International Journal of Research
Available at https://edupediapublications.org/journals
Special Issue on Conference Papers
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 06
March 2018

Enhancing Electric Power quality improvement solar sources by using UPQC

[1]*Malka.Naveen kumar*, [2]*Dr. A.Prasad Raju*

1(Research Scholar(25617079), Dept of ECE, Shri Jagadishprasad Jhabarmal Tibrewala Uinversity, Jhunjhunu, Rajasthan .&
Assistant professor, Dept. Electrical and Electronics Engineering
Mother Theressa College of Engg & Tech. Peddapalli, , India
2professor, Dept. Electrical and Electronics Engineering.
Sree Chaitanya Institute of Technological Science ,karimnagar, India
E-Mail: naveenmalka@gmail.com1 , prasadraj55@gmail.com2

Abstract

In this paper presents a Design of a Unified Power Quality conditioner (UPQC) connected to three phase four wire system. The neutral of series transformer used in the fourth wire for the 3P4W system. The neutral current that may flow toward transformer neutral point is compensated by using a four-leg voltage source inverter topology for shunt part. The series transformer neutral will be at virtual zero potential during all operating conditions. In this simulation we observe the power quality problems such as unbalanced voltage and current, harmonics by connecting non linear load to 3P4W system with Unified Power Quality conditioner. A new control strategy such as unit vector template is used to design the series APF to balance the unbalanced current present in the load currents by expanding the concept of single phase P-Q theory. The M-C applied for balanced three phase system. And also be used for each phase of unbalanced system independently. The MATLAB/Simulink based simulations are provided the functionality of the UPQC.

I.INTRODUCTION

The power electronic devices due to their inherent nonlinearity draw harmonic and reactive power from the supply. In three phase systems, they could also cause unbalance and draw excessive neutral currents. The injected harmonics, reactive power burden, unbalance, and excessive neutral currents cause low system efficiency and poor power factor. The design of shunt active filter is described in The use of the sophisticated equipment/loads at transmission and distribution level has increased considerably in recent years due to the development in the semiconductor device technology. The equipment needs clean power in order to function properly. At the same time, the switching operation of these devices generates current harmonics resulting in a polluted distribution system. The power electronics based devices have been used to overcome the major power quality problems. A 3P4W distribution system can be realized by providing the neutral conductor along with the 3 power lines from generation station. The unbalanced load currents are very common and an important Problem in 3P4W

distribution system. To improve the power quality by connecting the series active power filter (APF) and shunt (APF).They are two types of filters one is passive filters and another one is active filters. In passive filters they are using L and C components are connected. By connecting passive filters the system is simplicity and cost is very low. And so many dis-advantages is there, that is resonance problems and filter for every frequency and bucky. That’s we are choosing the active filters. By using active filters the power converter circuit using active

International Journal of Research
Available at https://edupediapublications.org/journals
Special Issue on Conference Papers
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 06
March 2018

components like IGBTs, MOSFETs, etc., and energy storage device (L or C).The advantages are filtering for a range of frequencies and no resonance problems and fast response. But only very few dis advantages is there that is cost is high. By connecting series active filters the voltage harmonic compensation, high impedance path to harmonic currents these are the main functions. All these non-linear loads draw highly distorted currents from the utility system, with their third harmonics component almost as large as the fundamental. The increasing use of non-linear loads, accompanied by an increase in associated problems concerns both electrical utilities and utility customer alike.

Recent research efforts have been made towards utilizing a device called Unified Power Quality Conditioner (UPQC) to solve almost all power quality problems. To put in nutshell, UPQC aims at the integration of series active and shunt active power filters connected through a common DC link capacitor. This led to the development of advanced control techniques for UPQC. In [Basu et al., 2001], some remarkable work has been done based on the quadrature voltage injection by the series compensator of the UPQC. This scheme, though leads to purely reactive power handling by the series compensator, does not necessarily result in minimum VA consumption of the overall UPQC, and hence is not optimized from the point of view of VA loading and efficiency.

The series voltage injection at an optimized angle not only results in load voltage regulation but also in overall minimized VA loading and improved efficiency. This paper is presents an optimized UPQC where the series voltage injection is at an optimized angle for minimum VA loading of the overall UPQC while compensating for load reactive power, harmonics, and supply voltage sag/swell. Additionally, unbalanced voltage sag, which is a practical characteristic of the sags occurring on a real system, has been successfully mitigated.

II. CONVENTIONAL

UPQC The schematic block diagram of conventional UPQC-Q is shown in the Fig. 1. The UPQC consists of two 3-phase voltage source inverters connected in cascade through a common DC link capacitor. The DVR and the STATCOM are series and shunt connected voltage source inverters (VSIs) respectively. The main objectives of STATCOM are to compensate for the reactive power demanded by the load, to eliminate the harmonics from the supply current, and to regulate the DC link voltage. The STATCOM operates with hysteresis current control mode to force the source current, is, in phase with vs such that input power factor is always maintained unity.

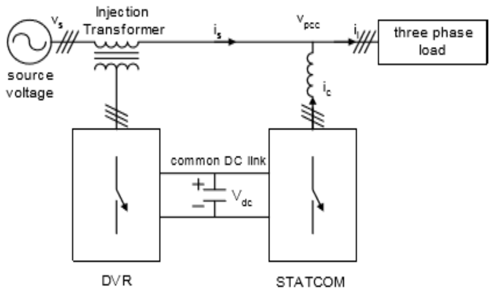


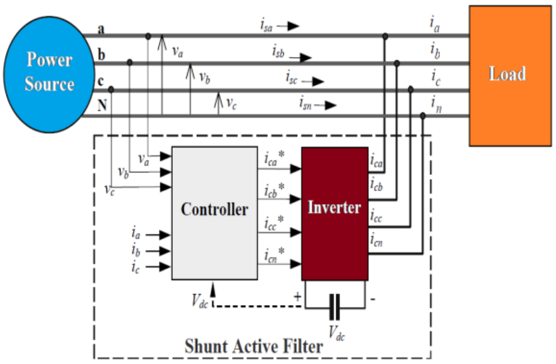
Fig.1 Block diagram of UPQC

Fig 1 is the fundamental block diagram of series AF.

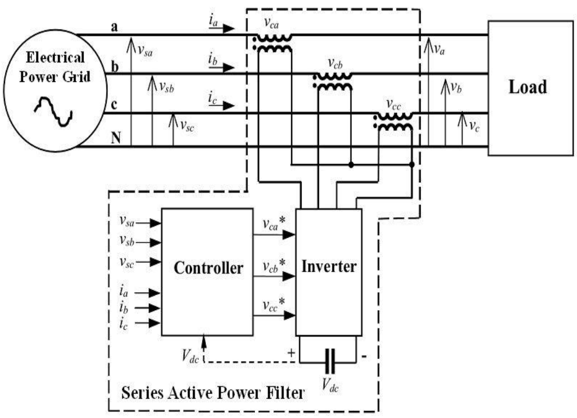
To minimize voltage harmonics and to balance and control, the terminal voltage of the load or line, using a series transformer series AF is connected in series with the mains before the load. It is used to reduce negative-sequence voltage and control the voltage on three-phase systems. It can be installed by electric utilities to damp out harmonic propagation caused by resonance with line impedances

International Journal of Research
Available at https://edupediapublications.org/journals
Special Issue on Conference Papers
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 06
March 2018

and passive shunt compensators and to compensate voltage harmonics.



1.1 shunt connected active filter



1.2 series connected active filter

III. Multi converter unified power quality conditioner(MC-UPQC)

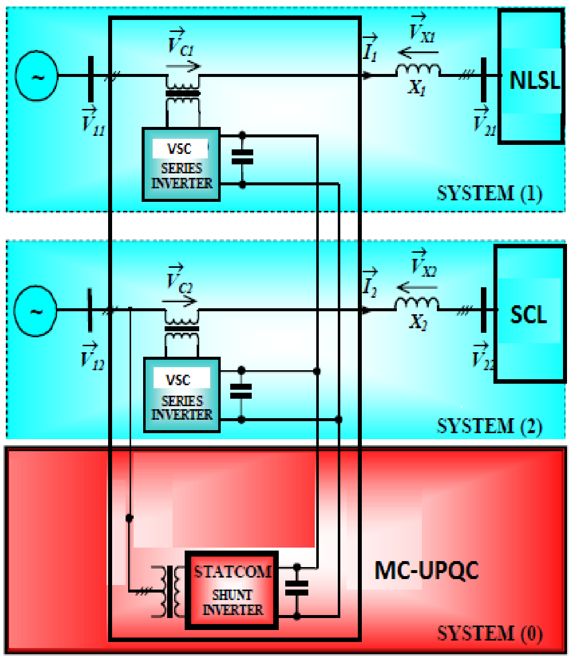


Fig.1.2 Typical MC-UPQC used in distribution system.

This work concentrates on a new custom power device called MC-UPQC for a twobus/twofeeder distribution system. For different types of controllers, the response of the MC-UPQC are studied. The MC-UPQC device is capable of simultaneous compensation for current and voltage in two-bus/two-feeder systems. To compensate for interruption and sag/swell, the power can be transferred from one feeder to adjacent feeder. To regulate the load, voltage against disturbance and sag/swell in the system for protecting the sensitive critical loads and nonlinear sensitive load. To compensate for the harmonic and reactive components of nonlinear load current. The single-line diagram of a distribution system with an MC-UPQC is shown in Fig.1.2

A new structure of UPQC which is called as the MC-UPQC proposed in this work. The system is prolonged by inserting a series-VSC in the neighboring feeder. This configuration used for compensation of voltage as well as current deviations by distributing power capacities between the feeders which are not joined without requiring battery storage system. The rectification principle and various control strategies which are used are based on ANN&PI controllers. The execution of the MC-UPQC and control process is depicted by PSCAD/MATLAB for a two feeder/bus system

The main aim of the control system is to maintain the constant voltage magnitude at the point where a sensitive load is connected, under system disturbances. In recent days voltage sags are the most significant PQ problems in the power system. The compensation of voltage sag/swell can be limited by a number of factors.

Due to the development in the semiconductor device technology,the use of highly developed equipment/loads at

International Journal of Research
Available at https://edupediapublications.org/journals
Special Issue on Conference Papers
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 06
March 2018

distribution and transmission level has extended considerably in recent years. In order to function properly the equipment needs clean power. The switching operation of the devices generates current harmonics resulting in a polluted distribution system at the same time. In order to overcome the major PQ problems the power-electronics-based devices have been used.

The MC-UPQC is one of the best solutions, to provide a balance, constant magnitude power to sensitive load ,distortion-free, at the same time, to control the harmonic, unbalance, and reactive power demanded by the load hence to make the overall power distribution system more healthy .

IV. MC-UPQC SYSTE

A. Circuit configuration

A device which is similar in construction to a unified power flow conditioner (UPFC) is called the UPQC, like a UPFC it utilize two voltage source inverters (VSIs) that are connected to a common DC energy storage capacitor. One of these two VSIs is connected in shunt with the ac line while the other is connected in series with the same line.

To perform the shunt and series compensation at the same time a UPFC is utilized in a power transmission system. Similarly in a power distribution system a UPQC can also execute both the assignment . A power distribution system, on the other hand, may contain unbalance, distortion and even DC components. Therefore a UPQC must operate under this environment while providing series or shunt compensation.

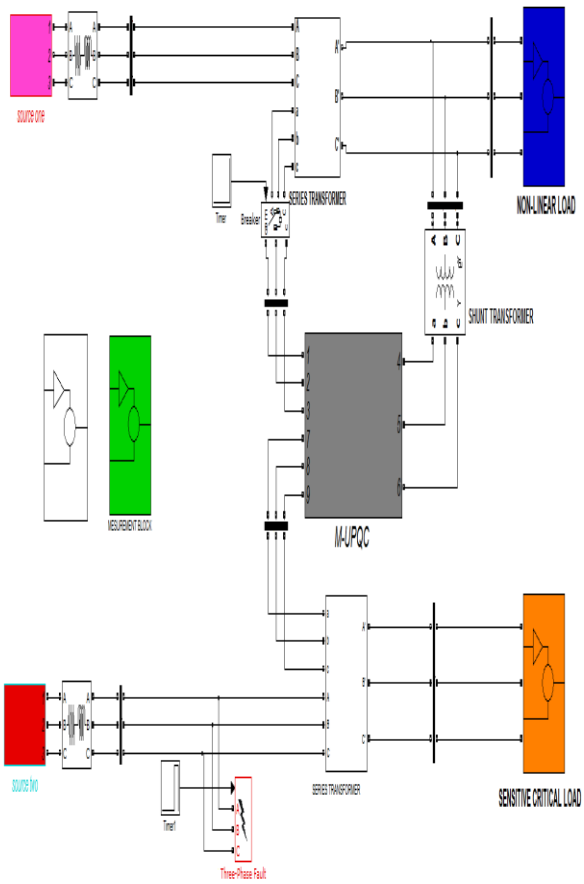


Fig.2 Typical Simulink Block diagram MC-UPQC used in distribution system

B. MC-UPQC Structure

The internal architecture of the MC-UPQC is shown in Fig. 2. It is having three VSCs (VSC1, VSC2, and VSC3) which are edside by side through a common dc-link capacitor. VSC1 is associated in sequence with BUS1 and VSC2 is united laterally with load L1 at the end of Feeder1. VSC3 is associated in sequence with BUS2 at the Feeder2 endand all of the three VSCs in Fig. 2 is executed by a three-phase converter having a commutation reactor and high-pass output filter is shown in Fig. 3. The commutation reactor (L_f) and high-pass output filter (R_{f}, C_f) are joined to interrupt the movement of switching harmonics into the power supply as shown inFig. 2.

International Journal of Research
Available at https://edupediapublications.org/journals
Special Issue on Conference Papers
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 06
March 2018

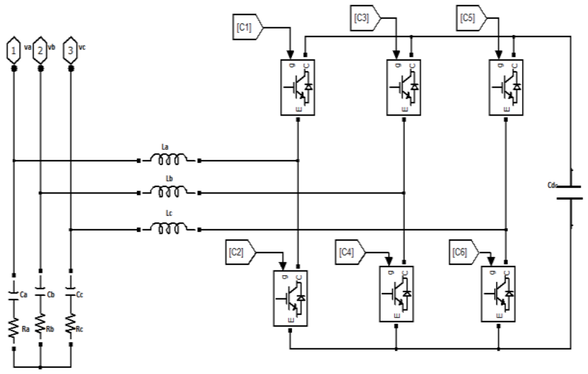


Fig.2.1 Schematic structure of a VSC

Each converter is supplied with a common dc-link capacitor and joined to the distribution system over the transformer. Secondary (Distribution) sides of the series-connected transformers are united in sequence with BUS1 and BUS2, and the secondary (distribution) side of the shunt-connected transformer is joined in laterally with load L1. The main objectives of the MC-UPQC shown in Fig. 2 are:

1. For controlling the load voltage (u_{l1}) counter to dip/surge and disturbances in the system to preserve the nonlinear/sensitive load L1;

2. To control the load voltage (u_{l2}) against dip/surge, interruption and disturbances in the system to preserve the sensitive/critical load L2;

3. To rectify the reactive and harmonic components of nonlinear load current (i_{l1})

To attain these goals, series VSCs (i.e., VSC1 and VSC3) works as voltage controllers while the shunt VSC (i.e., VSC2) works as a current controller.

C. Control Strategy

As shown in Fig. 2, the MC-UPQC comprises of two series and one shunt VSCs which are controlled individually. The switching control approach for series and shunt VSCs are preferred to be sinusoidal Pulse width-modulation (SPWM) voltage control and hysteresis current control, correspondingly. Particulars of the control method, which depends on the *d-q* method[12], will be examined later.

Shunt-VSC: Activities of the shunt-VSC are:

- Reactive component of the load L1 current is remunerated;
- Harmonic components of the load current is compensated;
- To control the voltage of the common dc-link capacitor.

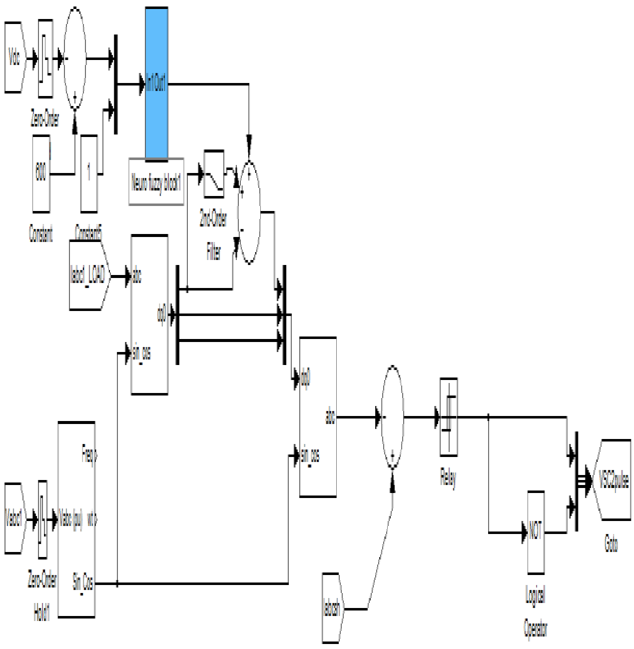
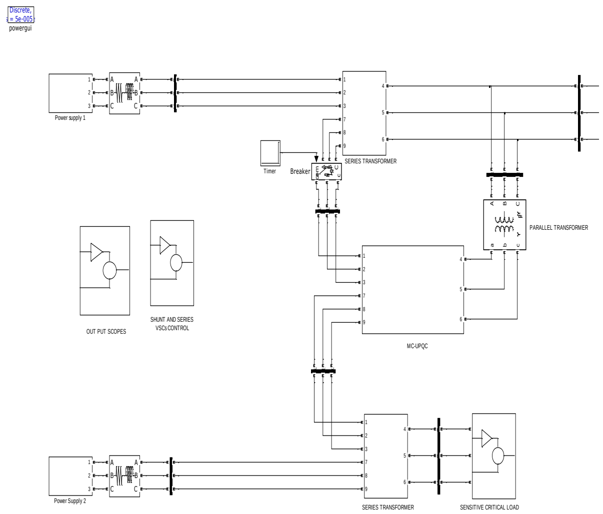


Fig.3.0 .Simulink Model of shunt VSC control with Neuro-fuzzy logic controller

In order to verify the control algorithm effectiveness which is discussed in the previous section, supply network with realistic parameters and moderately complex load situation, a digital simulation based MATLAB/SIMULINK is carried out. The MC-UPQC execution under such circumstances with different conditions such as voltage harmonics, current harmonics, voltage swell and voltage sags compensation are tested.

III. Overall Simulink model of MC-UPQC in 2-Bus System with and without fault



- Fig 3.1. Overall Simulink model of MC-UPQC in 2-Bus System without fault

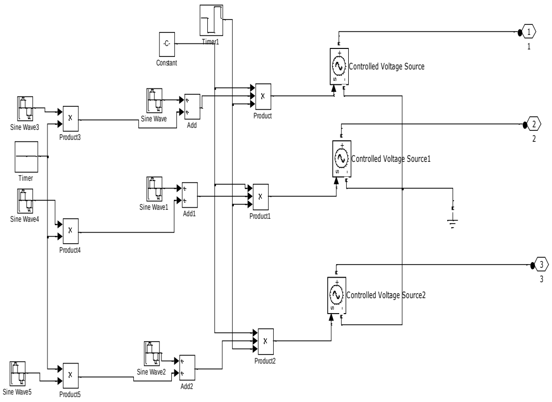


Fig.3.2. Simulink model of Power supply

The simulated results for nonlinear load current, with PI controller and its shunt compensation current introduced by VSC2compensation Feeder1 current, and finally the DC-link capacitor voltage are shown in Fig.5.15.The nonlinear load current is distorted and is compensated efficiently; the total harmonic distortion (THD) of the feeder current is minimized from 22% to less than 5%. Also, in both feeders the DC voltage regulation loop has functioned properly under all the disturbances, such as sag/swell with PI, FUZZY and NEURO-FUZZY logic controllers effectively are shown in figures respectively.

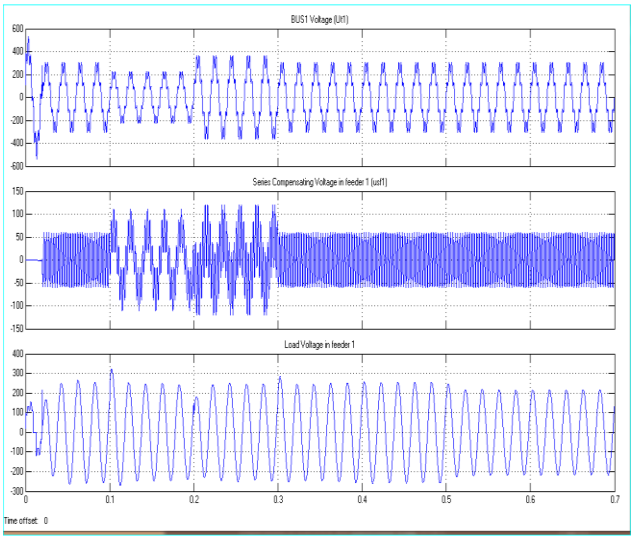


Fig.3.3 simulated results for bus1 voltage, its series compensating voltage and load voltage in Feeder 1

Similarly, the BUS2 voltage, and its corresponding compensation voltage injected by VSC3, and finally, the load L2 voltage are shown in Fig. 5.14. As shown in these figures, distorted voltages of BUS1 and BUS2 are adequately compensated across the loads L1 and L2 with efficient dynamic response.

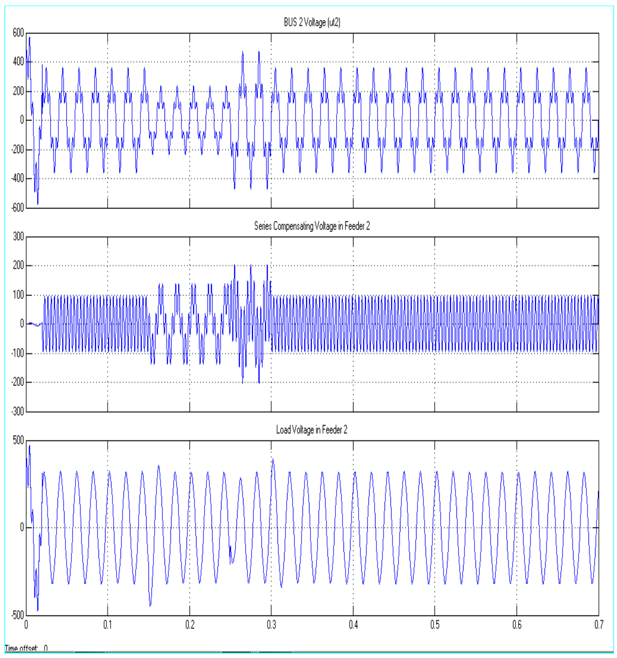


Fig. 3.4 Simulated results for BUS2 voltage, series compensating voltage in feeder 2

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 06
March 2018

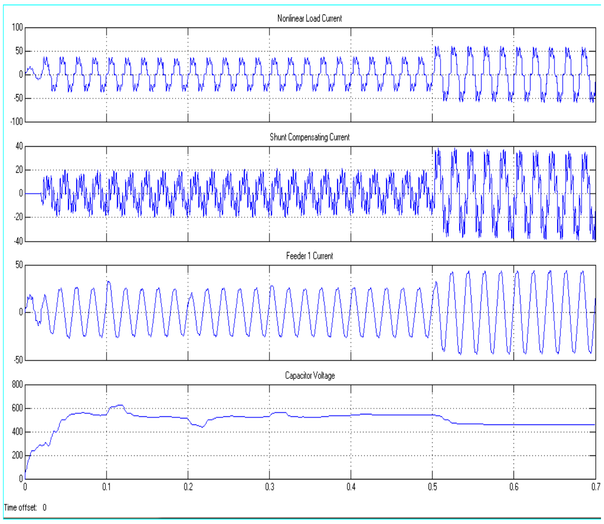


Fig.3.5. Simulated results for Nonlinear load current, with PI controller and its shunt compensating current, Feeder1 current, and DC capacitor voltage.

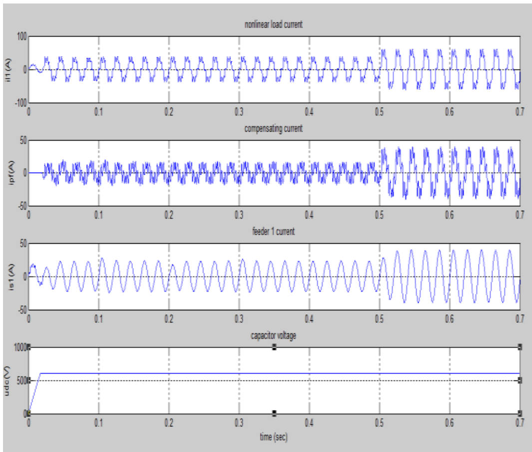


Fig.3.6. Simulated results for Nonlinear load current, with FUZZY controller and its Shunt compensating current, Feeder1 current, and DC capacitor voltage.

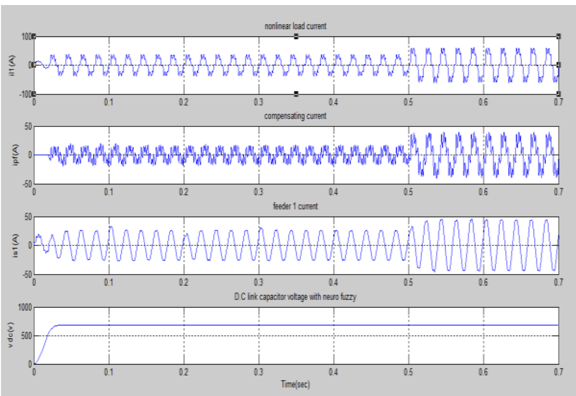


Fig. 3.7 Simulated results for nonlinear load current, with NEURO-FUZZY controller

Conclusions

In this thesis, a new unified power-quality conditioning system (called MC-UPQC) is capable to compensation for current and voltage in adjacent feeder that is modeled using MATLAB/SIMULINK and results are represented. Compared to a conventional MC-UPQC, in two-feeder system the MC-UPQC is capable of fully protecting sensitive &critical loads against sag/swell, distortions, and interruption with PQ Theory. From these Results we can say that the MC-UPQC system is also capable to compensate without the need for a battery storage system for interruptions.

1. New configurations for simultaneous compensation of current and voltage in adjacent feeders has been brought forward with three phase Four Wire MC-UPQC.
2. The execution of the MC-UPQC is to evaluated under various disturbance conditions and it is shown that the advanced MC-UPQC offers the following advantages:
3. Power transfer between two adjacent feeders for sag/swell and interruption compensation.
4. Without the need for battery storage system compensation for interruptions has been done.
5. The transient response is improved by using FLC controller in place of the PI controller for Dc voltage Link.
6. Implementing Neuro-fuzzy logic controller instead of the Fuzzy controller the D.C capacitor voltage capacity has been improved.

Scope for Future Work

Future scope work is extended to compensate total drop in the system using three feeder distribution systems with Adaptive Neuro fuzzy controller, PSO and GA, AGA techniques can also be implemented for this proposed MC-UPQC System.

This topology can be extended to multi bus/multifeeder systems by adding more series VSCs. A generalized unified power quality conditioner (GUPQC) by using three single-phase three-level voltage source converters (VSCs) connected back-to-back through a common DC-link is proposed for three-feeder distribution system

It can be analyzed the system in Islanding mode operation with renewable energy source using Intelligence techniques & with optimization techniques.

REFERENCES

[1] Hamid Reza Mohammadi, Ali Yazdian Varjani, and Hossein Mokhtari, "Multi converter Unified Power-Quality Conditioning System: MC- UPQC" IEEE RANSACTIONS ON POWER DELIVERY, VOL. 24,NO. 3, JULY 2009.
[2] R.Rezaeipour and A.Kazemi, "Review of Novel control strategies for UPQC" Internal Journal of Electric and power Engineering 2(4) 241-247, 2008.
[3] S. Ravi Kumar and S.Siva Nagaraju "Simulation of DSTATCOM and DVR in power systems" Vol. 2, No. 3, June 2007 ISSN 1819-6608 ARPN Journal of Engineering and Applied Sciences.
[4] M.V.KasuniPerera" Control of a Dynamic Voltage Restorer to compensate single phase voltage sags" Master of Science Thesis, Stockholm, Sweden 2007.
[5] M. Basu, S. P. Das, and G. K. Dubey, "Comparative evaluation of two models of UPQC for suitable interface to enhance power quality," *Elect. Power Syst. Res.*, pp. 821–830, 2007.
[6] A. K. Jindal, A. Ghosh, and A. Joshi, "Interline unified power quality conditioner," *IEEE Trans. Power Del.*, vol. 22, no. 1, pp. 364–372, Jan. 2007.
[7] B. Singh, K. Al-Haddad, and A. Chandra, "A review of active power filters for power quality improvement," *IEEE Trans. Ind. Electron.*, vol. 45,no. 5, pp. 960–971, Oct. 1999.
[8] C. A. Quinn and N.Mohan, "Active filtering of harmonic currents in three phase, four-wire systems with three-phase and single-phase nonlinear loads," in *Proc. 7th IEEE APEC*, 1992, pp. 829–836.
[9] H. Akagi, Y. Kanazawa, and A. Nabae, "Instantaneous reactive power compensators comprising switching devices without energy storage components, "*IEEE Trans. Ind. Appl.*, vol. IA-20, no. 3, pp. 625–630,May/Jun. 1984.
[10] Y. Komatsu and T. Kawabata, "A control method of active power filter in unsymmetrical and distorted voltage system," in *Proc. Conf. IEEE Power Convers.*, 1997, vol. 1, pp. 161–168.