



Performance Evaluation of VSI Based Active Filter and Passive Filters

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ABSTRACT: The aim of this project is to simulate VSI based active power filters to Non-linear load for improving power quality. THD is used as measuring index for comparing performances of these filters. These filters can reduce harmonic in supply current. When a non-linear load is connected to an AC supply it produces a quasi square waveform which contains harmonic current. Thus, active filters injects harmonic currents and changes quasi-square waveform to sinusoidal current. In this work, SVM based the voltage source shunt active filters and passive filters are compared. The circuits are simulated using MATLAB simulink. Harmonic distortion is found to be lowest in the case of VSI filter.

I. INTRODUCTION

The growing number of power electronics base equipment has produced an important impact on the quality of electric power supply. Both high power industrial loads and domestic loads cause harmonics in the network voltages. At the same time, much of the equipments causing the disturbances is quite sensitive to deviations from the ideal sinusoidal line voltage.[1] Therefore, power quality problems may originate in the system or may be caused by the consumer itself.

Consumers that are becoming increasingly aware of the power quality issues and being more informed about the consequences of harmonics, interruptions, sags, switching transients, etc. Motivated by deregulation, they are challenging the energy suppliers to improve the quality of the power delivered.[2-4]

The technology of active power filter has been developed during the past two decades reaching maturity for harmonics compensation, reactive power, voltage balance in ac power networks. All active power filters are developed with PWM inverters (current source or voltage source inverters). The current fed PWM inverter bridge structure behaves as a sinusoidal current source to meet the harmonic current requirement of the non-linear load. It has a self supported dc capacitor that ensures the continuous circulation of the dc current. They present good reliability and require higher values of parallel capacitor filters at the ac terminals to remove unwanted current harmonics.[5] However, they cannot be used in multilevel or multistep diodes configurations to allow compensation in higher power ratings. The other converters used in active power filters topologies is the voltage-source PWM inverter. This converter is more convenient for active power filtering applications since it is lighter, cheaper, expandable to multilevel and multistep versions, to improve its performance for high power rating compensation with lower switching frequencies. The PWM voltage source inverter has to be connected to the ac mains through the coupling reactors. An electrolytic capacitor keeps a dc voltage constant and ripple free.

II. ACTIVE FILTERS

An active filter is basically a power electronic converter incorporating energy-storage components. In theory, the active filter can perform various functions. depending on the configuration of active filter, to improve the power quality of an electrical system. For example, a so-called shunt active filter can inject harmonic currents into a system at the point of common coupling to cancel the current distortion of the supply. Other forms of active filters also exist such as a series active filter and a unified active filter. Two main types of converters can be used as an active filter, -. namely voltage-source inverter (VSI) and current-source inverter (CSI).[6-8]

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A. Voltage-Source Active Power Filter

The PWM bridge consists of six controllable switches (IGBTs) with antiparallel diodes. The voltage-source topology requires the filter to be placed between the supply and the PWM bridge. The filter has usually either first order(L) or third-order (LCL) structure. More-over, the filter makes it possible to control the currents. In the dc link there is an electrolytic capacitor with a dc voltage as an energy storage. The limited lifetime of the electrolytic capacitor can be considered a disadvantage.[9] The dc link voltage should be so high that the filter currents can be controlled to draw the load current harmonics through the supply filter.[10]

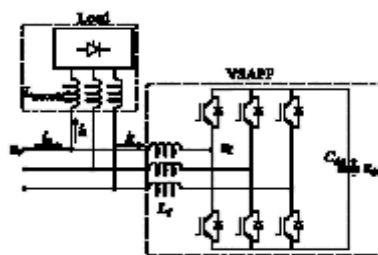


Fig Voltage Source Shunt Active filter.

III. PASSIVE HARMONIC FILTERS

Passive harmonic filters work on the principle of electrical resonance in tuned circuits which is useful in mitigating harmonic orders corresponding to a particular frequency.[11-12] The concept is that at resonant frequency the tuned RLC circuit considered to be the passive filter provides a least resistance path for the harmonic current to flow out of the system that feeds the loads. Thus it reduces harmonics in the system. [13]The impedance offered by the filters is minimum and purely influenced only by the resistive nature of the circuit at resonance conditions. Thus maximum current corresponding to the harmonic order is filtered out from the path that feeds the loads.

FILTER TYPE	VALUES
Double tuned filter 3 rd & 5 th Harmonics	L=5mH, C=225e-6 F and 81.057 F
High pass filter	R=100 ohms. C=31.58e-6F
Single tuned filter (7 th harmonics)	L=5mH, C=41.356e-6F

IV. SPACE VECTOR MODULATION (SVM)

Space Vector Modulation (SVM) is quite different from the PWM methods. In the figures presented, the following notations are used: “+ ” refers to the on-state of the upper switch and “- ” to the on-state of the lower switch while “0” indicates that both of the switches in a phase are in off-state and “+ ” that both of the switches in a phase are on.

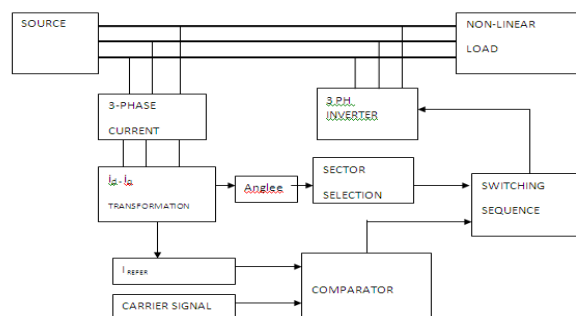


Fig. Block diagram representation of SVM

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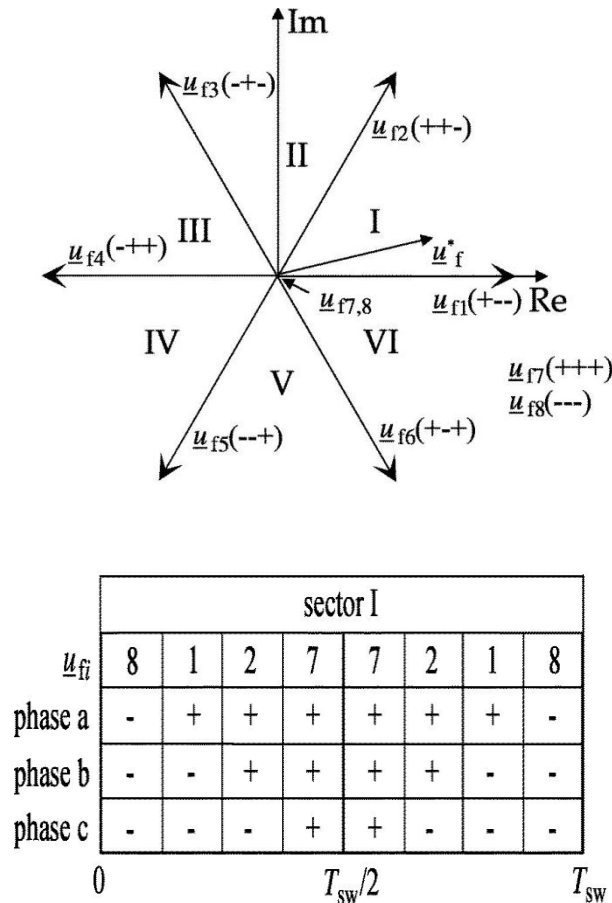
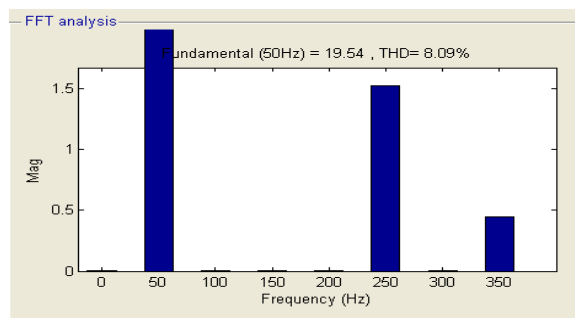


Fig. Switching vectors and applied sequence of vectors when the reference vectors lies in sector I in the case of fig1 voltage-source PWM bridge.

IV. SIMULATION RESULTS



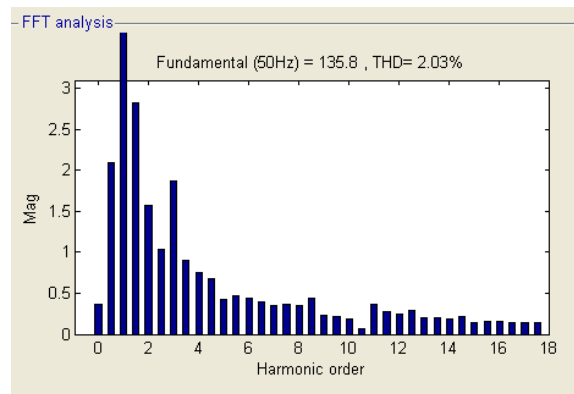
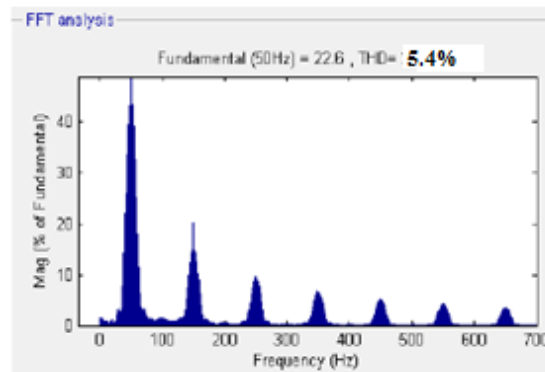
FFT Analysis without filter

The above shown fig represents the FFT Analysis without filter. The THD content is found to be 24.68% which should be reduced to obtain an undistorted waveform, for this purpose we use shunt active filters.

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FFT Analysis with VSI SVM filter

The fig represents the FFT Analysis with VSI SVM filter and found that the THD content is reduced to 3.33%. Thus the THD content is reduced with the use of SVM based VSI filter than the use of SVM based VSI filter

V. CONCLUSION AND SCOPE FOR FUTRE WORK

CONCLUSION:

Highly inductive load is connected at the output of the rectifier. The A.C current drawn by the rectifier is Non-linear as shown in fig 6.a. The current drawn is quasi-sinusoidal current, thus the load acts as a Non-linear load. The harmonic distortion is found to be 24.68%.

When the power system is fed with CSI SVM filter the harmonic content is found as 3.57% and when it is fed with VSI SVM filter the harmonic the harmonic content is found as 3.33%. Thus the THD content is found to be reduced with the use of SVM based VSI filters.

In this work Vector modulated voltage source inverter and Passive filters are compared and found that VSI filter is best among the two. The harmonics are eliminated more in volage source inverter than passive filters has high on-state losses and inefficient inductive energy storage element on the DC side of the bridge.

Thus Harmonic distortion is found to be lowest in the case of VSI filter and hence it is widely used in industrial applications.

FUTURE WORK:

The following work can be imposed on the topic done

- To simulate CSI fed active filter using SVM technique.

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