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Improvement of Power Quality using Fuzzy based Dual UPQC

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ABSTRACT: In the distribution system grid, the operation of power quality conditioner has increased during the past few years due to the constant increase of nonlinear loads linked to the electrical network. It is feasible to ensure a modulated voltage for the loads, balanced and with low harmonic distortion and at the same time leaving undistorted current from the utility grid by employing a Dual topology of unified power quality conditioner. The Dual UPQC incorporates of two active filters the shunt active filter and the series active filter. The Dual UPQC(iUPQC) is combination of two active filters, a series active filter and a shunt active filter (parallel active filter), used to terminate harmonics and unbalances. Divergent from a conventional UPQC, the iUPQC has the series filter managed as a sinusoidal current source and the shunt filter constrained as a sinusoidal voltage source. Thus, the pulse width modulation controls of the iUPQC deal with a well-known frequency spectrum, since it is supervised employing voltage and current sinusoidal references, divergent from the conventional UPQC that is Controlled employing non sinusoidal references.This paper presents a Fuzzy based controller for dual topology of the Interline Unified Power Quality Conditioner (iUPQC) for power quality improvement by considering sudden load changes.

KEYWORDS: Active power filters (APF), Interline Unified power quality conditioner (iUPQC), Power quality, unified power quality conditioner (UPQC), Fuzzy logic controller

I.INTRODUCTION

Due to use of nonlinear power electronics loads, like static rectifiers, variable speed drives, dc/ac converter, has produce many electric power quality problems such as high current harmonics, poor power factor and more neutral current, etc. "Power Quality is a set of limits of electrical properties that permits Electrical system to function in their intended manner without loss of performance or life". Trouble caused by power quality can have an adverse economic impact on utilities.

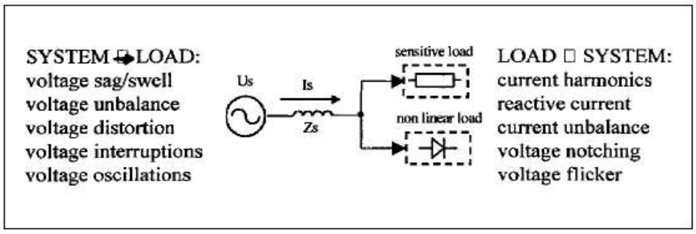

Fig.1 Power quality difficulty in a typical industrial installation

Power flow is controlled by the control actions employing FACTS devices, which incorporate (i) Static VAR Compensators, (ii) Thyristor Controlled Series Capacitors, (iii) Static Series Synchronous Compensators, (iv) Static Compensators, (v) Unified Power Flow controllers (vi) Unified Power Quality Conditioner, etc. out of these facts controller here for power quality enhancement we examine Dual topology of Unified Power Quality Conditioner.

By the use of Dual topology of unified power quality conditioners, these power quality problems can be resolved. The Dual unified power quality conditioner, which is fusion of the shunt and series active filters used to remove harmonics and unbalances.

II. DUAL UPQC

Classical UPQC arrangement is collected of a SAF and a PAF, as shown in Fig.2. In this topology, the SAF works as voltage source in way to compensate the grid distortion, unbalances, and disturbances like sags, swells, and flicker. Consequently, the voltage compensated by the Series active filter is composed of a major content and the harmonics. The PAF acts as a current source and it is responsible for reimbursing the displacement, unbalances ,and harmonics of the load current, make sure a sinusoidal grid current.

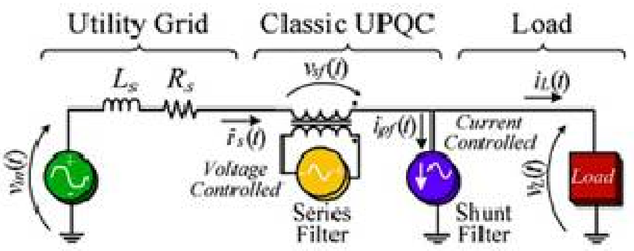

Fig 2. Conventional UPQC

The series filter construction to the utility grid is prepared through a transformer; however the shunt filter is ordinarily connected straight to the load, generally in low-voltage grid applications. The classical UPQC has the resulting drawbacks: complex harmonic abstraction of the grid voltage and the load including composite calculations, current voltage and references with harmonic contents demanding a high bandwidth control, and the leakage inductance of the series connection transformer disturbing the voltage compensation generated by the series filter.
In order to reduce these drawbacks, the iUPQC is discovered in this project, and its structure is shown in Fig. 3

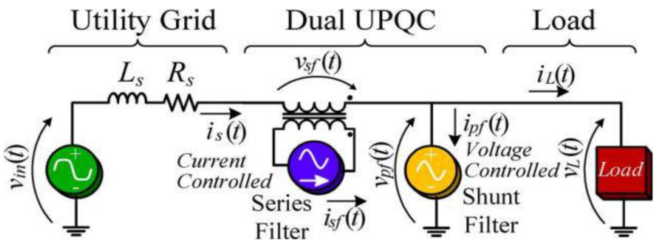

Fig.3 Dual UPQC

The scheme of the iUPQC is much related to the conventional UPQC, using an association of the PAF and SAF, differing only from the way the shunt and series filters are controlled. In the iUPQC, the SAF works as a current source, which inflicts a sinusoidal input current synchronized with the grid voltage. In iUPQC, the SAF act as a current source, which deliver to a sinusoidal input current synchronized with the network voltage. The PAF works such as voltage source dignifying sinusoidal load voltage synchronized with the network voltage. Therefore, the pulse width modulation (PWM) controls of the iUPQC deal with a well-known frequency spectrum, since it is controlled by using voltage and current sinusoidal references for both active filters.The SAF acts as high impedance for the current harmonics and indirectly compensates the harmonics, Unbalances, and interference of the network voltage since the connection transformer voltages is equal to the distinction between the grid voltage and the load voltage. Similarly, the PAF indirectly compensate the unbalances, displacement, and harmonics of the network current, provision of a low-impedance path for the harmonic load current. By employing Dual UPQC we can separate the complex harmonic extraction of the grid voltage

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The main purpose of the Dual UPQC is
1) Source current linear concerning with nonlinear load
2) Constant load voltage
3) Eliminates harmonic load voltage

III. CONTROL SCHEMES

In the present control scheme, the power computation and harmonic extraction are not needed since the harmonics, unbalances, disturbances, displacement should be recompensed. The SAF has a current loop in order to certify a sinusoidal grid current synchronized with the network voltage. The PAF has a voltage loop in order to verify a balanced modulated load voltage with low harmonic deformation. These control loops are self-determining from each other since they act independently in each active filter.

A**.SAF Control:** The SAF control strategy contains of three identical grid current loops and two voltage loops. The current loops are liable for tracking the reference to each grid input phase in order to control the grid currents. One voltage loop is responsible for regulating the total dc link voltage, and the other is liable for avoiding the unbalances between the dc link

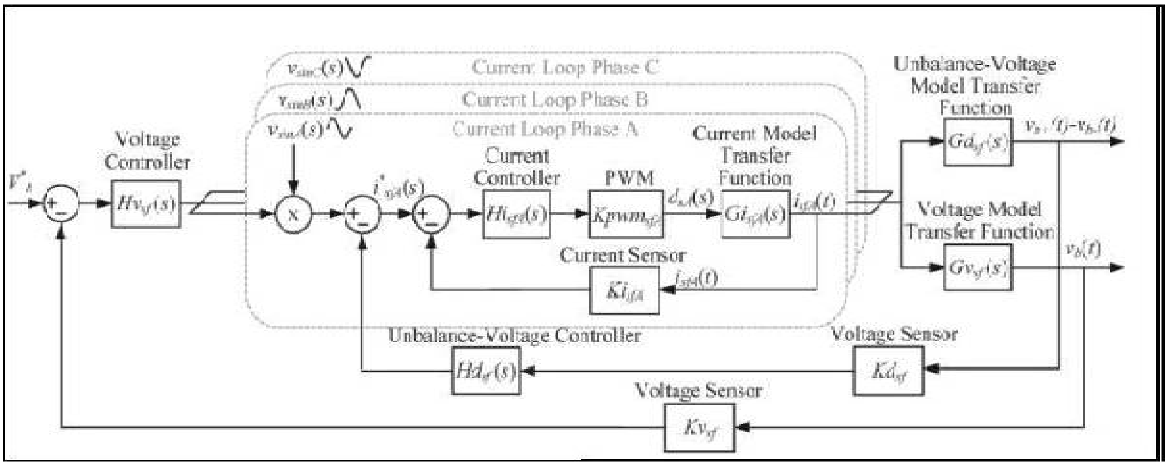

Fig.4. control of SAF controller

When the load increases, overcoming the input grid current, the dc link provides momentarily the active power utilization, resulting in diminish of its voltage. This voltage controller proceed to raise the grid current reference, when the load diminish, the voltage controller reduces the grid current reference to modulate the dc link voltage

. *B.* **PAF Control**: Figure 5 shows the control block diagram of the shunt active filter controller. The PAF control scheme is form by three identical load voltage feedback loops; the voltage loops are liable for tracking the instantaneous voltage reference for each load output phase in order to control the load voltages separately. The dynamic model is achieved by the circuit analysis using average values related to the switching period. Through small signal scrutiny and by employing Laplace.

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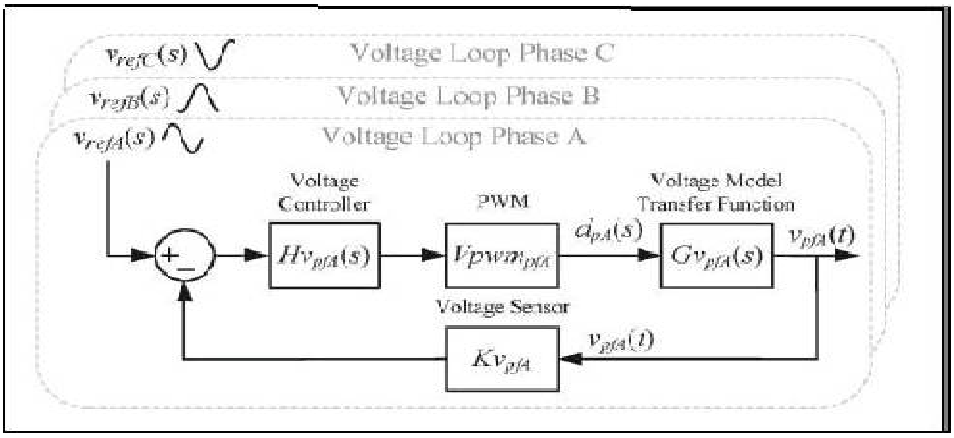
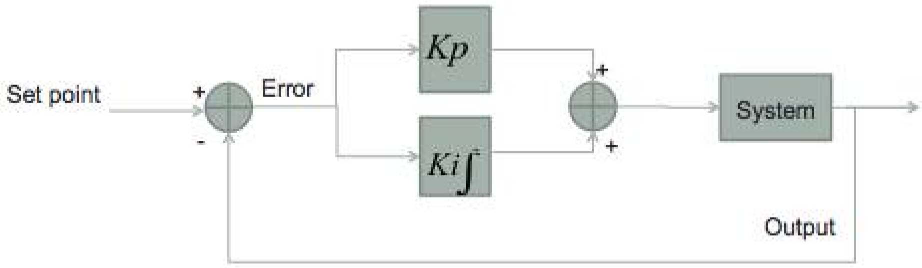


Fig.5 control block diagram of PAF voltage loop

To generate pulses in the series active filter we are using PI CONTROLLER and as well as fuzzy logic controller

IV. EXISTING SYSTEM [WITH PI CONTROLLER]



A P.I Controller is a feedback control loop that calculates an error signal by taking the difference between the output of a system, which in this case is the power being drawn from the battery, and the set point. The set point is the level at which we'd like to have our system running, ideally we'd like our system to be running near max power (990W) without causing the limiter to engage.It is important to point out that due the the complexity of the electronic components within the circuit path(i.e ESC, power limiter, and motor) I was not able to accurately create model (transfer function) for the system. Having a transfer function would have allowed me to simulate the system in a software package such as MATLAB/Simulink and assist me in finding the right proportional and integral constant parameters for the controller. Unfortunately, due to the lack of a model, the parameters were obtained via a trial and error format.

.V. PROPOSED SYSTEM [WITH FUZZY LOGIC CONTROLLER]

A. Fuzzification The first step in the design of a fuzzy logic controller is to define membership functions for the inputs as shown in Fig.6. Seven fuzzy levels or sets are chosen and defined by the following library of fuzzy-set values for the error e and change in error. They are as follows

- NB negative big
- NM negative medium
- NS negative small
- ZE zero equal

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- PS positive small
- PM positive medium
- PB positive big
- The number of fuzzy levels is not fixed and depends on the input resolution needed in an application.
- The larger the number of fuzzy levels, the higher is the input resolution.
- The fuzzy controller utilizes triangular membership functions on the controller input. The triangular membership function is chosen due to its simplicity. For a given crisp input, fuzzifier finds the degree of membership in every linguistic variable.
- Since there are only two overlapping memberships in this specific case, all linguistic variables except two will have zero membership.

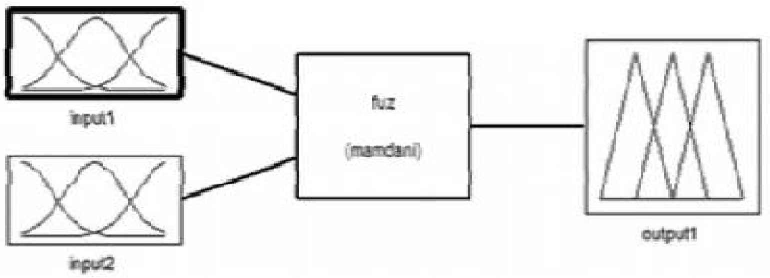

Fig.6.Block diagram of the Fuzzy Logic Controller (FLC) for proposed converter.

Rule Base: The elements of this rule base table are determined based on the theory that in the transient state, large errors need coarse control, which requires coarse in-put/output variables; in the steady state, small errors need fine control, which requires fine input/output variables as shown in Fig.7. Based on this the elements of the rule table are obtained as shown in Table 1, with _V_{dc}‘ and _V_{dc-ref}‘ as inputs.

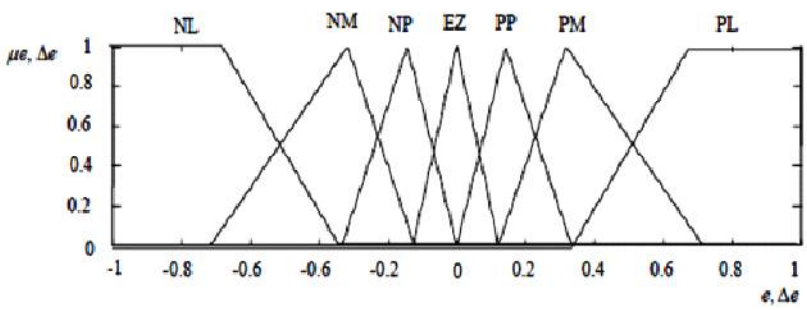

Fig.7. Membership functions for Input, Change in input, Output.

- When the output of the converter is far from the set point, the change of duty cycle must be large so as to bring the output to the set point quickly.
- When the output of the converter is approaching the set point, a small change of duty cycle is necessary.
- When the output of the converter is near the set point and is approaching it rapidly, the duty cycle must be kept constant so as to prevent overshoot.
- When the set point is reached and the output is still changing, the duty cycle must be changed a little bit to prevent the output from moving away.
- When the set point is reached and the output is steady, the duty cycle remains unchanged. When the output is above the set point, the sign of the change of duty cycle must be negative, and vice versa.

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Δe \ e	NL	NM	NS	EZ	PS	PM	PL
NL	NL	NL	NL	NL	NM	NS	EZ
NM	NL	NL	NL	NM	NS	EZ	PS
NS	NL	NL	NM	NS	EZ	PS	PM
EZ	NL	NM	NS	EZ	PS	PM	PL
PS	NM	NS	EZ	PS	PM	PL	PL
PM	NS	EZ	PS	PM	PL	PL	PL
PL	NL	NM	NS	EZ	PS	PM	PL

Table 1 . Rule base

VI. SIMULATION RESULTS

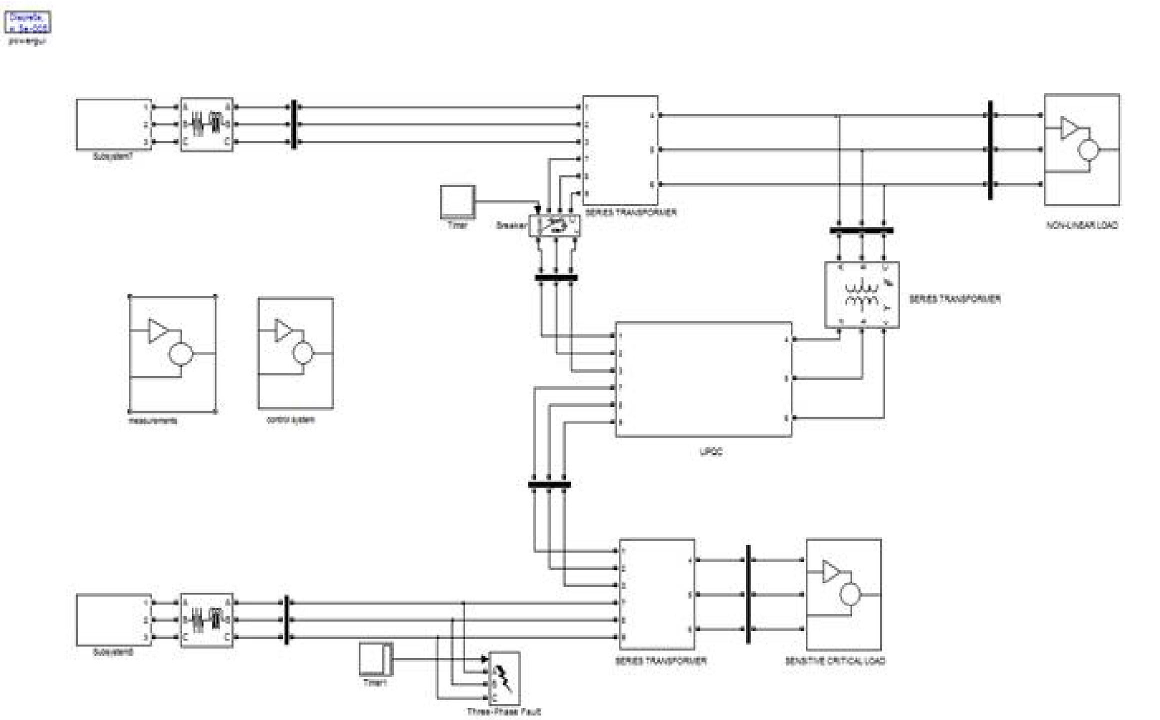

Fig.8 shows the Matlab/Simulink model of existing UPQC model with Control scheme using Matlab/Simulink platform.

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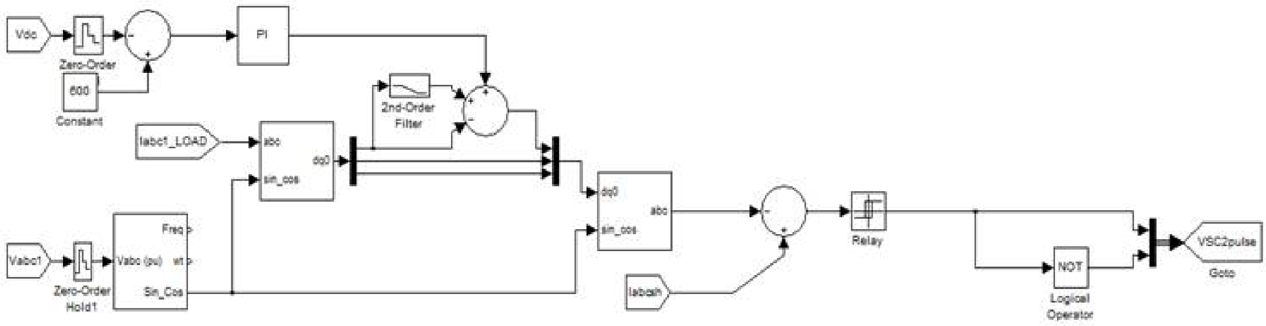

Fig 9 shows control strategy for generation of pulses using PI controller

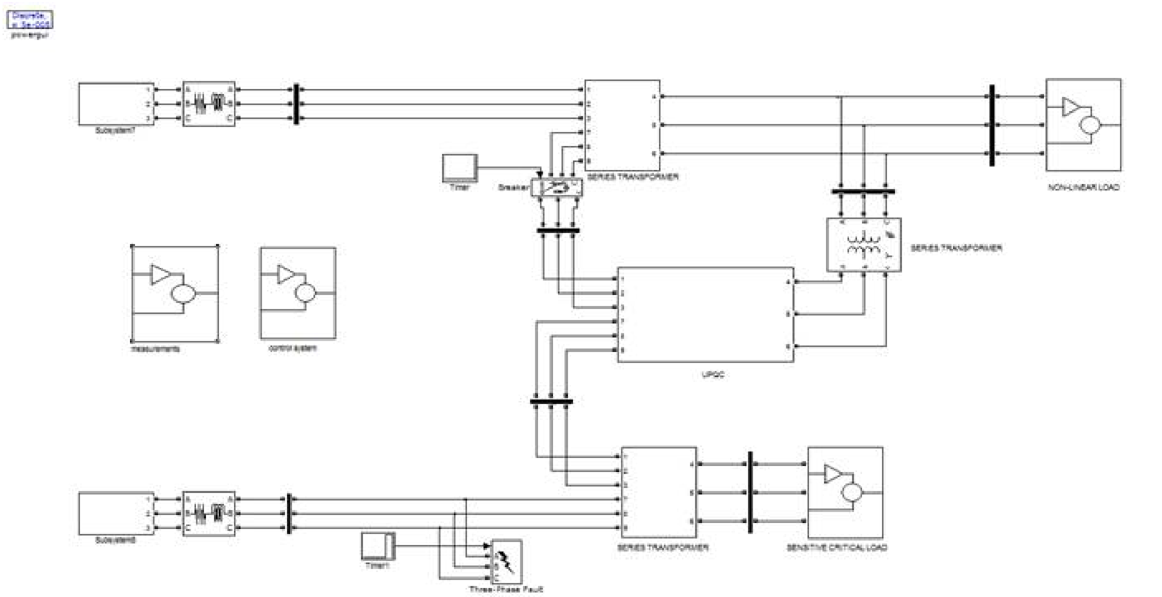

Fig.10 shows the Matlab/Simulink model of proposed UPQC model with simplified Control scheme using Matlab/Simulink platform.

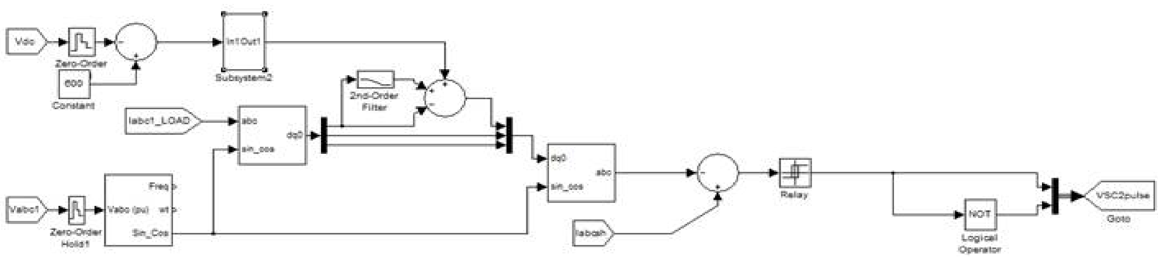

Fig 11 shows control strategy for generation of pulses using FLC

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The results are taken out by considering sudden changes in load conditions. Such as low voltage, rapid load step.

A. Consider a three phase source current. Out of those three phases, phase A has dip after two cycles. But by Dual UPQC compensation modulated load voltage is taken out. Figure 12 shows the load voltage and source current by considering dip in source current and modulated load voltage

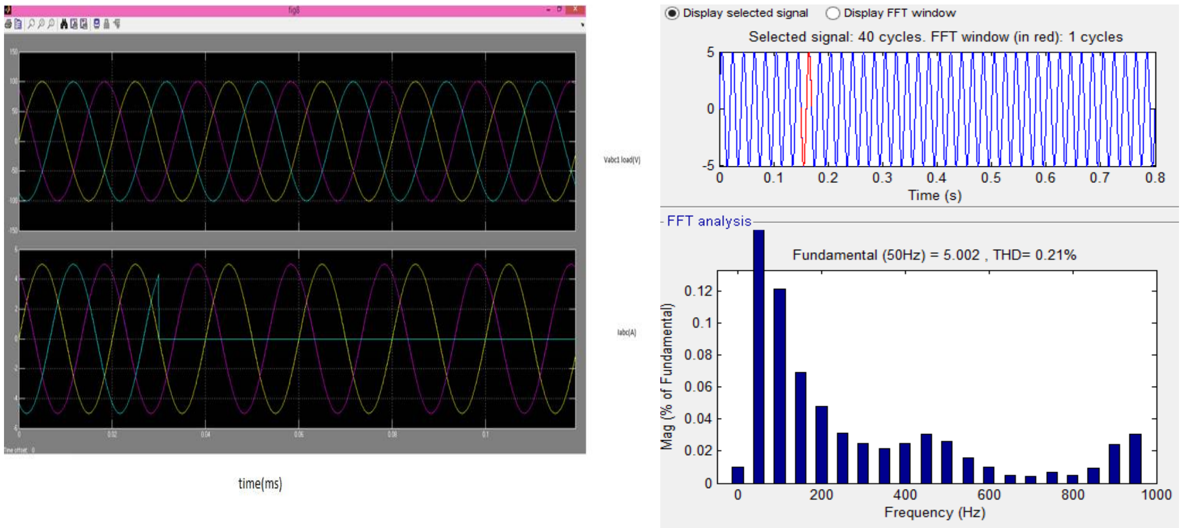

Fig 12. source voltage and load voltage during voltage dip in phase A and THD ANALYSIS

B.. Consider a three phase load current. There is immediate increase in a magnitude of current. But by Dual UPQC compensation modulated load voltage without change in magnitude is taken out. Figure13 shows the load voltage and load current by considering load current step from 50% to 100%

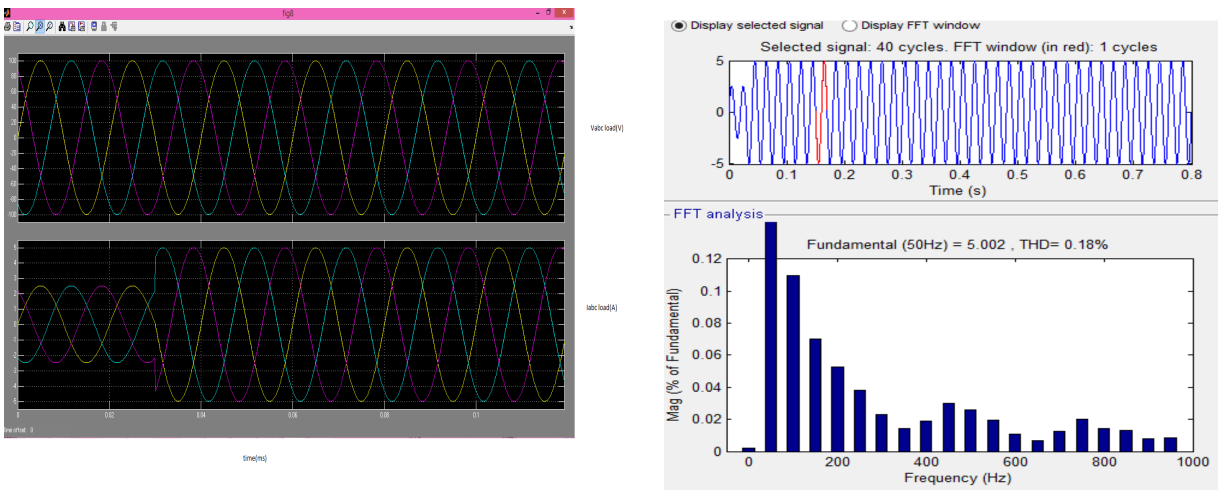

Fig 13. Load voltage and load current step and THD ANALYSIS

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C. Consider a three load current. There is a rapid decrease in magnitude of current. But by Dual UPQC compensation modulated load voltage without change in magnitude is separated. Figure 14 shows the load voltage and load current by considering load current steps from 100% to 50%

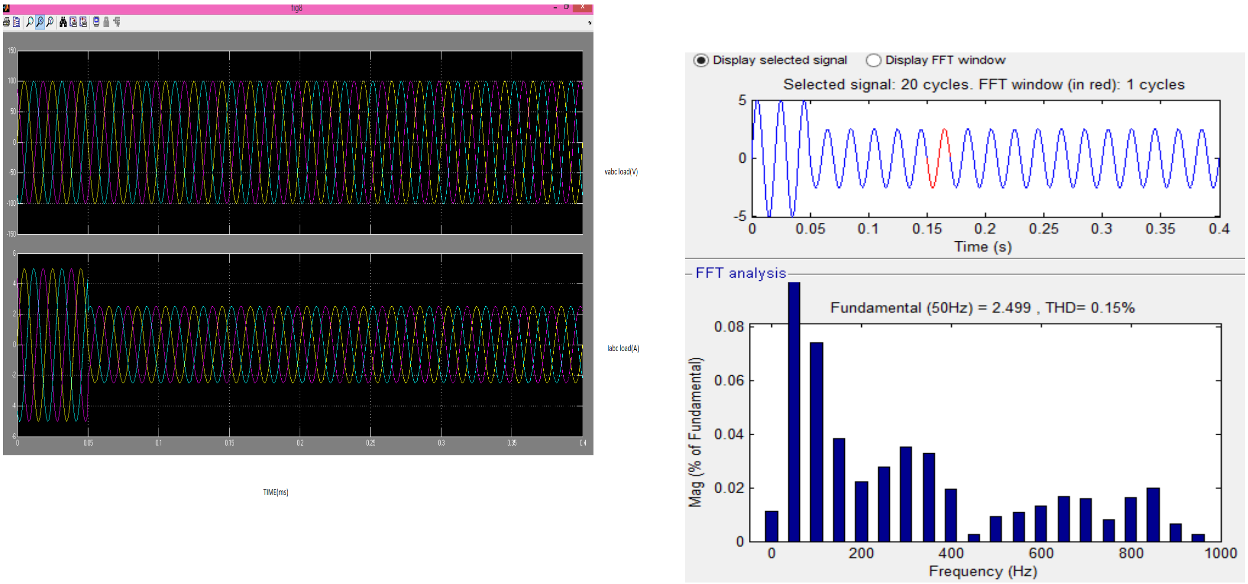

Fig 14. Load voltage and load current step and THD ANALYSIS

Comparision of THD

Cases	With PI controller	With fuzzy logic controller
A	1.31	0.21
B	1.31	0.18
C	2.61	0.15

VII. CONCLUSION

The results obtained with the iUPQC able to compensate the nonlinear load currents and also certain the sinusoidal voltage for the load in all three phases. The control also had a great operation during the load steps and voltage disturbances at the source. The main advantages of this initiate control in relation to the other proposed schemes were the utilization of sinusoidal references for both series and shunt active filter controls without the requirement of complicated calculations or coordinate transformations. By the use of Dual UPQC, it can confirm that current source linear with respect to nonlinear load, Constant load voltage; this model Eliminates harmonic load voltage. By using fuzzy logic controller instead of PI controller in the control scheme , we can see the improvement in total harmonic distortion.

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REFERENCES

[1] Vinod Khadkikar, "A New Control Philosophy for a UPQC to Co-ordinate Load-Reactive Power Demand between Shunt & Series Inverter" IEEE Transaction on Power Delivery, Vol.23, No.4, October2008.
[2] Mr. Suhas M Shembekar, "A Comparative Analysis of UPQC for Power Quality Improvement" IJIRAE ISSN: 2349-2163, Issue 4, Vol 2, April 2015.
[3] AhmetTeke, "A Novel Reference Signal Generation Method for Power Quality Improvement of UPQC"IEEE Transaction ONPower delivery, Vol.26, No.2, April 2010.
[4] Santhanayaki.T "Identification of Sags and Swells using PIC Microcontroller" IJSRET, vol.1 Issue12, pp. 011-016 March 2013.
[5] Sung-Hunko, "Application of Voltage & Current Controlled Voltage Source Inverter for Distributed Generation System" IEEE Transaction on Energy Conversion, Vol.21, No.3, September 2006.
[6] S.Mangayarkarasi, "Enhancing Electric Power Quality Using Dual Unified Power Quality Conditioner" IJETCSE ISSN:0976-1353 Volume 12 Issue 3-January 2015.
[7] Amit Kumar Jindal, "Interline Unified Power Quality Conditioner," IEEE Transaction on Power Delivery, Vol.22, No.1, January 2007.
[8] Dong Myung Lee, "New Control Scheme for a UPQC-Q with Minimum Active Power Injection" IEEE Transaction on Power Delivery, Vol.25,No.2, April 2010.
[9] Morris Brenna, "A New Proposal for Power Quality & Custom Power Improvement: OPEN UPQC" IEEE Transaction on Power Delivery,Vol.24, No.4, OCTOBER 2009.
[10] Dusan Graovac, "Power Quality Problems Compensation with Universal Power Quality Conditioning System" IEEE Transaction on Power Delivery, Vol.22, No.2, April 2007.
[11] B.Han, "New Configuration of UPQC for Medium-Voltage Application" IEEE Transaction on Power Delivery, Vol.21, NO.3, July 2006.
[12] Hideaki Fujita and Hirofumi Akagi, "The Unified Power Quality Conditioner: The Integration of Series- and Shunt- Active Filters", IEEETransactions on Power Electronics, VOL. 13, NO.2, MARCH 1998.