF). All three techniques are analyzed mathematically first and then it is simulated and analyzed in MATLAB platform. It is evaluated considering total harmonic distortion (THD). Simulation results demonstrate the performance of system and it is shown in paper.*

Keywords*-Shunt Active Power Filter, Voltage Source Inverter, Current control, Non linear load, SRF, THD*

I- INTRODUCTION

The expanding number of non-direct receptive loads, for example, fans, pumps, variable rate drives, rectifiers and more power electronic based burdens makes a chasing impact on force supply. These non-straight loads cause a symphonious era and slacking responsive force in framework. Thus there is voltage and subsequently current bending results in poor force quality. The unsettling influence in the force quality influences the execution of the different transmission line gear's, for example, generator, transformer, capacitors, wires and circuit breakers. The greater part of the gears in framework is more delicate to the force quality and subsequently there is probability of mal-operation of the hardware. These force quality twisting issues must be illuminated to enhance the execution of the framework. There are different systems to take care of this issue as

- Power System Design
- 12-Pulse Converter front End
- Delta-Delta and Delta-Star Transformer
- Isolation Transformer
- Line Reactors
- Harmonic Trap Filters
- Passive Filter remuneration.

The utilization of these strategies is restricted to some degree in light of the fact that these systems are not ready to remunerate every one of the sounds and not give complete responsive force pay. There are a few constraints to these systems as

- Sometimes it gives over remuneration of receptive force.
- These are very little proficient.
- It gets over-burden when music in the framework are expansions.
- Their execution gets influenced because of variety i n the heap and symphonious frequency.
- It may bring about reverberation in the framework.

Because of these downsides of the above pay procedures, these are not helpful for the consonant and responsive force pay.

To conquer these issues the new strategy called Shunt Active Power Filter is designed to wipe out sounds and to repay the responsive force in the framework. The

fundamental chart of dynamic channel is as appeared in beneath figure.

The essential guideline of Shunt dynamic force channel is to repay the symphonious substance and receptive force pay. It produces the reference current utilizing different reference current era procedures and do contrast the reference current and the real framework current. The mistake is sustained to inverter and it creates definite equivalent and hostile to stage streams and infuses it to the framework at the purpose of regular coupling. In spite of the fact that the music are of any frequencies they get repaid with the utilization of shunt dynamic force channel. Subsequently shunt dynamic force channel are more proficient and viable for the end of sounds.

II-METHOLOGY

Shunt Active Power filter

Shunt active power filter is a device that is connected parallel to the load to cancel the reactive and harmonic current injections. The shunt active power fi lter is a voltage source inverter driven to generate the currents that are equal but opposite to the harmonic currents in the current waveforms. The proposed active power fi lter consists of three singlephase IGBT based voltage source inverters having capacitors on dc bus. The ac side of the inverter is connected to the power supply through the link reactors The Synchronous Reference Frame (SRF) theory is used to calculate the compensation currents to be supplied by the active fi lter plays an important role in deciding the effectiveness of the compensation provided by the Shunt Active Filter. The desired current waveform is obtained by accurately controlling the switching of the igbts in the inverter. On the base of current references a hysteresis current controllers are employed to derive the gating signals for the igbts.

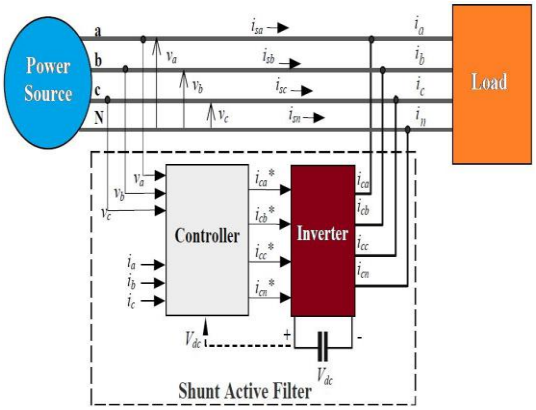

Fig. 01- Shut Active Power Filter

Synchronous Reference Frame

The Synchronous Reference Frame method (SRF) is based on the fact that harmonics change their frequency in a rotating reference frame, and so they are better isolated with high pass filters. In this method the measured load currents are transformed into the rotating reference frame (d-q frame) that is synchronously rotating at the line voltage frequency. The line frequency components of the load currents become DC quantities and the harmonic components are frequency shifted by ωs in the d-q reference frame. A high pass filter in the d-q frame, with a cutoff at the line frequency can be used to extract the DC components. If the phase of the d-axis current is locked to the phase voltage, ea, of the a-b-c coordinates with a phase locked loop (PLL), and then the i_d^{dc} component represents the fundamental real current and I_q^{dc} represents the fundamental reactive component. By subtracting these quantities from I_{ld} and I_{lq} the harmonic content is obtained.

Simulation Results & Discussion

The model for a three phase three wire shunt active power filter using SRF method has been successfully modeled and tested using MATLAB/SIMULINK 7.1 toolbox. The performance of APF in steady state condition is evaluated using FFT simulation.

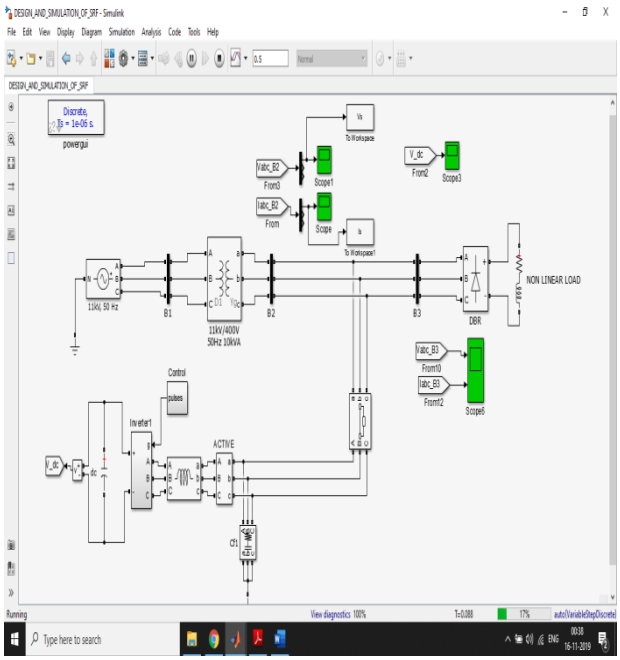

Fig. 02 Simulation of Synchronous Reference Frame

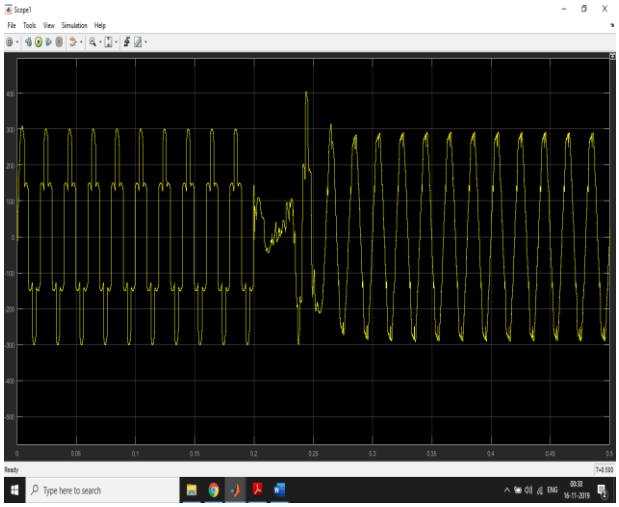

Fig. 03 AC Source Voltage

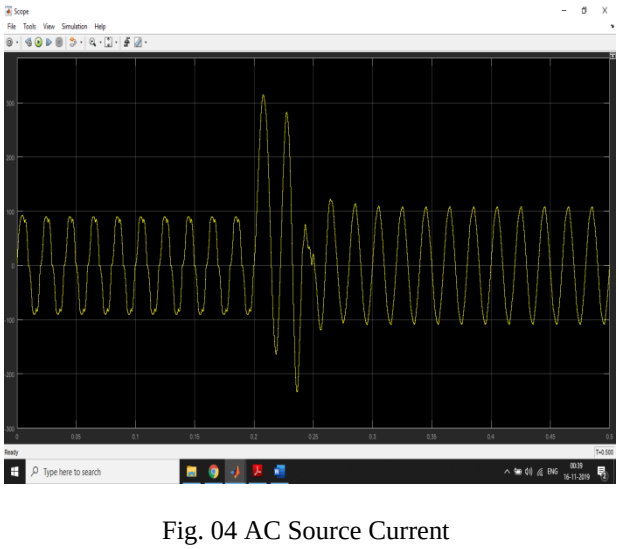

Fig. 04 AC Source Current

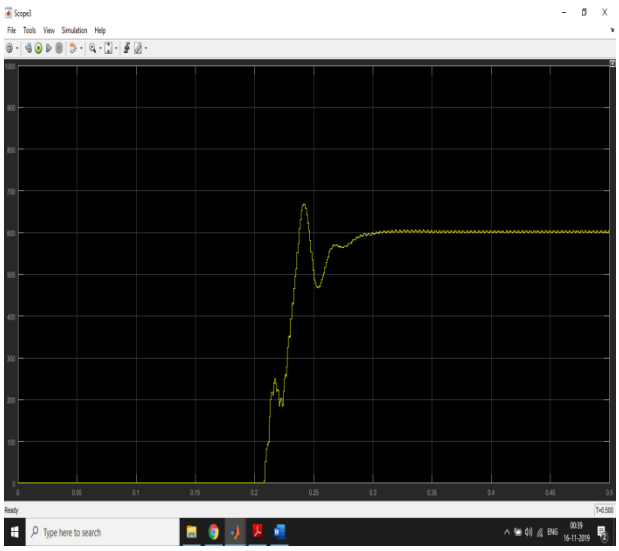

Fig. 05 DC Voltage of Capacito

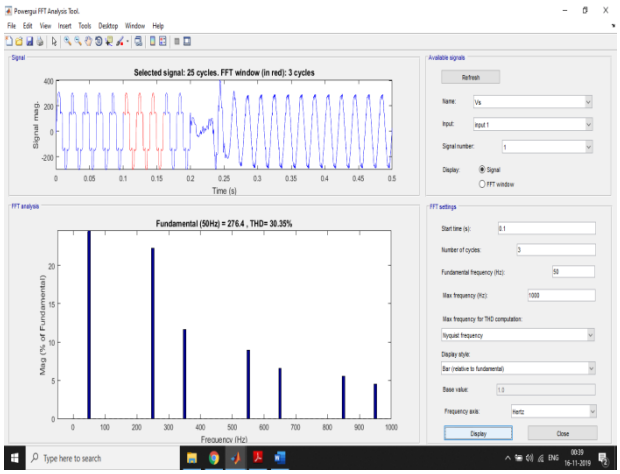

Fig. 06 Total Voltage Harmonics Distortion

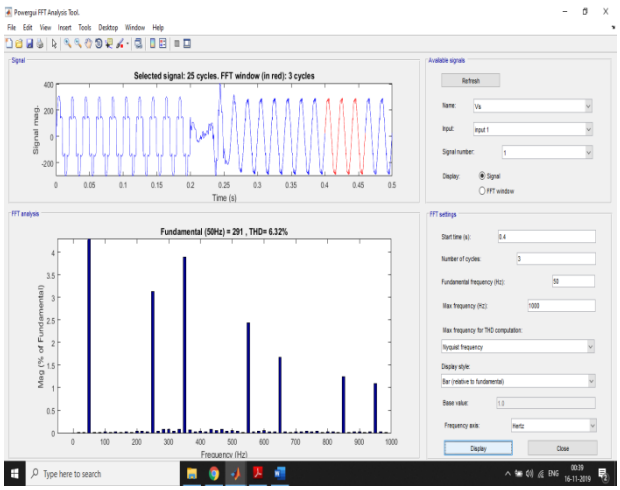

Fig. 07 Total Voltage Harmonics Distortion

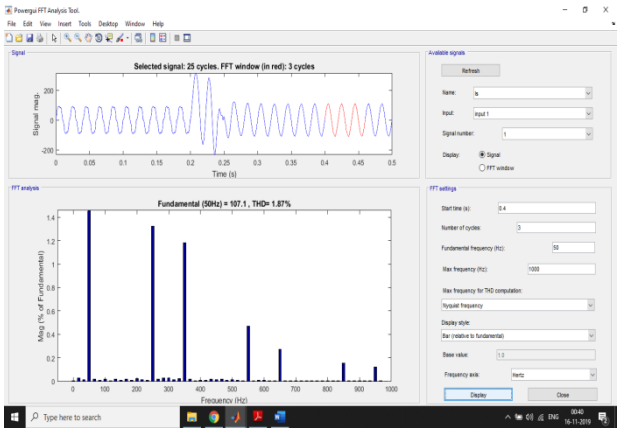

Fig. 08 Total Current Harmonics Distortion

III- CONCLUSION

The process of verifying a complex design in any field is expensive and time consuming and actually under serious reconsideration. So, simulation tools like SIMULINK prove to be essential and cheaper allowing the designer to determine the correctness and efficiency of a design before the system is actually constructed. It permits system designers to study a problem at several different levels of abstraction. Visualization of output waveforms of currents and harmonic content in the waveforms help in analyzing the applied shunt active filter model and control strategy feasibility to improve the power quality. From the results it is observed that SRF theory based APF can be used for elimination of harmonics for a three phase three wire system supplying a nonlinear load.

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