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DESIGN AND CONTROL METHODOLOGY OF SHUNT ACTIVE POWER FILTER FOR HARMONIC REDUCTION

S.K.S.ANGURAJ Dr. S.SENTHIL KUMAR
Department of EEE
Govt. College of Engineering
Salem – 11
sengce2009@yahoo.in, sksanguraj@gmail.com

ABSTRACT

This paper deals with the design and control methodology of shunt active power filter (SAPF). The main objective of Shunt active power filter is to minimize the total harmonic distortion for all kinds of load (either balanced or unbalanced load). The topology of the filter is based on a single phase voltage source inverter(VSI).A low pass filter is also incorporated in the output of the inverter to provide a sufficient attenuation of the high switching ripples caused by the VSI. In this paper develop the algorithm based on fuzzy logic for controlling the switching of shunt active power filter.

Index Terms – shunt active power filter, fuzzy logic controller, hysteresis controller, THD

1. INTRODUCTION

The electrical power system has been increasing in complexity at a rapid rate in the last few decades. Many measures have been introduced to improve its reliability and security. However, the system is more and more polluted owing to the increasing use of power – electronic converters and controllers for industrial processes and drives, among other types of disturbing loads. These are the nonlinear loads. The rapid use of power electronic controlled equipment in electrical distribution system offers highly nonlinear characteristics and produces voltage and current wave forms distortions called as harmonics. Hence, the power converter behaves as a current source, injecting harmonic current into the supply network. Distorted current and voltage waveform further affects other consumers connected to the same point of common coupling (PCC) by propagating these distortions in their premises.

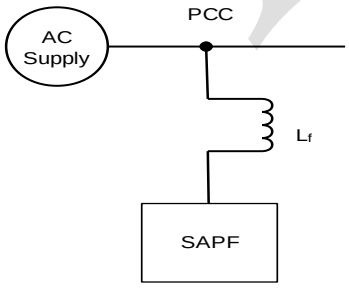

fig1. Block Diagram Of Shunt Active Power Filter

In order to overcome these Problems **ShuntActive power** filter is designed, which are used to eliminate the unwanted harmonics and compensate power factor by means of injecting equal but opposite harmonic compensation currents. It is based on the fuzzy control VSI topology to compensate simultaneously all the order of Harmonics. Using Current Harmonic Compensation the shunt active power filter is given better performance. Thus the basic principle of shunt active power filter is that generates acurrent equal and opposite to the harmonic current drawn by the load and injects it to the point of common coupling (PCC) there by forcing the source current to be pure sinusoidal

2.FUZZY LOGIC HYSTERESIS CONTROLLER

The FLC in order to convert the crisp variables into linguistic variables uses the following seven fuzzy sets, which are: NL (negative big), NM (negative medium), NS (negative small), Z (zero), PS (positive small), PM (positive medium), NL (positive big). The fuzzy logic controller characteristics used in this section are: Seven fuzzy sets for each input (e, Δe) and output (ierror) with triangular and trapezoidal membership functions.

- Fuzzification using continuous universe of discourse.
- Implications using Mamdani's 'min' operator.
- Defuzzification using the 'centroid' method

Figure.4 shows the normalized triangular and trapezoidal membership functions for the input and

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output variables.

In the design of the fuzzy control algorithm, the knowledge of the systems behavior is very important. This knowledge is put in the form of rules of inference. The rule table which is shown in Table I contains 49 rules. The elements of the rule table are obtained from an understanding of the SAPF behavior.One of the best known and most effective current control methods is the hysteresis controller

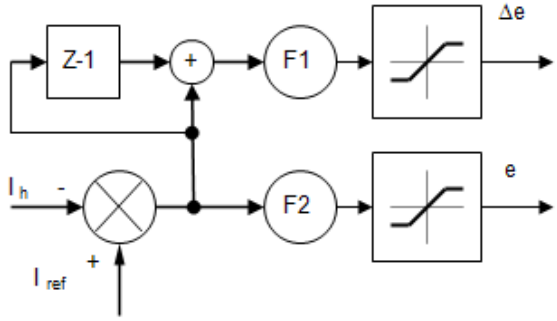

Fig 2. Reference current Generation

Tab.1 Fuzzuy control rule

Δe	e						
	NB	NM	NS	Z	PS	PM	PB
NB	NB	NB	NB	NB	NM	NS	Z
NM	NB	NB	NB	NM	NS	Z	PS
NS	NB	NB	NM	NS	Z		PM
Z	NB	NM	NS	Z	PS	PM	PB
PS	NM	NS	Z	PS	PM	PB	PB
PM	NS	Z	PS	PM	PB	PB	PB
PB	Z	PS	PM	PB	PB	PB	PB

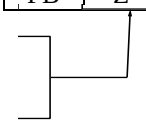

Fig.3. Fuzzy logic controller

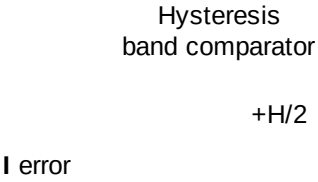

Fig.4. Hysteresis controller

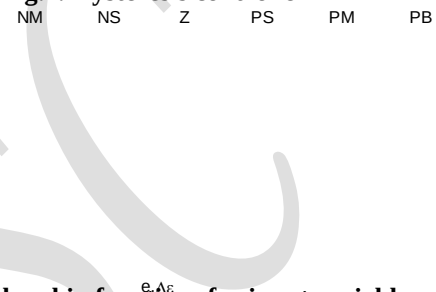

Fig.5. Membership functions for input variable e , Δe

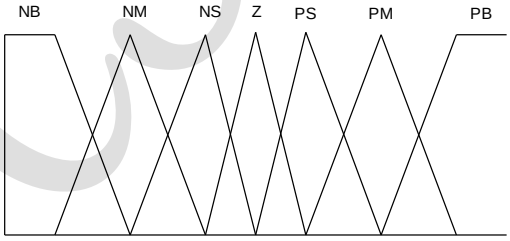

Fig.6. Membership functions for output variable I error

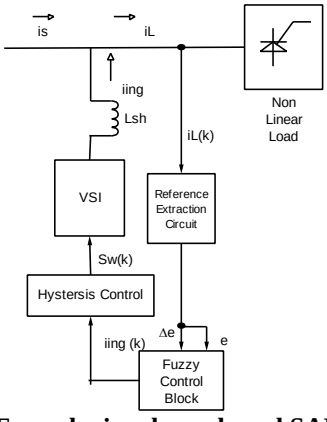

Fig.7. Fuzzy logic scheme based SAPF

3.Fuzzy logic scheme based SAPF

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The main concept of this SAPF, the non linear load current is sensed by a current transducer. The sensed I_L (k) is passed through an extraction circuit to filter out fundamental components of the I_L and output of the extraction circuit is given to the fuzzy hysteresis control blocks. The output of the hysteresis controller is the gating signal of VSI. Finally the SAPF injecting current to the point of common coupling (PCC) there by forcing the source current to be pure sinusoidal

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4. CONCLUSION

In this paper, a new control design for the shunt active power filter has been presented. In this paper a modified version of the p-q theory was proposed, in order to improve the performance of the (SAPF) shunt active power filter. The control design is based on the fuzzy logic hysteresis controller proposed shunt active power filter can compensate for balanced and unbalanced nonlinear load currents and minimize the percentage of THD. In this shunt active power filter to be highly effective and robust.

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