APPLICATION OF PI FOR IMPROVEMENT OF POWER QUALITY USING UPQC

[1]Dara Kiran, [2]Mr. Sadiq Ahamed

[1]Student, [2]Asst.Proff, Dept.of EEE, Nimra College of Engineering & Technology, Ibrahimpatnam, VJA (India)

ABSTRACT

This project report emphasis enhancement of power quality by using UPQC with the conventional proportional-integral (PI) controller. The unified power quality conditioner (UPQC) is being used as a universal active power conditioning device to mitigate both current and voltage harmonics at a distribution side of power system network. The proposed PI are capable of providing good static and dynamic performances compared to PID controller

I INTRODUCTION

Power Quality (PQ) has become an important issue since many loads at various distribution ends like adjustable speed drives, process industries, printers, domestic utilities, computers, microprocessor based equipments etc. have become intolerant to voltage fluctuations, harmonic content and interruptions. Power Quality (PQ) mainly deals with issues like maintaining a fixed voltage at the Point of Common Coupling (PCC) for various distribution voltage levels irrespective of voltage fluctuations, maintaining near unity power factor power drawn from the supply, blocking of voltage and current unbalance from passing upwards from various distribution levels, reduction of voltage and current harmonics in the system and suppression of excessive supply neutral current.

Conventionally, passive LC filters and fixed compensating devices with some degree of variation like thyristor switched capacitors, thyristor switched reactors were employed to improve the power factor of ac loads. Such devices have the demerits of fixed compensation, large size, ageing and resonance. Nowadays equipments using power semiconductor devices, generally known as active power filters (APF's), Active Power Line Conditioners (APLC's) etc. are used for the power quality issues due to their dynamic and adjustable solutions. Flexible AC Transmission Systems (FACTS) and Custom Power products like STATCOM (STATic synchronous COMpensator), DVR (Dynamic Voltage Restorer), etc. deal with the issues related to power quality using similar control strategies and concepts. Basically, they are different only in the location in a power system where they are deployed and the objectives for which they are deployed.

In this paper, various extraction algorithms for generating reference signals and various modulation techniques for generating pulses already developed and published are discussed. Criterion for selection of dc link capacitor and interfacing filter design are also discussed.

II UNIFIED POWER FLOW CONTROLLER

Basic block diagram of UPQC is shown in Fig 1. The voltage at PCC may be or may not be distorted depending on the other non-linear loads connected at PCC. Here we assume the voltage at PCC is distorted. Two voltage source inverters are connected back to back, sharing a common dc link. One inverter is connected parallel with the load. It acts as shunt APF, helps in compensating load harmonic current as well as to maintain dc link voltage at constant level. The second inverter is connected in series with utility voltage by using series transformers and helps in maintaining the load voltage sinusoidal.

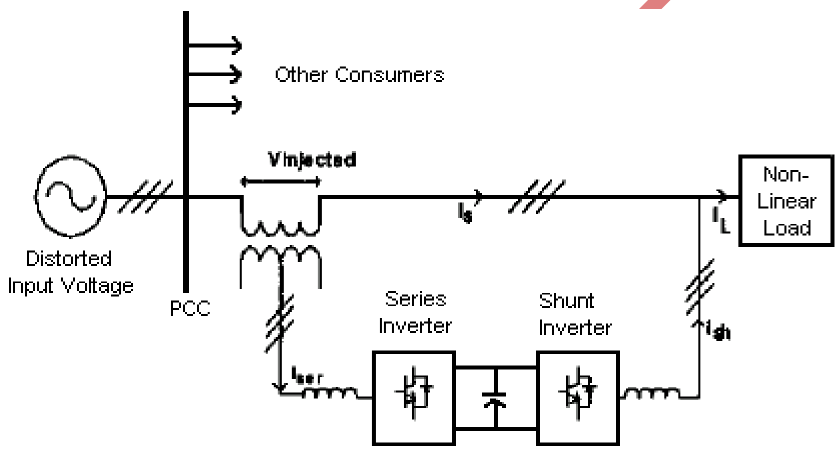

Fig 1 Basic Block Diagram of UPQC

The major disadvantage of p-q theory is that it gives poor results under distorted and/or unbalanced input/utility voltages. In order to eliminate these limitations, the reference load voltage signals extracted for series APF are used instead of actual load voltages.

For phase a, the load voltage and current in α-β coordinates can be represented by π/2 lead as

$$\begin{bmatrix} v_{La\_\alpha} \\ v_{Lb\_\beta} \end{bmatrix} = \begin{bmatrix} v^*_{La}(\omega t) \\ v^*_{La}\left(\omega t + {}^{\pi}/_{2}\right) \end{bmatrix} = \begin{bmatrix} V_{Lm} sin(\omega t) \\ V_{Lm} cos(\omega t) \end{bmatrix}$$

$$\begin{bmatrix} i_{La\_\alpha} \\ i_{La\_\beta} \end{bmatrix} = \begin{bmatrix} i_{La}(\omega t + \varphi_L) \\ i_{La}\left[(\omega t + \varphi_L) + {}^{\pi}/_{2}\right] \end{bmatrix}$$

Considering phase *a*, the phase-*a* instantaneous load active and instantaneous load reactive powers can be represented by

$$\begin{bmatrix} p_{La} \\ q_{La} \end{bmatrix} = \begin{bmatrix} v_{La\_\alpha} & v_{La\_\beta} \\ -v_{La\_\beta} & v_{La\_\alpha} \end{bmatrix} \cdot \begin{bmatrix} i_{La\_\alpha} \\ i_{La\_\beta} \end{bmatrix}$$

Where $p_{La} = \bar{p}_{La} + \tilde{p}_{La}$, $q_{La} = \bar{q}_{La} + \tilde{q}_{La}$

III CONTROLING TECHNIQUES FOR UPQC

3.1 PI Controller

A **PI Controller** (proportional-integral controller) is a special case of the PID controller in which the derivative (D) of the error is not used.

The controller output is given by

$$K_P\Delta + K_I \int \Delta \, dt$$

The lack of derivative action may make the system more steady in the steady state in the case of noisy data. This is because derivative action is more sensitive to higher-frequency terms in the inputs. Without derivative action, a PI-controlled system is less responsive to real (non-noise) and relatively fast alterations in state and so the system will be slower to reach set point and slower to respond to perturbations.

IV SIMULATION RESULTS

To verify the operating performance of the proposed UPQC, a 3-phase electrical system is simulated using MATLAB software.

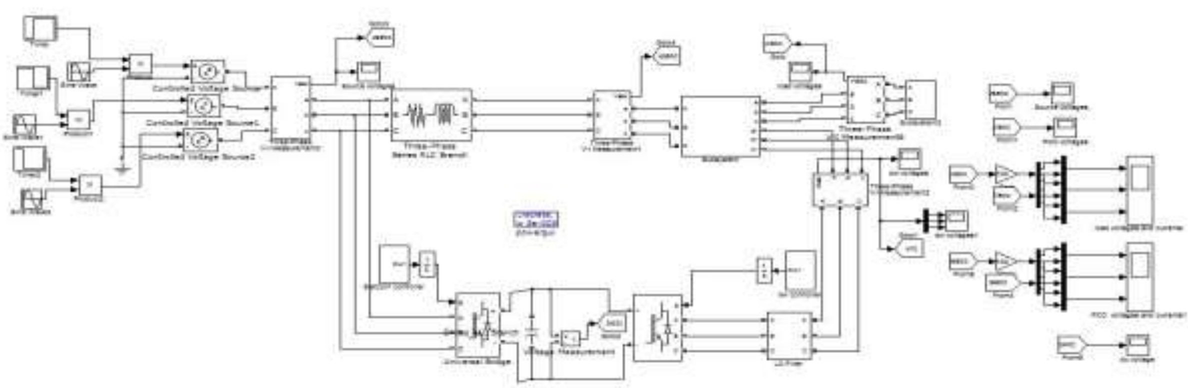

Fig 5 Matlab/Simulink model

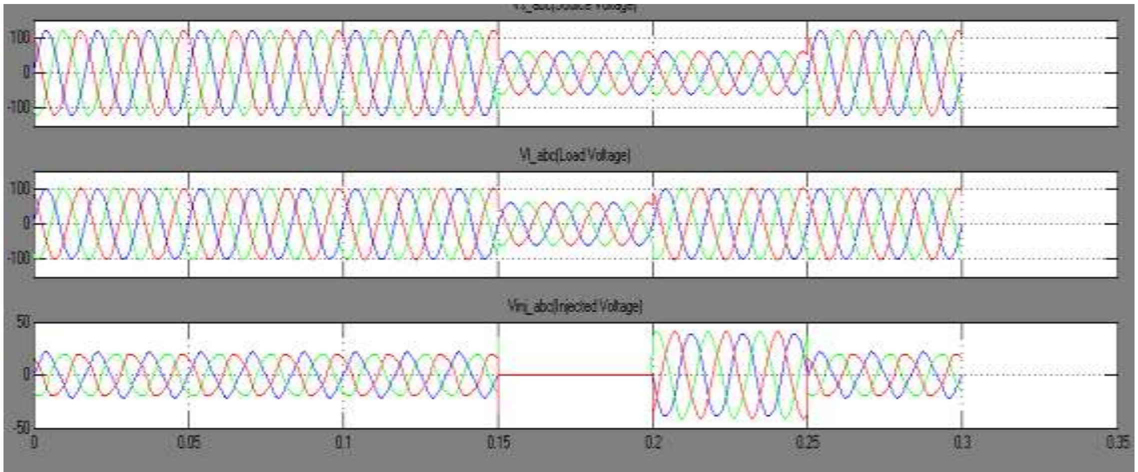

Fig 6 Matlab/Simulink source and load voltages with PI controller

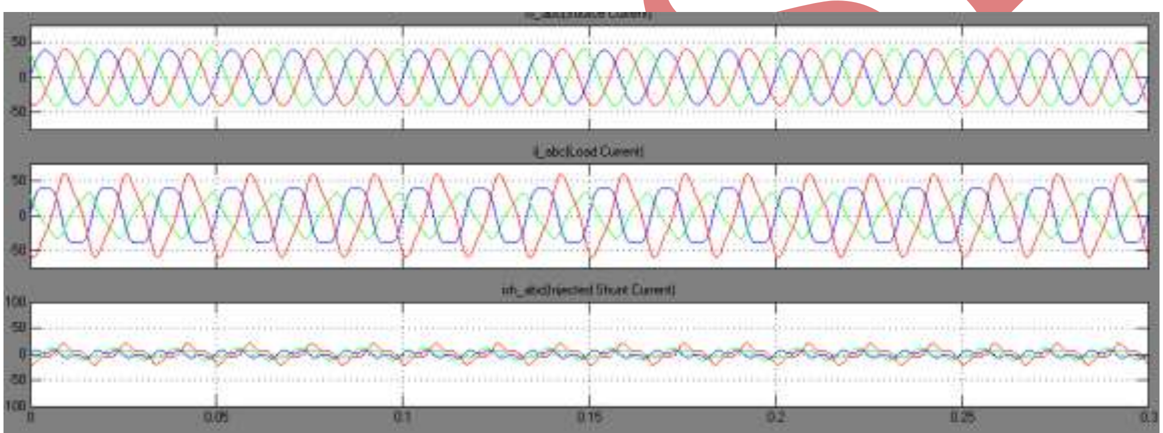

Fig 7 Matlab/Simulink source and load currents with PI controller

V CONCLUSION

Custom power devices like DVR, D-STATCOM, and UPQC can enhance power quality in the distribution system. Based on the power quality problem at the load or at the distribution system, there is a choice to choose particular custom power device with specific compensation. Unified Power Quality Conditioner (UPQC) is the combination of series and shunt APF, which compensates supply voltage and load current imperfections in the distribution system.

The UPQC considered in this project is a multifunction power conditioner which can be used to compensate for various voltage disturbance of the power supply, to correct any voltage fluctuation and to prevent the harmonic load current from entering the power system.

A simple control technique based on unit vector templates generation is proposed for UPQC. Proposed model has been simulated in MATLAB. The simulation results show that the input voltage harmonics and current harmonics caused by non-linear load can be compensated effectively by the proposed control strategy. The closed loop control schemes of direct current control, for the proposed UPQC have been described. A suitable mathematical model of the UPQC has been developed with different shunt controllers (PI) and simulated results have been described.

REFERENCES

[1] E. W. Gunther and H. Mehta, "A survey of distribution system power quality-preliminary results," IEEE Trans. Power Del., vol. 10, no. 1,pp. 322–329, Jan. 1995.

[2] M. F. McGranaghan, D. R. Mueller, and M. J. Samotyi, "Voltage sags in industrial system," IEEE Trans. Ind. Appl., vol. 29, no. 2, pp.397–503, Mar./Apr. 1993.

[3] H. Akagi, "Trends in active filters line conditioner," IEEE Trans. Power Electron., vol. 9, no. 3, pp. 263–268, May 1994.

[4] H.Akagi,"Newtrendsinactivefilters for power conditioning," IEEE Trans. Ind. Appl., vol. 32, no. 6, pp. 1312–1322, Nov./Dec. 1996.

[5] H. Fujita and H. Akagi, "The unified power quality conditioner: The integration of series active filters and shunt active filter," IEEE Trans.Power. Electron., vol. 13, no. 2, pp. 315–322, Mar. 1998.

[6] M. H. H. Chen, "Modeling and controlling of unified power quality conditioners," in Proc. Conf. Rec., Hong Kong, China, pp. 413–435.

[7] C. Sepúlveda, J. Espinoza, L. Moran, and R. Ortega, "Analysis and design of a linear control strategy for three-phase UPQCs," in Proc.Conf. Rec., Nov. 2004, vol. 3, pp. 3060–3065.

[8] L. Landaeta, C. Sepúlveda, J. Espinoza, and C. Baier, "A mixed LQRI/PI based control for three-phase UPQCs," in Proc. Conf.IECON, Nov. 2006, pp. 2494–2499.

[9] P. Kenneth, "Current-source converter for AC motor drives," IEEE Trans. Ind. Appl., vol. IA-8, no. 6, pp. 679–683, Nov. 1972.

[10] D. Graovac, V. Kati, A. Rufer, and J. Kne, "Unified power quality conditioner based on current source converter topology," presented at the Conf. Rec. Elect. Power Eng., Graz, Austria, Aug. 2001.

[11] K. Vadirajacharya, P. Agarwal, and H. Gupta, "A simple control strategy for unified power quality conditioner using current source inverter," in Proc. Conf. Rec. IPEC, May 2008, pp. 1219–1223.

[12] P. Melin, J. Espinoza, N. Zargari, M. Sanchez, and J. Guzman, "Modeling issues in three-phase current source rectifiers that use damping resistors,"

[13] N. Zargari, G. Joos, and P. Ziogas, "Input filter design for PWM current-source rectifiers," IEEE Trans. Ind. Appl., vol. 30, no. 6, pp.1573–1579, Nov./Dec. 1994.

[14] J. Espinoza and G. Joos, "State variable decoupling and power flow control in PWM current-source rectifier," IEEE Trans. Ind. Electron., vol. 45, no. 1, pp. 78–87, Feb. 1998.

[15] P. Melín, J. Espinoza, J. Muñoz, C. Baier, and E. Espinosa, "Decoupled control of a unified power conditioner based on current source topology for fast AC mains disturbance compensation," in Proc. Conf. Rec. ICIT, Mar. 2010, pp. 730–736.