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A FUZZY LOGIC CONTROLLER FOR TCR BASED SHUNT ACTIVE FILTER TO IMPROVE POWER QUALITY

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ABSTRACT

In general, with the increasing demand of electrical power, the reliability has to be decrease due to its general power quality issues like harmonics or current unbalances. In order to improve its quality and reliability generally we need a common LC filter. But this type of filters has some disadvange such as these are not applicable for high power applications. For this, this paper proposes a concept of hybrid cascaded shunt active filter based Thyristor Controlled Reactor. Current tracking and voltage regulations was done in this a nonlinear control strategy of SPF The small-rating APF is used to improve the filtering characteristics of SPF and to suppress the Possibility of resonance between the SPF and line inductances. A proportional–integral controller was used, and a triggering alpha was extracted using a lookup table to control the TCR. In order to get improved result as compared to conventional PI controller, this paper proposed a concept of Fuzzy Logic Controller. This controller has the advantage of decreasing steady state error and improving the system response.

INTRODUCTION

Advanced power systems demand is increasing with the large usage of electrical power. This implies an increase of the electrical load and power electronic equipment, higher consumption of electrical energy, more demand for generated power, power quality, and stability problems. The concept of multilevel inverters, introduced to performing power conversion in multiple voltage steps by this we are improving power quality and high voltage capacity. In all topologies of multilevel inverters the most popular is cascaded H-bridge because of it has capability to use variable dc voltages on individual H-bridge cells it causes the splitting of power conversion among

Higher-voltage lower-frequency and lower-voltage higher-frequency inverters. Without using PWM techniques the total harmonic distortion (THD) is reduced with more number of steps in output voltage. A topology is proposed in this paper to get high 31 levels.

Recently non-linear loads usage is increasing mostly the power electronic equipment’s which effects the voltage waveforms quality at PCC. The harmonic pollution has been reduced by using Active power Filter (APF) in electrical networks. Ideal current source is nothing but an APF here, by selective harmonic compensation it inserts the compensating current into the ac lines to cancel the Harmonics of line current. To improve the power quality APF has more advantages over the traditional compensation methods like passive filters. The APF have better compensation for voltage and current disturbances in distribution systems [2].

APFs has two fundamental configurations, either active or passive i.e series or the shunt filter. The shunt active filter shown in Fig. 1. For harmonic compensation in low and medium power systems shunt active filter has a cost effective solution [3]. To the line a dc link capacitor which is large is connected, same structure and construction for both PWM voltage source inverter and APF

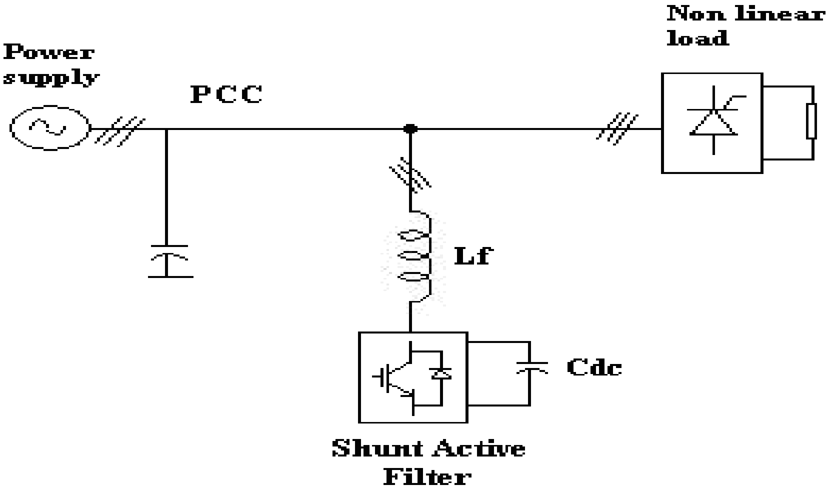

Fig. 1 Block diagram of shunt active power filter

Reduction of current distortion for power quality improvement is affectively done by harmonic current compensation in APF. The load current harmonic components harmonic are drawn from shunt compensator which acts as a controlled current source. APFs are also applicable in the line current compensation, harmonic damping and power flow control.

In this a proposed new combination of a shunt hybrid power filter (SHPF) and a TCR (SHPF-TCR compensator) for suppress current harmonics and mitigating the reactive power problems generated from the load. The hybrid filter consists of a series connection of a small-rated active filter and a fifth-tuned LC passive filter. In the proposed topology, the major part of the compensation is supported by the passive filter and the TCR while the APF is meant to improve the filtering characteristics and damps the resonance, which can occur between the passive filter, the TCR, and the source impedance. The shunt APF when used alone suffers from the high kilovolt ampere rating of the inverter, which requires a lot of energy stored at high dc-link voltage.

CONTROL STRATEGY FOR APF

In the control of APF, the approaches are fully depends on feed forward open loop control and it is sensitive to the parameter mismatches so it effects the ability to accurate prediction of the current reference of voltage-source inverter and its performance controllability. The close-loop control has detection and the source current is control target. We known that closed loop control is feedback control so it is having the following benefits: Disturbances to the output to transfer function is reduces

Fig.2 shows the method of synchronous reference frame used to extract the reference current in closed loop control scheme for using. Fig 3 shows the harmonic detection bloc function. In the SRF method using Park’s transformation [14] the 3-phase line currents are transformed into 2-phase quantities.

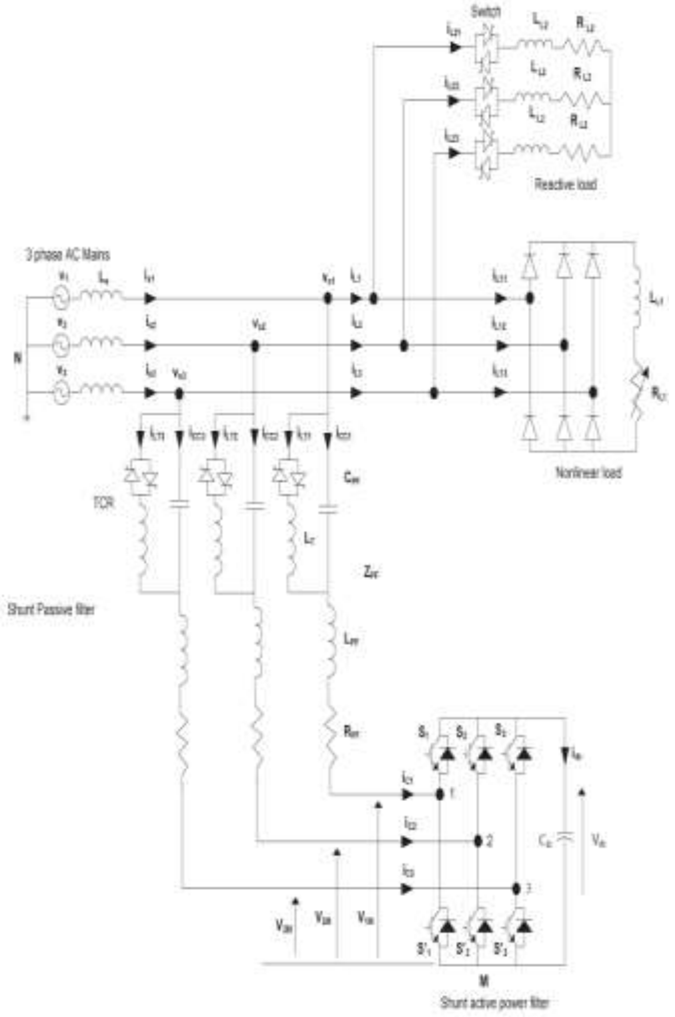

Fig.2 Proposed SHPF_TCR compensator

Positive and negative sequence components are two main blocks corresponded, transformation of de–qe axes by generating positive sequence phase information +_ from PLL circuit was done in positive sequence component of load current. All harmonic components are included in AC quantities of positive sequence waveform while the fundamental line current component is dc quantity. The negative sequence component of the current is same but from the PLL it generates negative sequence phase information. If the voltages and currents are balanced in 3-Φ system then the oututt signal is '0' for the block. The dominant harmonic component is the output from the comparison of the positive and negative sequence controller. To convert 3-Φ components in to 2- Φ components inverse transformation is applied.

Both the currents from the harmonic component and dc voltage control block is compared and signal is send.

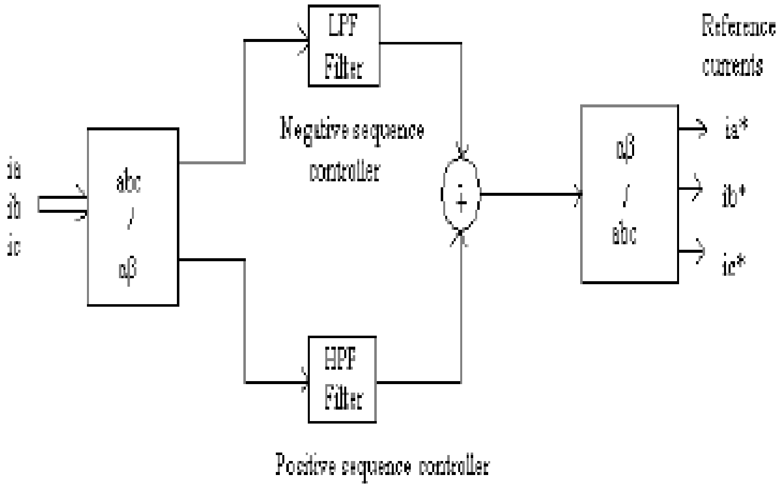

Fig.3 Scheme of harmonic detection

The control target is determined by summing the capacitor voltages at every cluster. The voltage reference is taken from the dc capacitor is used for generating u-phase overall voltage signal and is divided into V1, V2. In feature this control strategy is extended to N-phase H-bridge cascaded inverter.

With the usage of the one or more cascade converters the compensation performance was better.

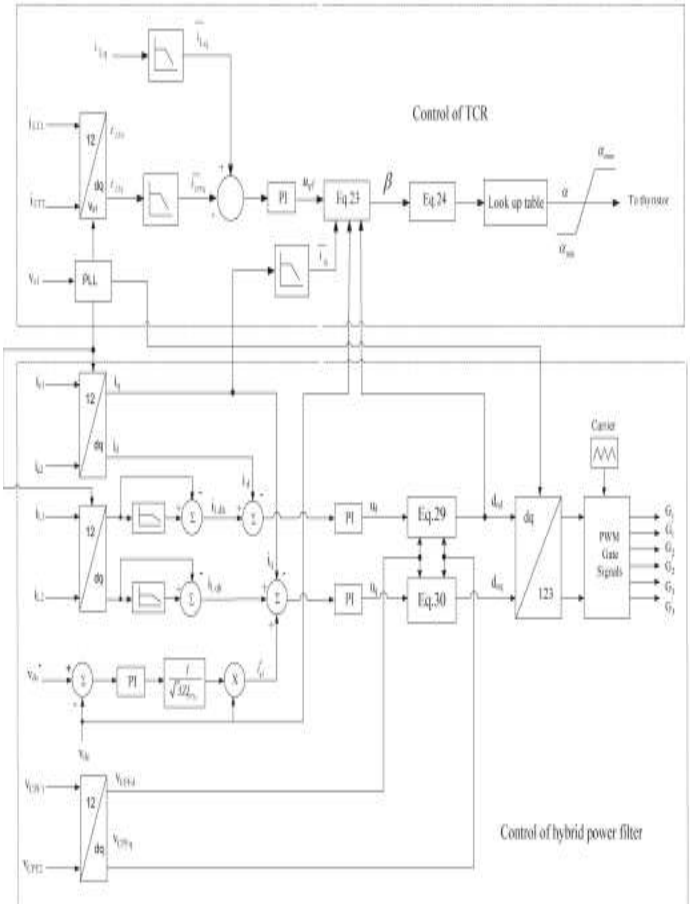

Fig.4 Control Diagram

The fig.4 show the whole control diagram for phase-u of the proposed u AAPF is given in, which contains the source current direct control, load current feed forward compensation, voltage-balance control and voltage control.

FUZZY LOGIC CONTROLLER

Fuzzy controllers are directly using the fuzzy rules. The fuzzy logic control system is a mathematical system which analyzes the input values in terms of logical variables i.e 0 &1.Logic involved in the fuzzy is dealing the concepts that which cannot be expressed as true or false. The Fuzzy Logic Controller main diagram is shown below.

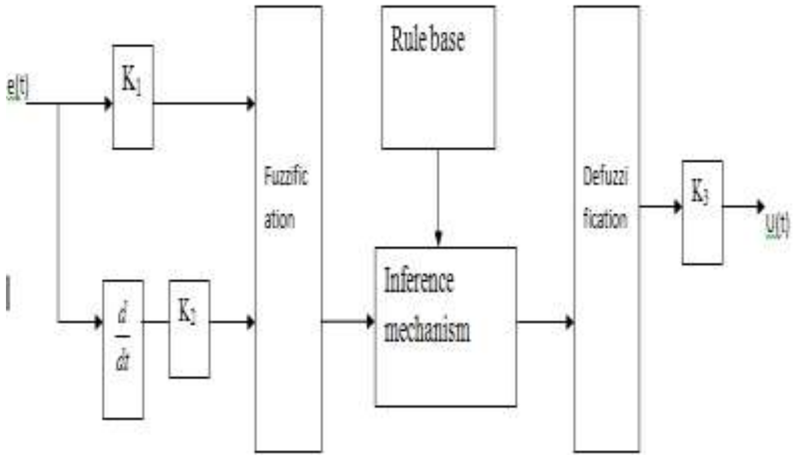

Fig.5 Fuzzy Logic Controller main diagram

Three stages of Fuzzy controllers are output stage, processing stage, input stage. The input stage senses the input, processing stage generates result for each, and output stage combines the results and shows a final output value. For low cost implementation fuzzy logic is preferred

EXPERIMENTAL RESULTS

The compensation performance of APF is verified by simulink results. Fig. 6 shows the simulated results for the 400-Hz EPS SW with inductive load. Nonlinear loads start to work at 0.2 s and are half unloaded at 0.25 s.

Case 1: Simulation Results with PI controller:

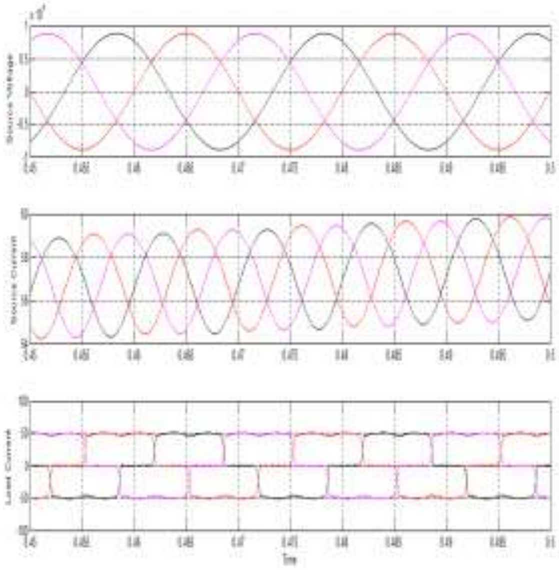

Fig 6: Simulated results for the given APF converter system

As in Fig. 6 the first waveform shows the result of source voltage, second one is .compensated source current and finally third waveform is the load current waveform which is effected by the non-linear load.

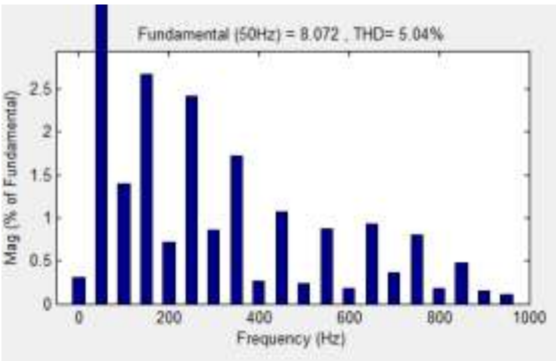

Fig 7: simulation result show for THD of Source Current

Case 2: Simulation Result with Fuzzy Controller:

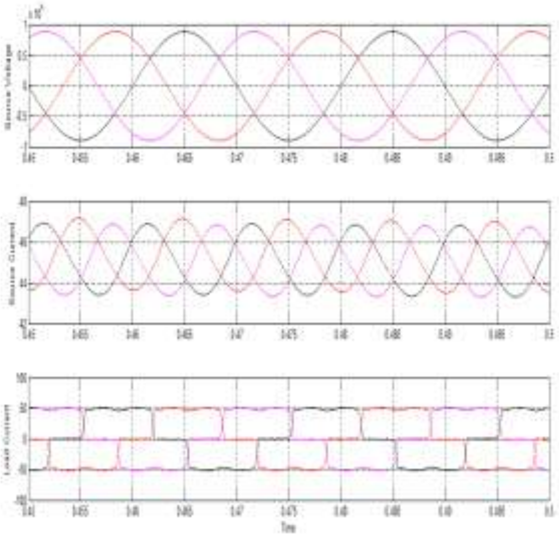

Fig 8: Simulated results for the given APF converter system

As in Fig. 8 the first waveform shows the result of source voltage, second one is.compensated source current and finally third waveform is the load current waveform which is effected by the non-linear load.

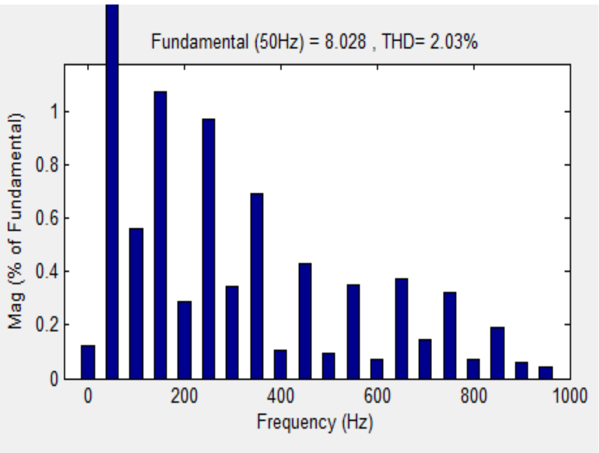

Fig 9: simulation result show for THD of Source Current

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CONCLUSION

Power quality issues are compensated by using shunt active filter along with thyristor controlled reactor is proposed. The corresponding control strategy is designed for cascaded H-bridge multi-level inverter based active filter system. This paper mainly highlights the concept regarding utilization of non-linear load and their effects on source current of the power system. These harmonics in source currents are effectively eliminated with the shunt active power filter based TCR. In this paper we also proposes the concept of fuzzy logic controller based active power filter along with thyristor controlled reactor. This fuzzy controller mainly concentrates on the reduction of steady state error. From the simulation result we conclude that the fuzzy controller puts better effort for controlling as compared with the conventional controller. And the comparison of THD are shown in above figures.

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