

Power quality improvement by a shunt active power filter using PI and FUZZY logic controller

Abedhusen R. Moknojia¹, Harsh Sharma²

¹P.G. Scholar, Hansaba college of engineering & technology, Siddhpur, Gujarat, India

²Assistant Professor, Dept. of Electrical Engineering, Hansaba college of engineering & technology, Siddhpur, Gujarat, India

Abstract - In this paper we use PI and FUZZY logic controllers for improve the power quality using shunt active power filter. And PWM patterns generations is based on carrier less hysteresis based current control to obtain the switching signals to the voltage sourced PWM converter. Make a simulation of shunt active power filter in MATLAB.

Key Words: Active shunt power filter, PI controller, FUZZY logic controller, Hysteresis current controller, Power Quality, Harmonics.

1.INTRODUCTION

The application of power electronics devices such as are furnaces, adjustable speed devices, Computer power supply etc. are some typical non-linear characteristics loads used in most of the industrial applications and are increasing rapidly due to technical improvements of semiconductors devices, digital controller and flexibility in controlling the power usage. The use of the above power electronics devices in power distribution system gives rise to harmonics and reactive power disturbances.

The Harmonics and reactive power cause a number of undesirable effects like heating, equipment damage and Electromagnetic Interference effects in the power system. The conventional method to mitigate the harmonics and reactive power compensation is by using passive LC filters but this method has drawbacks like large size, resonance problem and fixed compensation behaviour. The solution of this problem is the active power filter (APF) comes in to the picture, which gives promising solution to compensate for the above adverse effects of harmonics and reactive power simultaneously by using suitable control algorithms.

This report contains issues related with electrical system about power quality and available solutions to mitigate those issues.

1.1 Power Quality Issue

The PQ issue is defined as "any occurrence manifested in voltage, current, or frequency deviations that results in damage, upset, failure, or misprision of end-use equipment. Almost all PQ issues are closely related with PE in almost every aspect of commercial, domestic, and industrial application. Equipment using power electronic devise are residential appliances like TVs, PCs etc. business and office equipment like copiers, printers etc. industrial equipment like programmable logic controllers (PLCs), adjustable speed drives (ASDs), rectifiers, inverters, CNC tools and so on [5]. The Power Quality (PQ) problem can be detected from one of the following several symptoms depending on the type of issue involved.

- Lamp flicker
- Frequent blackouts
- Sensitive-equipment frequent dropouts
- Voltage to ground in unexpected
- Communications interference
- Overheated elements and equipment

1.2 Solution of Power Quality Problem

There are two approaches to the mitigation of power quality problems. The first approach is called load conditioning, which ensures that the equipment is made less sensitive to power disturbances, allowing the operation even under significant voltage distortion. The other solution is to install line-conditioning systems that suppress or counteract the power system disturbances. Passive filters have been most commonly used to limit the flow of harmonic currents in distribution systems. They are usually custom designed for the application. However, their performance is limited to a few harmonics, and they can introduce resonance in the power system. Among the different new technical options available to

improve power quality, active power filters have proved to be an important and flexible alternative to compensate for current and voltage disturbances in power distribution systems. The idea of active filters is relatively old, but their practical development was made possible with the new improvements in power electronics and microcomputer control strategies as well as with cost reduction in electronic components. Active power filters are becoming a viable alternative to passive filters and are gaining market share speedily as their cost becomes competitive with the passive variety. Through power electronics, the active filter introduces current or voltage components, which cancel the harmonic components of the nonlinear loads or supply lines, respectively. Different active power filters topologies have been introduced and many of them are already available in the market.

2. PI CONTROL SCHEME

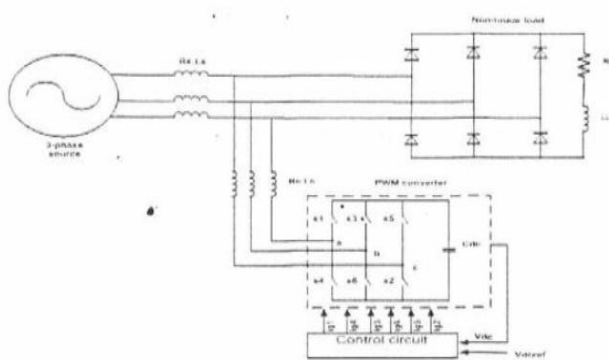


Fig-1. Schematic diagram of shunt active filter.

Table -1: Sample Table format

System Parameters	Values
Source voltage (V_s)	415 (peak)
System frequency (f)	50 Hz
Source impedance (L_s)	0.15 mH
Filter impedance (R_c, L_c)	0.4Ω, 3mH
Load impedance (R_l, L_l)	6.7Ω, 20mH
DC link capacitance	2000μF
Reference DC link voltage (V_{dref})	600V

2.1. Fuzzy Control Scheme

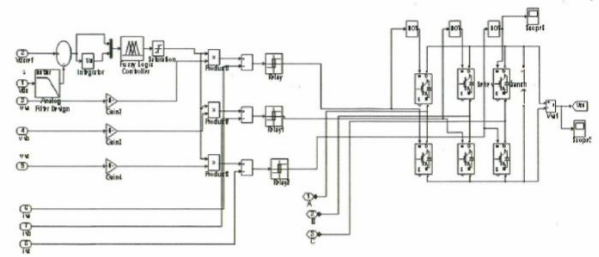


Fig- 2. Control Block of SAPF Using FUZZY Controller

2.2. Comparisons Between Pi and Fuzzy Controller

Table 2 Simulation Parameter

	% THD
Without SAPF	26.92
With PI controller SAPF	2.39
With Fuzzy Logic controller SAPF	1.85

3. CONCLUSIONS

This paper has presented a simulation study of PI and FUZZY logic-based hysteresis current controlled active shunt power filter for harmonic compensation of the non-linear load. Using PI controller, the source current THD is reduce 26.92% 2.39%. Using FUZZY logic controller, the current source THD is reduce 26.92% to 1.89%. It is found from simulation results that shunt active power filter improves power quality of the power system by eliminating harmonics of the source current, which makes the source current sinusoidal and in phase with the source voltage.

ACKNOWLEDGEMENT

I am glad to offer my sincerest gratitude and respect to my supervisor, Prof. Harsh sharma, for his guidance from the foundation stage of this research to the entire dissertation work. I truly appreciate his esteemed guidance and encouragement throughout the work. I consider myself extremely fortunate to have had the opportunity of associating myself with him.

REFERENCES

- [1] D. F. Z. Peng, H. Akagi, and A. Nabae. "Study of active power filters using quad series voltage source PWM converters for harmonic compensation," IEEE - Transactions on Power Electronics, vol. 5, no. 1, Jan. 1990. pp. 9-15.
- [2] W. M. Grady, M. J. Samotyj, and A. H. Noyola, "Survey of active power line conditioning methodologies," IEEE Transactions on Power Delivery, vol. 5, no. 3. Jul. 1990, pp. 1536-1542.
- [3] S. K. Jain, P. Agrawal, and H. O. Gupta, "Fuzzy logic-controlled shunt active power filter for power quality improvement," Proceedings of Institute of Electrical Engineers, Electrical Power Applications, vol. 149, no. 5.
- [4] J. W. Dixon, J.J. Garcia & L. Morgan. "Control system for three phase active power filter which simultaneously compensates power factor and unbalanced loads," IEEE Transactions on Industrial Electronics, vol.42, no.6, 1995, pp636-641.