

Mitigation of Harmonics by Non-linear Load Using Shunt Active Filter

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Abstract—Most of the pollution issues created in power systems are due to the non-linear characteristics and fast switching of power electronic equipment. Power quality issues are becoming stronger because sensitive equipment will be more sensitive for market competition reasons, equipment will continue polluting the system more and more due to cost increase caused by the built-in compensation and sometimes for the lack of enforced regulations. Efficiency and cost are considered today almost at the same level. Active power filters have been developed over the years to solve these problems to improve power quality. In This Paper It has been designed a hysteresis band PWM (HBPWM) current controller for a three level voltage source inverter (VSI). The HBPWM approach has been selected for the research, since it has the potential to provide an improved method of deriving non-linear models which is complementary to conventional techniques. The simulation model of HBPWM current controller is developed in SIMULINK/MATLAB environment.

Keywords— Current Harmonics, Power quality, 3-phase supply, 1-phase supply, hysteresis current controller.

I. INTRODUCTION

In electric network there is many types of distortion will created so that distortion like a harmonic, unregulated dc voltage due to a non-linear load so that distortion we will try to remove using shunt active filter. The non-linear load which is coupled to the power system network by there is current harmonics, so there active power filter is connect parallel to the supply and maintain a current sinusoidal. Using active power filter used for minimization for harmonics minimization and reactive power compensation required by a variable non-linear load.[1]

In the system problem related with harmonic so using different control strategy we can use such as fuzzy logic control, p-q theory. FLC is used to implement the control algorithm of a shunt active filter. it can compensate for harmonic currents, power factor and load unbalance regulated dc voltage. Improve a system that is active power filter through improve a response of system and mitigation of harmonics. Classically, many types of filter are available in power system such as a series and shunt active filters, LC filters passive filters are used to improve a power quality We not used Passive filters because there is some limitation such as a operation cannot be limited to a certain load; resonances can occur with unpredictable results. So that problem over come used shunt active filter (SAF). The controller is the most important part of the active power filter and currently lot of research is being conducted in this area. Conventional PI controllers have been used to control the harmonic current and dc capacitor voltage of the shunt APF.

However, the conventional PI controller requires precise linear mathematical model of the system, which is difficult to obtain under parameter variations, nonlinearity, and load disturbances. Another drawback of the system is that the proportional and integral gains are chosen heuristically.[1,2,3]

Fuzzy logic control schemes that are suitable for harmonic current mitigation and inverter dc voltage control to improve the performances of the shunt APF. The performance of fuzzy controller is evaluated through computer simulations under steady state and transient conditions.[2]

II. SHUNT ACTIVE FILTER

It means the power line conditioners which are able to compensate voltage and current harmonics , reactive power regulated terminal voltage ,supply flicker and improve voltage balance 3 phase system is called as an APF (active power filter).

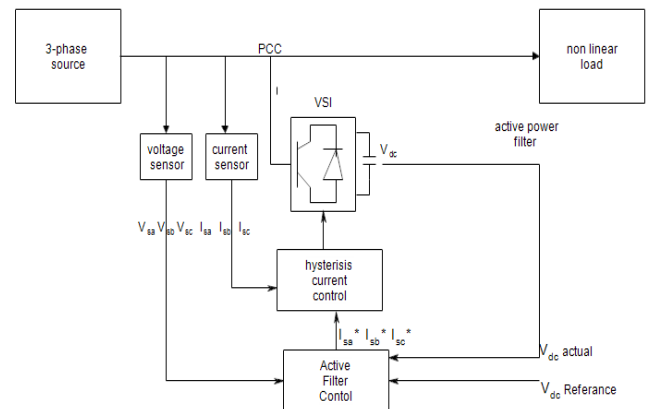


Fig 1. Shunt Active Filter

An power electronic equipment providing the dynamic and adjustable solution to power quality problem and adjustable solution to power quality problems to decreases the severalty of harmonic pollution in the network is called active power filter or power line conditioners. Active power filter for power conditioner are quiet different circuit and principal from the active filter for analog signal processing. The power line conditioners are able to compensate voltage and current harmonics, reactive power regulate voltage and current harmonics, reactive power regulate terminal voltage, suppress flickers and improve voltage balance in 3 phase system.[5,6,7]

A. Linear Load

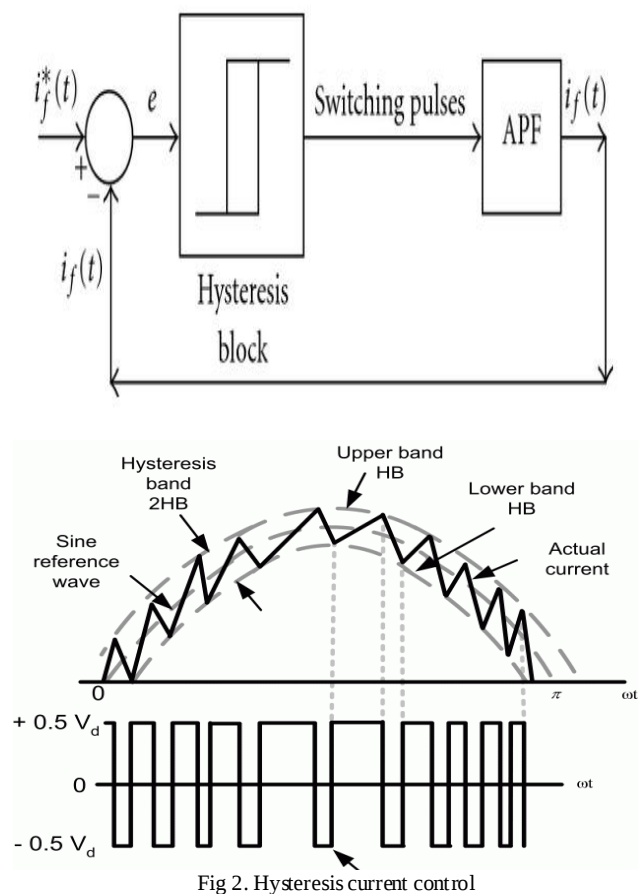
Linear load is load in which the signal of voltage and current are same means in input of signal is a sine wave so in output also sinusoidal waves are generated. In the linear load current is in relation of proposal to voltage waveform .its obeys the ohm's law it means relation between the voltage source and resistance there is no showing a harmonics[1,2]

B. Non-Linear Load

Non-linear load in which the current waveform does not resemble the applied voltage waveform due to a number of reason power Are loads in which the current waveform does not resemble the applied voltage waveform there is some reasons, for example. Therefore nonlinear loads as those in which Ohm's law does not follow V and I relationship.[1]

In power converters, power sources, uninterruptible power supply (UPS) units, and arc devices like electric furnaces and fluorescent lamps. nonlinear loads cause a number of disturbances like voltage waveform distortion, overheating in transformers and other power devices, over current on equipment neutral connection leads, telephone interference, and microprocessor control problems due to a non-linear load The presence of harmonics in power lines there is power losses in the distribution system, interference problems in communication systems and, in operation failures of electronic equipment, which are more and more sensitive since they include microelectronic control systems, which work with very low energy levels.[11]

III. HYSTERESIS CURRENT CONTROLLER



Reference current is induced in the hysteresis block and this hysteresis block work as a switching device and it will be generate the switching pulse and these switching pulses induced in active power filter (APF). And will generate actual current now this actual current and reference current is compared and will generate error. The limit point of the error is given by negative and positive form. In their limit is taken 2 to -2 than the switch will off, similarly if it exceeds 2 than again the switch will off.[8,9,10]

IV. SIMULATION AND ITS RESULTS

A. Single phase controlled rectifier

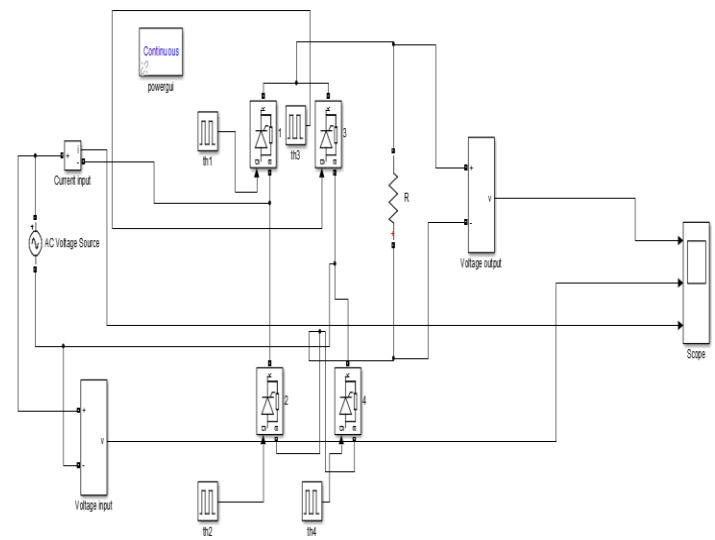


Fig 3 waveform of single phase controlled rectifier

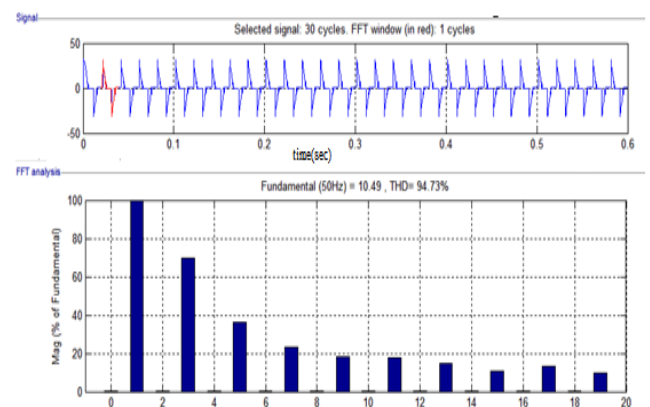


Fig 4 hamonic profile of single phase controlled rectifier

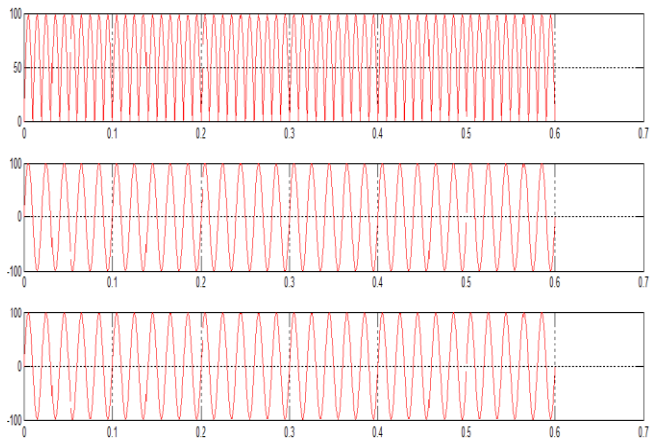


Fig 5 waveform of single phase controlled rectifier
B. Single phase uncontrolled rectifier

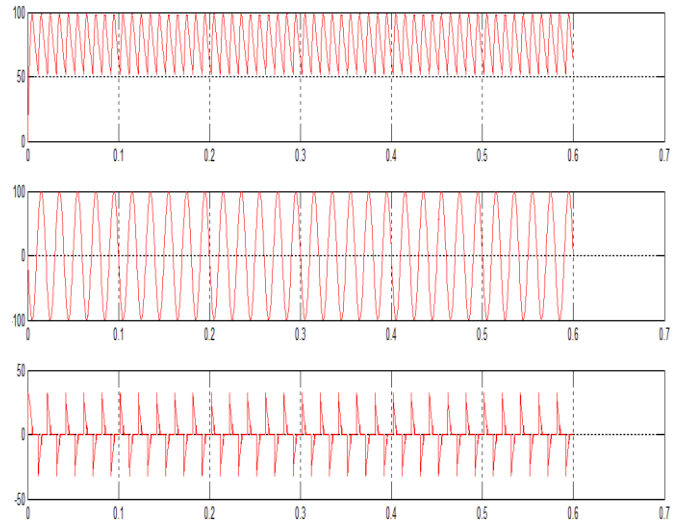


Fig 8 Waveform of uncontrolled rectifier

C. Three phase controlled rectifier

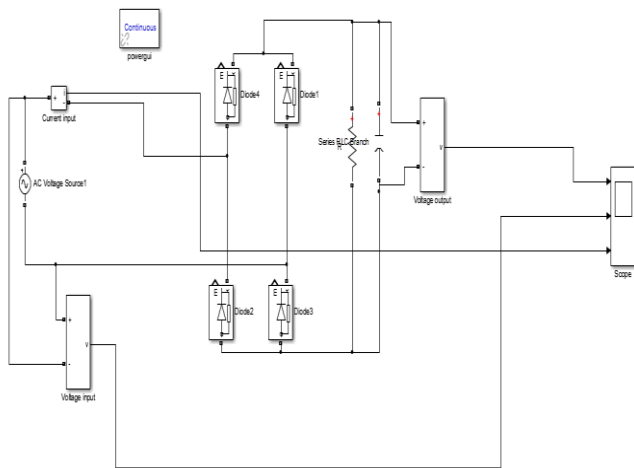


Fig 6 single phase uncontrolled rectifier

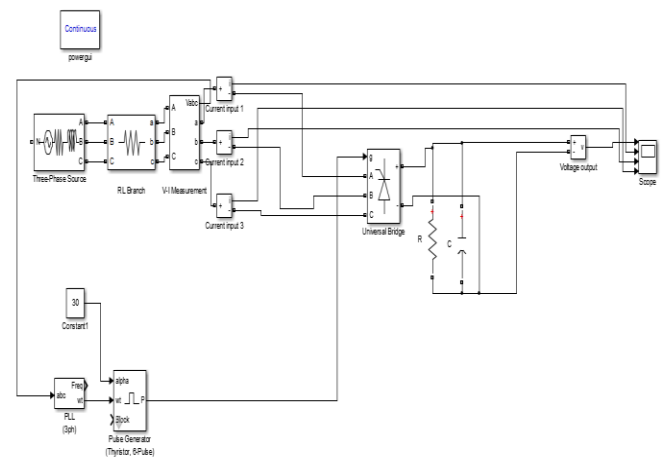


Fig 9 Three phase controlled rectifier

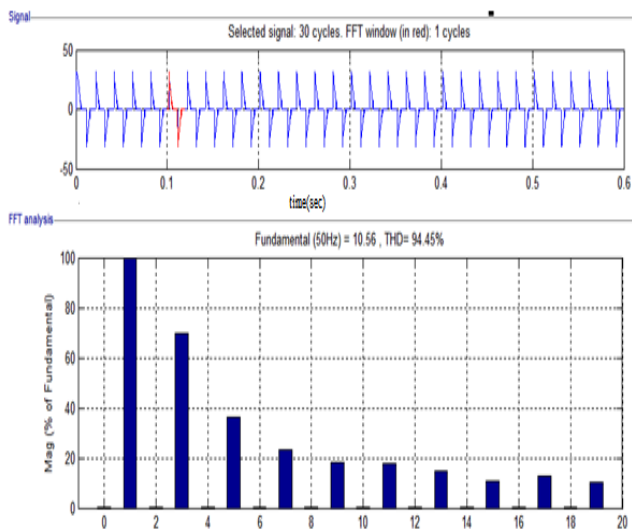


Fig 7 Harmonic profile of single phase controlled rectifier

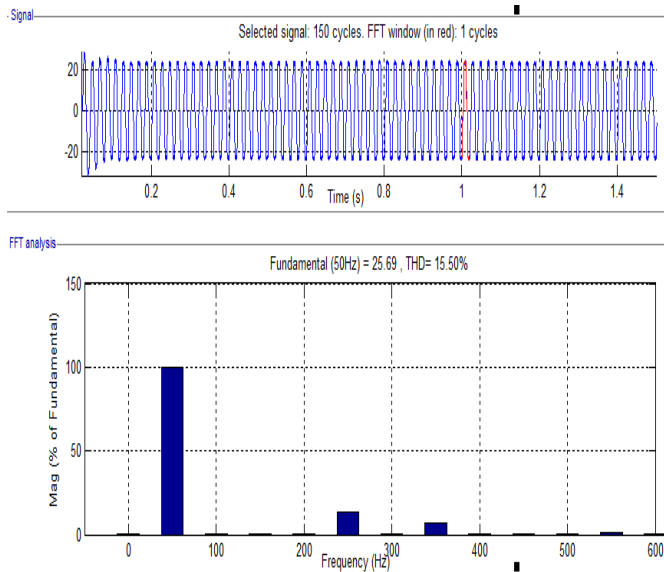


Fig 10 Harmonic profile of Three phase controlled rectifier

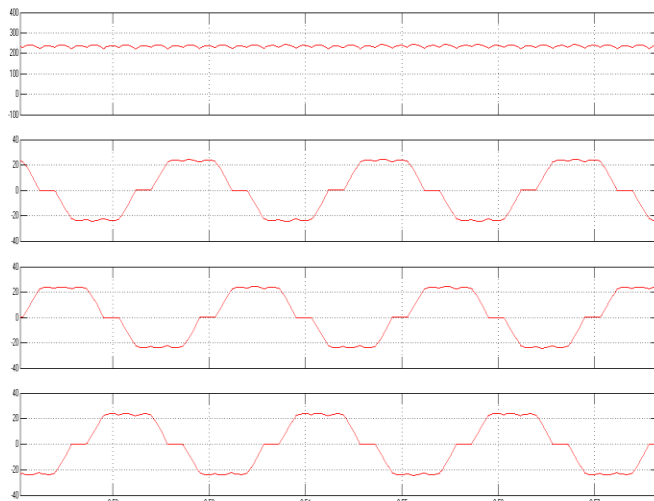


Fig 11 Waveform of Three phase controlled rectifier

D. Three phase uncontrolled

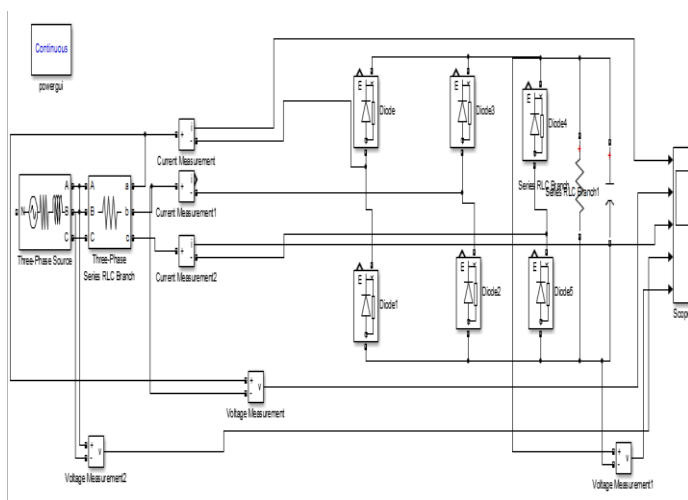


Fig.12 Three phase uncontrolled rectifier

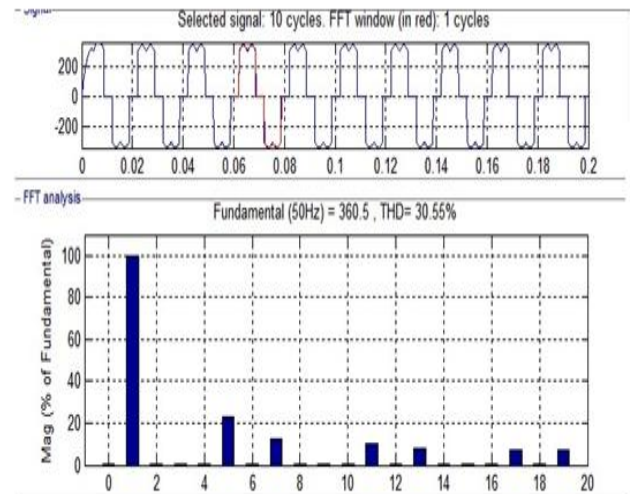


Fig 13 Hamonic profile of three phase uncontrolled rectifier

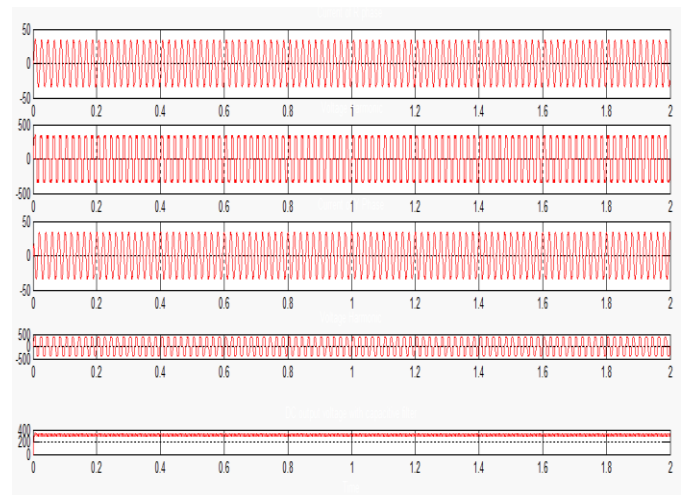


Fig.14 Waveform of three phase uncontrolled rectifier

E. Hysteresis current control

Sr No.	1phase Con Rect.	1phase Un Rect.	3phase Con Rect.	3phase un Rect.
THD (Total Harmonic Dist.)	94.73%	94.45%	30.55%	15.50%
Output Voltage Harmonic s	10.49	10.56	360.5	25.69

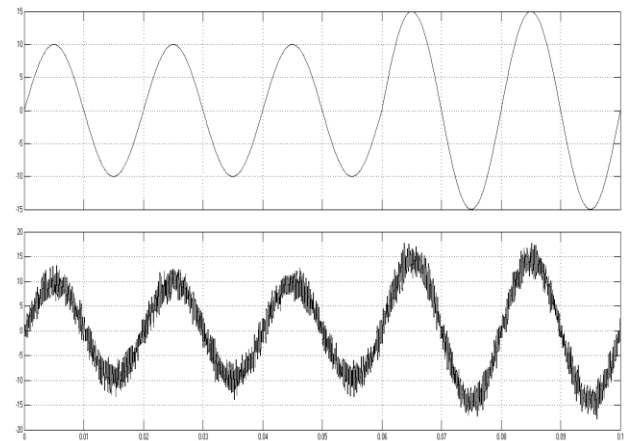
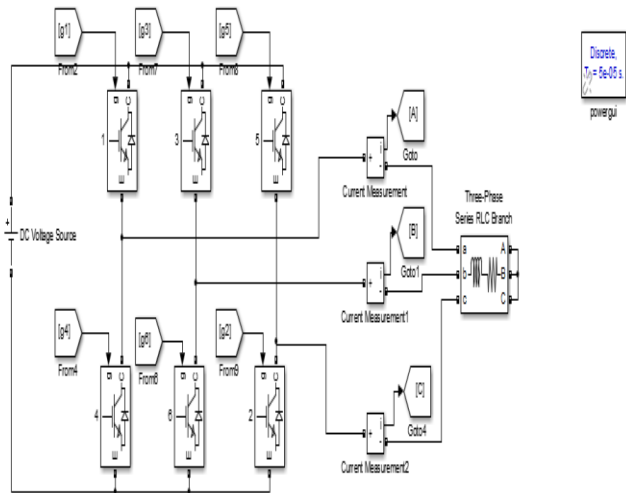


Fig 16 Waveform of three phase uncontrolled rectifier

Table 1 simulation results

V. CONCLUSION

In this paper a new reference current generation technique is proposed, aiming at improving the performance of the SAPF when the mains voltages are non ideal. And also i had seen %THD of various type of rectifier load. And also introduce new novel current control technique whose name is Hysteresis current control and come to know that this technique has Excellent dynamic response. Low cost and easy implementation. In this Paper the working principle of HBPWM current controller and its modeling in SIMULINK for an inverter control is discussed.

REFERENCES:

- [1] Francisco C. De La Rosa "Harmonics and power system" Distribution Control Systems, Inc. Hazelwood, Missouri, U.S.A. in 2006.
- [2] Akagi, "Instantaneous Power Theory & Applications to Power Conditioning", John Wiley & Sons Publication.
- [3] Karuppanan P and KamalaKanta Mahapatra "PLL with PID and fuzzy logic controllers based shunt active power line conditioner" IEEE PEDES- International Conference on Power Electronics, Drives and Energy Systems-Dec 21, 2010 at IIT-Delhi.
- [4] Karuppanan P and KamalaKanta Mahapatra "Fuzzy Logic Controlled Active Power Line Conditioners for Power quality Improvements" 177 International Conference on Advances in Energy Conversion Technologies (ICAECT 2010), Jan07 -10, 2010.
- [5] Chennai Salim, Benchouia M-T and Golea A "Harmonic Current Compensation based on Three-phase Three-level Shunt Active Filter using Fuzzy Logic Current Controller" Journal of Electrical Engineering & Technology Vol.6, 2011.
- [6] Chennai Salim, Benchouia M-T and Golea A "Harmonic Current Compensation based on Three-phase Three-level Shunt Active Filter using Fuzzy Logic Current Controller" Journal of Electrical Engineering & Technology Vol.6, No.5, 2011.
- [7] Saheb Hussain, K.Satyanarayana "Power quality improvement by active power filter" International Journal Of Engineering Science & Advanced Technology Volume .1
- [8] Brahim. Berbaoui, Chellali. Benachaiba, Rachid. Dehini, Brahim. Ferdi "Optimization Of Shunt Active Power Filter

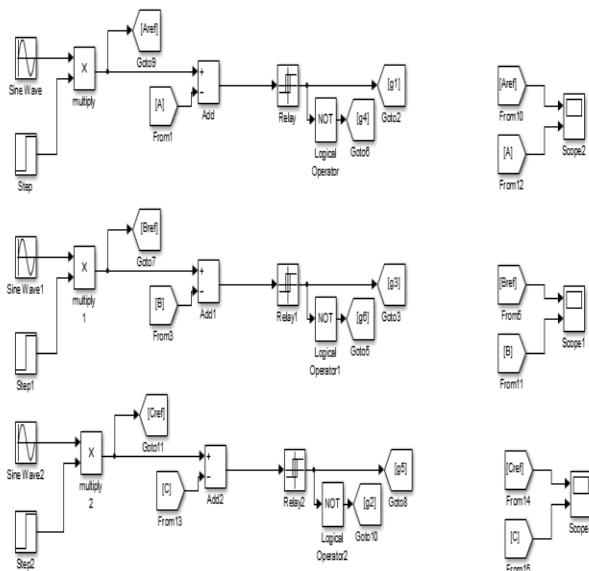


Fig.15 Simulation of Hysteresis current control

System Fuzzy Logic Controller (Flc) Based On Ant Colon Algorithm” 2005 - 2010 Jatit.

- [9] P. Salmerón and S. P. Litran “Improvement of electric power quality using series active & shunt passive filter” IEEE, April 2010.
- [10] Joao L. Afonso, H. J. Ribeiro da Silva and Júlio. S. Martins “Active Filters for Power Quality Improvement ” 2001 IEEE Power Tech.
- [11] Saheb Hussain K.Satyanarayana, B.K.V.Prasad “ Power Quality Improvement By Using Active Power Filters ” [IJESAT] International Journal of Engineering Science & Advanced Technology Volume – 1.