Voltage Magnitude Improvement With Space Vector PWM UPQC Along With PVA At DC Link

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Abstract *:* Because future load demand is expected to rise, generation will need to rise as well. The usage of traditional resources such as coal, diesel fuels, and other fossil fuels contributes to global warming, prompting us to switch to renewable energy sources. Solar, wind, and tidal energy are examples of renewable energy resources that can be used to generate electricity. These are employed as Distribution Generators (DG) in small quantities throughout a bus system. We refer to these sources as micro-grids since their generation is reduced when they are connected to the grid. These DGs are often used to distribute electricity to loads in micro grids, and power electronic elements are used to manage the generation. It adds energy to the system, but it also causes harmonic distortions and voltage drops. We deploy a UPQC (Unified Power Quality Conditioner) technology to reduce sags and harmonics in the micro grid system generated by the power electronic devices used by renewable energy sources. The UPQC technology removes harmonics from the system and restores the micro-grid system's voltage. We use RES (Renewable Energy Resources) at the DC-link to create a new topology called instantaneous reactive power (irp) theory in the UPQC control to operate more efficiently. The RES support the UPQC system by injecting the active power generated by the resources through DC-link.

IndexTerms **- Power Quality, shunt compensator, series compensator,UPQC, Solar PV, MPPT.**

I. INTRODUCTION

Microgrids have boosted consumer reliability and reduced total energy losses, and have emerged as a viable alternative to standard power distribution systems [1], [2]. The impact of power quality (PQ) issues on overall power system performance is one topic of research for connecting a microgrid to the distribution grid. Voltage and frequency variations in the grid voltage, as well as harmonics in the grid voltage and load currents, are examples of PQ issues. Consumers typically use active filters [3], [4], uninterruptible power supplies [5], [6], dynamic voltage restorers [7], [8], and unified PQ conditioners [9] to protect their loads and systems from PQ disruptions in the distribution network. These devices, on the other hand, are typically deployed on the consumer side, and the PQ problems that they can manage are usually limited. A flexible ac distribution system device for the microgrid is proposed in this study, which is implemented utilising a combination of series and shunt voltage source inverters (VSIs).

This study presents a comprehensive solution based on a multi-input–multi-output (MIMO) state-space model for the operation of a flexible ac distribution system device for a microgrid.

The device will perform the following functions at the same time:

1) compensating for grid voltage and load current harmonics;
2) real and reactive power control for load sharing during peak periods and grid power factor correction;
3) maintaining PQ despite minor voltage and frequency variations in the grid voltage;
4) dispatching real and reactive power to the microgrid when it becomes islanded.

II SYSTEM DEVELOPMENT

1.BASIC GUPQC

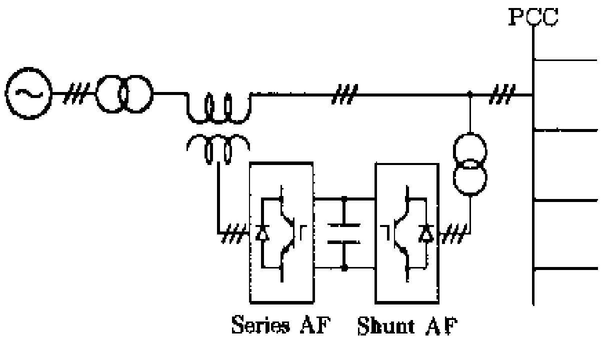
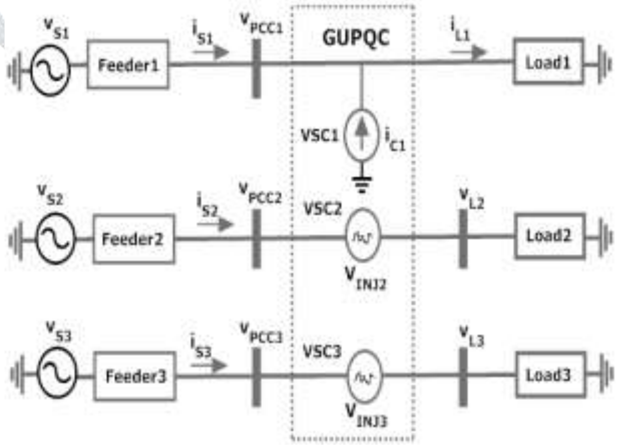


Fig. 1. General UPQC.

Figure 1 depicts the indispensable system configuration of a everyday UPQC, which consists of a series-active and shunt-active filter combination [1]. In the close to future, electric energy utilities will installation the usual UPQC at substations. Harmonic isolation between a subtransmission machine and a distribution device is the most important aim of the series-active filter. At the utility-consumer factor of common connection, the series-active filter can also compensate for voltage flicker/imbalance, voltageregulation, and harmonic compensation (PCC). The shunt-active filter's most important function is to absorb modern-day harmonics, modify for reactive strength and negative-sequence current, and control the dc-link voltage between the two energetic filters.The integration of series-active and shunt-active filters is referred to as the UPQC in this study, and it is linked to Gyugyi's unified strength drift controller [8].

2. SYSTEM CONFIGURATION

As illustrated in Fig. 1, the GUPQC is connected to a multi-bus/three-feeder distribution system that supplies a nonlinear load (load1) via feeder1 and two sensitive critical loads (load2 and load3) via feeders 2 and 3. The VSC1 shunt compensator, which functions as a controlled current source, is used to compensate feeder1 current harmonics, provide the reactive power required by load1, and support the real power required by the two series compensators, VSC2 and VSC3. The two series compensators are employed as regulated voltage sources to safeguard the feeder2 and feeder3's sensitive loads (load2 and load3) from voltage fluctuations.

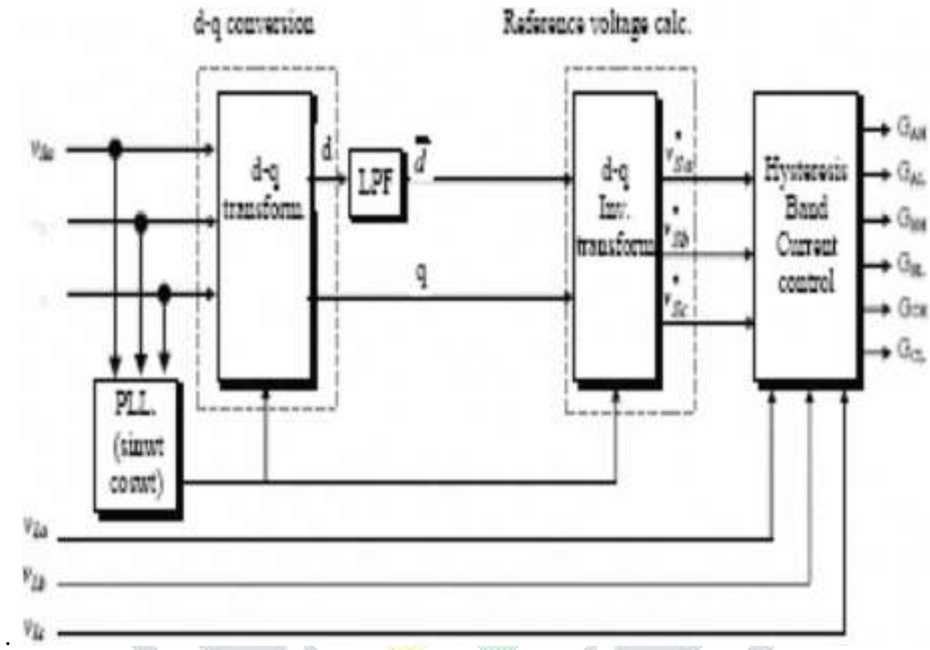


Vs,vPPC, vL, vINJ are the supply, point of common coupling, load, and compensation voltages, respectively, whereas iS, iL, iC are the supply, load, and compensation currents.

III CONTROL CIRCUITS OF PROPOSED GUPQC

The control techniques of shunt and series compensators are significant because the GUPQC controllers detect voltage and current faults and then provide corresponding gating signals to IGBTs. Different control mechanisms for UPQC and shunt active power filter are proposed in the published study as in 9]-[12]. For shunt and series compensators, two alternative control algorithms are used in this research. To create the gating signals for VSC1's IGBTs, the sensed three-phase shunt compensator output currents of feeder1 are compared to the reference currents. The estimation of reference signals is based on Akagi, Kanazawa, and Nabae's instantaneous reactive power theory, or p-q theory, which was introduced in 2007 [12]. To estimate the reference voltages in the case of a series compensator, a new control method based on synchronous reference frame voltage transformation is proposed.

Figure 4 depicts the production of a reference current signal for a shunt compensator using the p-q theory. The feeder1 instantaneous three-phase load currents iL1 and common coupling voltages vPCC1 are transformed from a, b, c coordinates to a, b, 0 coordinates, respectively, using the Clark transformation as in (1) and (2). (3). The series APF control algorithm compares the positive-sequence component with the load side line voltages to calculate the reference value to be injected by the series APF transformers. The supply voltages VSabc are converted to d-q-O coordinates in equation (1).



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$$\begin{bmatrix} V_{s0} \\ V_{sd} \\ V_{sq} \end{bmatrix} = \frac{2}{3} \begin{bmatrix} \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \sin(\omega t) & \sin(\omega t - 2\frac{\pi}{3}) & \sin(\omega t + 2\frac{\pi}{3}) \\ \cos(\omega t) & \cos(\omega t - 2\frac{\pi}{3}) & \cos(\omega t + 2\frac{\pi}{3}) \end{bmatrix} \begin{bmatrix} V_{sa} \\ V_{sb} \\ V_{sc} \end{bmatrix}$$

A verage and oscillating components of source voltages (VSd and VSd) make up the voltage in d axis (VSd) stated in (2). Using a second order LPF (low pass filter), the average voltage VSd is computed.

$$V_{sd} = \bar{V}_{sd} + \tilde{V}_{sd}$$

As seen in equation, the load side reference voltages Vl! 1bc are derived (3). The switching signals are evaluated using a sinusoidal PWM controller to compare reference voltages V 1 L*bc and load voltages (VLabc).

$$\begin{bmatrix} V^*_{la} \\ V^*_{lb} \\ V^*_{lc} \end{bmatrix} = \frac{2}{3} \begin{bmatrix} \sin(\omega t) & \cos(\omega t) & 1 \\ \sin(\omega t - 2\frac{\pi}{3}) & \cos(\omega t - 2\frac{\pi}{3}) & 1 \\ \sin(\omega t + 2\frac{\pi}{3}) & \cos(\omega t + 2\frac{\pi}{3}) & 1 \end{bmatrix} \begin{bmatrix} V_{sd} \\ 0 \\ 0 \end{bmatrix}$$

The three-phase load reference voltages are compared to the load line voltages, and the errors are processed by a sinusoidal PWM controller to provide the necessary switching signals for series APF switches.

IV SIMULATION RESULTS AND OUTPUTS

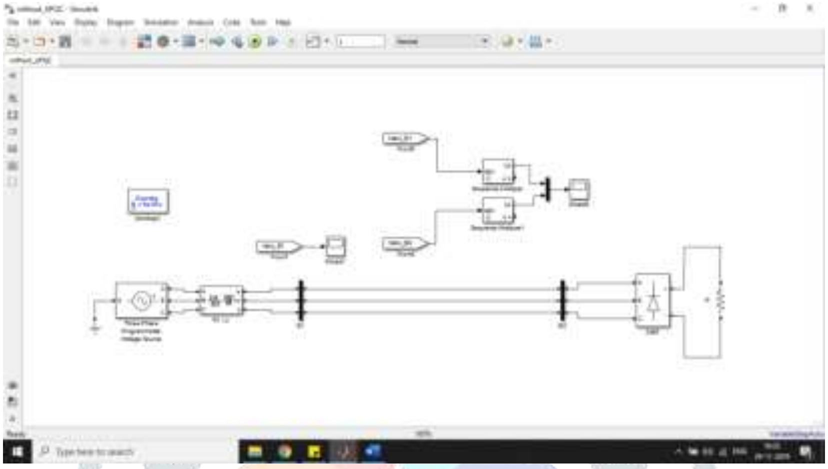

Fig i : Test system without UPQC

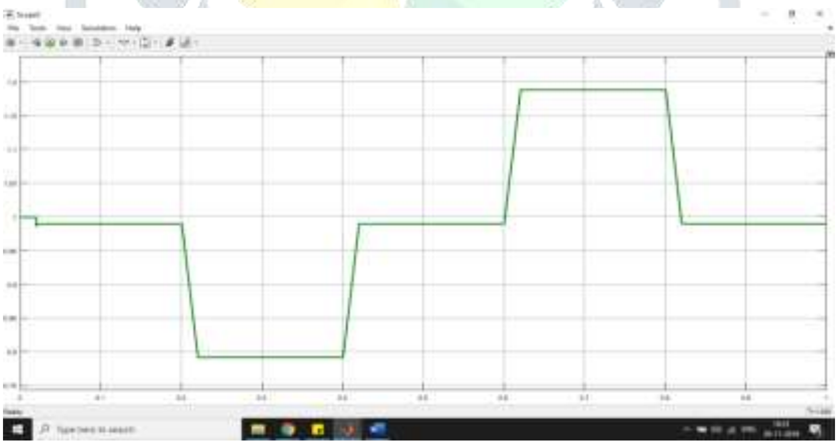

Fig. ii : Source and load voltage magnitudes without UPQC

Fig.iii : Source currents without PVA UPQC

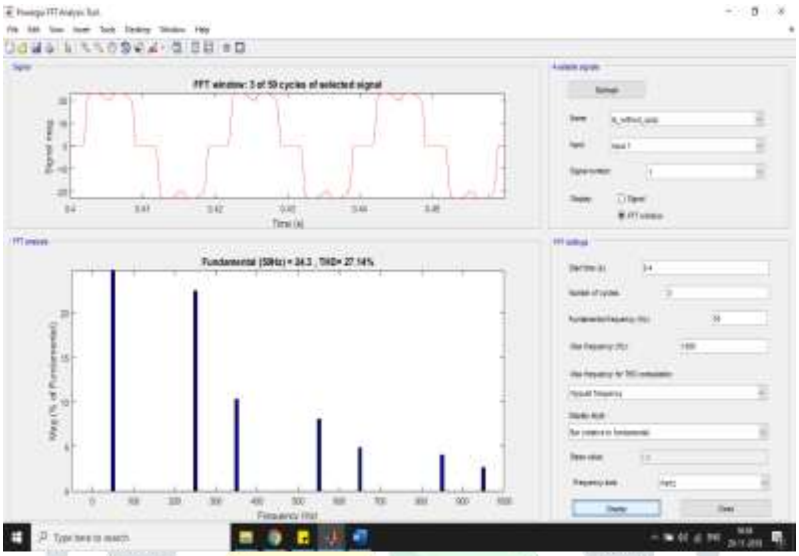

Fig.iv : THD of source current without PVA-UPQC

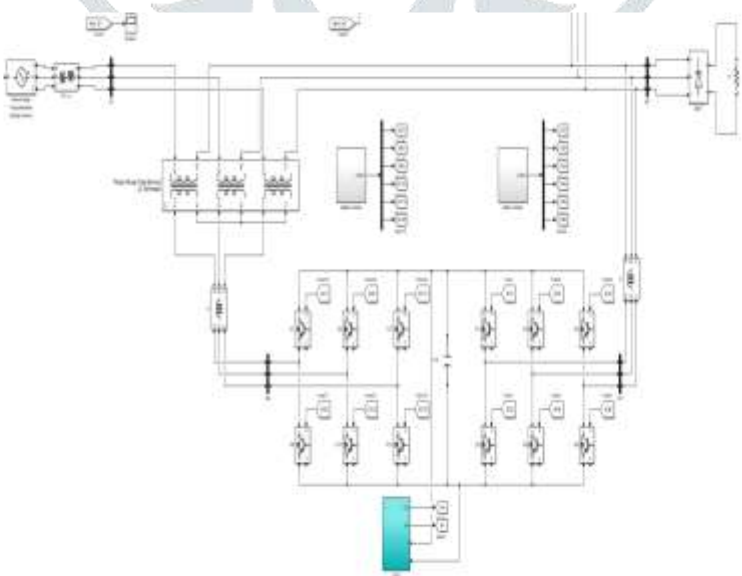

Fig.v : Test system with PVA-UPQC

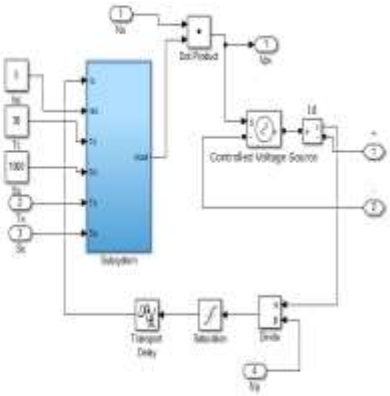

Fig vi. : PVA modelling

Fig.vii : Source and load voltage magnitudes with PVA-UPQC

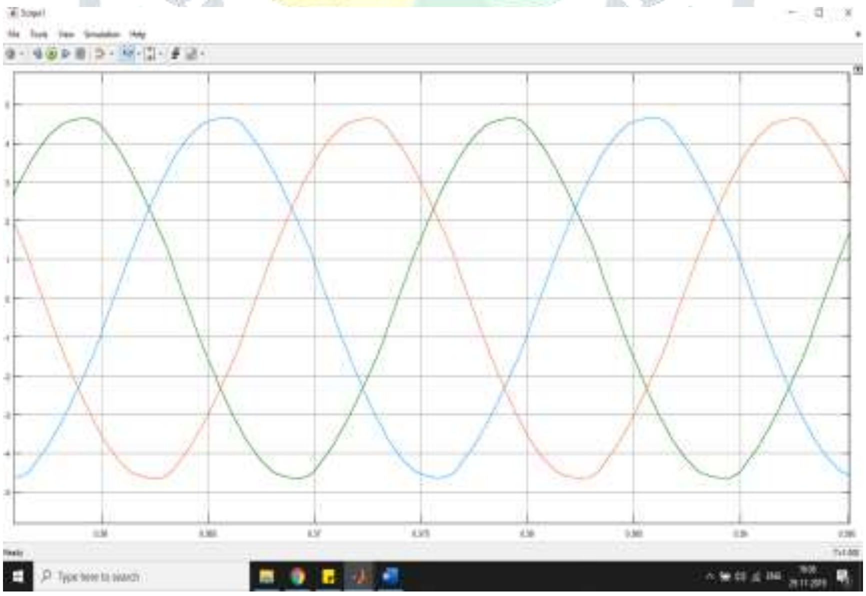

Fig.viii : Source current with PVA-UPQC

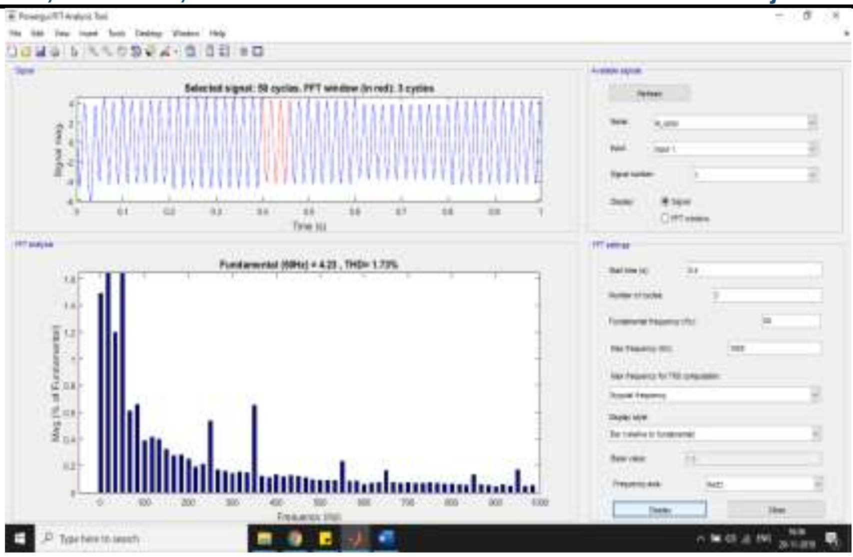

Fig.ix : THD of source current with PVA-UPQC

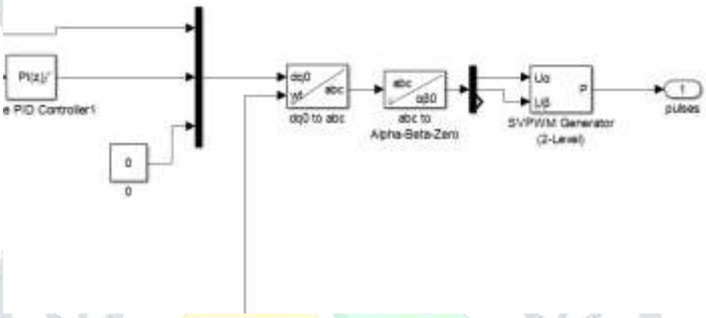

Fig.x. : PVA-UPQC updated with space vector PWM

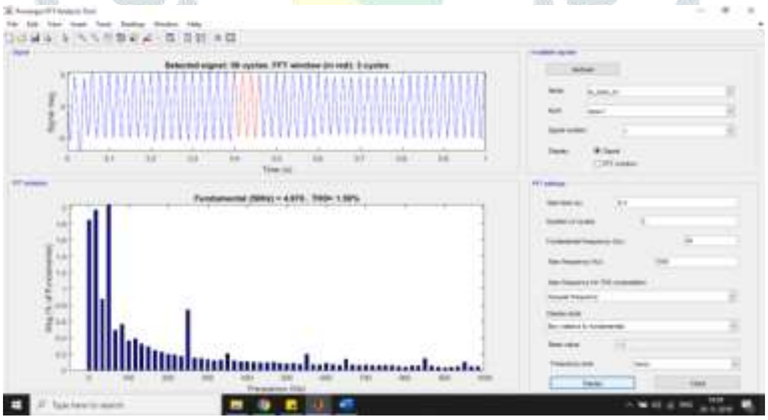

Fig.xi : THD of source current with PVA-UPQC using space vector PWM

CONCLUSION

Finally, with all of the grid and micro system output analysis and graphical display, implementing the UPQC FACTs device in a renewable grid system will increase the system's quality. The THD of the grid current is improved by the IRP method and the space vector for the shunt and series VSIs, respectively, from 27 percent to 1.76 percent and 1.5 percent with the space vector. The micro grid system's voltages and currents are improved by injecting active and reactive power from the UPQC system.

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