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ARTIFICIAL NEURAL NETWORK BASED TWO-STAGE MATRIX CONVERTER AND HARMONIC ELIMINATION TO IMPROVE POWER QUALITY

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Abstract—an efficient matrix converter using artificial neural network with power quality controller. Power quality conditioner aims at integrating both shunt and series converter through a common DC link capacitor. Due to the control technique DC link capacitor size is reduced comparably conventional method. The power quality controls distortion due to harmonics and unbalance in voltage in addition to control of flow of power at the fundamental frequency. The number of switches level is reduced due to the elimination of matrix converter. Space Vector Pulse Width Modulation (SVPWM) based Modulation technique is used to provide pulse to the gate driver. Third-harmonic injection is implemented. Due to the merits of sinusoidal input currents and excellent conversion efficiency.

Keywords—matrix converter, DC link capacitor, Space Vector Pulse Width Modulation (SVPWM),Third-harmonic injection ,Artificial neural network.

I. INTRODUCTION

Power Quality (PQ) related issues are of most concern nowadays. Electrical Power quality is the degree of any deviation from the nominal values of the voltage magnitude and frequency. From the customer perspective, a power quality problem is defined as any power problem manifested in voltage, current, or frequency deviations that result in power failure or disoperation of customer of equipment. The waveform of electric power at generation stage is purely sinusoidal and free from any distortion. Many of the Power conversion and consumption equipment are also designed to function under pure sinusoidal voltage waveforms. However, there are many devices that distort the waveform. These distortions may propagate all over the electrical network.

The widespread use of electronic equipment, such as information technology equipment, power electronics such as adjustable speed drives (ASD), programmable logic controllers (PLC), energy-efficient lighting, led to a complete change of electric loads nature. These loads are simultaneously the major causers and the major victims of power quality problems. Mainly there are different power quality problems. Voltage sag, voltage swell, harmonics, very short interruptions, long interruptions, voltage spike, noise, voltage unbalance these are the main PQ problems in power system.

A wide diversity of solutions to power quality problems is available for both the distribution network operator and end user. The measure of power quality depends upon the needs of the equipment that is being supplied. Custom Power devices are a better solution for these Power Quality related issues in distribution system. Out of these available power quality enhancement devices, the UPQC has better sag/swell compensation capability.

According to the basic idea of UPQC, it consists of back-to-back connection of two three-phase active filters (AFs) with a common dc link. The point of common coupling (PCC) could be highly distorted, also the switching ON/OFF of high rated load connected to PCC may result into voltage sags or swells on the PCC has been discussed. There are several sensitive loads, such as computer or microprocessor based AC/DC drive controller, with good voltage profile requirement; can function improperly or sometime can lose valuable data or in certain cases get damaged due to these voltage sag and swell conditions. One of the effective approaches is to use a unified power quality conditioner (UPQC) at PCC to protect the sensitive loads.
time, some dead time must be inserted between the turn-off of one transistor of the half-bridge and the turn-on of its

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complementary device. The output voltage is mostly created by a Pulse Width Modulation (PWM).

A UPQC is a combination of shunt and series APFs, sharing a common DC link. It is a versatile device that can compensate almost all power quality problems such as voltage harmonics, voltage unbalance, voltage flickers, voltage sags &swells, current harmonics, current unbalance, reactive current, etc. Recently more attention is being paid on mitigation of voltage sags and swells using UPQC. The swells are not as common as sags, but the effects of a swell can be more destructive than sag. For example, the excessive over voltage during swell condition may cause breakdown of components or equipments.

The common cause of voltage sag and swell is sudden change of line current flowing through the source impedance. The steady state analysis of UPQC during voltage sags and swells on the system. The main objective is to maintain the load bus voltage to be sinusoidal and the major concern is the flow of active and reactive power during these conditions. It plays an important role to select the KVA ratings of both shunt andseries APFs. Among different new technical options availableimprove power quality, unified power quality conditioner has found to be more promising for compensation of current as well as voltage harmonics simultaneously.

It is commonly configured with two voltage source converters connected back to back through a DC link capacitor. However, voltage source topology of UPQC has a drawback of slow control of inverter output voltage and no short circuit protection. In addition, when the active rectifier inside UPQC is used as a power factor corrector, DC bus voltage oscillations appears which makes the control of the series filter output voltage more difficult. Before mentioned problems are overcome by using current source inverter (CSI). CSI-based UPQC has a faster phase voltage control loop and inherent short circuit protection capability. It also minimizes the cost as in this case passive filter connection between UPQC and the load is not necessary.

SHUNTCONTROL STRATEGY

The shunt active power filter is provided the current and the reactive power (if the system need) compensation. It acts as a controlled current generator that compensated the load current to force the source currents drained from the network to be sinusoidal, balanced and in phase with the positive-sequence system voltages. The conventional SRF method can be used to extract the harmonics contained in the supply voltages or currents.

It is demonstrated that the dc-link capacitor could be removed through bidirectional implementation and proper control of the rectifier. An algorithm for achieving sinusoidal reactive power control range without lowering the voltage transfer ratio is developed, and mathematical proof of the correctness of the algorithm is also provided. Algorithm is also provided.

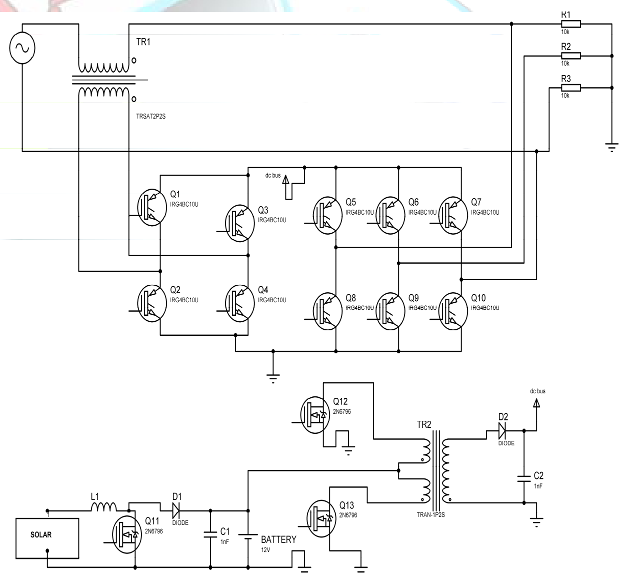
SERIES CONTROL STRATEGY

The series active power filter is provided the voltage compensation. It generates the compensation voltage that synthesized by the PWM converter and inserted in series with the supply voltage, to force the voltage of PCC to become sinusoidal and balanced. Supply voltages vabc are transformed to d-q-0 coordinates.

The voltage in d axes consists of average and oscillating components of source voltages. The average voltage is calculated by using second order LPF (low pass filter).The load side reference voltages are calculated. The switching signals are assessed by Comparing reference voltages and the load voltages and via sinusoidal PWM controller. Then d-q-0 are transformed to Vabc coordinates

These produced three-phase load reference voltages are compared with load line voltages and errors are then processed by sinusoidal PWM controller to generate the required switching signals for series APF IGBT switches.

input currents and significantly extending the input reactive power control range without lowering the voltage transfer ratio is developed, and mathematical proof of the correctness of the algorithm is also provided. Algorithm is also provided. The series active power filter is provided the voltage compensation. It generates the compensation voltage that synthesized by the PWM converter and inserted in series with the supply voltage, to force the voltage of PCC to become sinusoidal and balanced.



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II. APPLICATION SEQUENCE OF ANN

The rapid detection of the disturbance signal with high accuracy, fast processing of the reference signal, and high dynamic response of the controller are the prime requirements for desired compensation in case of UPQC. The conventional controller fails to perform satisfactorily under parameter variations nonlinearity load disturbance, etc.

A recent study shows that NN-based controllers provide fast dynamic response while maintaining stability of the converter system over wide operating range. The ANN is made up of interconnecting artificial neurons. It is essentially a cluster of suitably interconnected nonlinear elements of very simple form that possess the ability to learn and adapt.

It resembles the brain in two aspects

1) The knowledge is acquired by the network through the learning process and

2) Interneuron connection strengths are used to store the knowledge. These networks are characterized by their topology, the way in which they communicate with their environment, the manner in which they are trained, and their ability to process information.

ANNs are being used to solve AI problems without necessarily creating a model of a real dynamic system. For improving the performance of a UPQC, a multilayer feed forward type ANN-based controller is designed. This network is designed with three layers, the input layer with 2, the hidden layer with 21, and the output layer with neutral network.

A common use of the phrase "ANN model" is really the definition of a class of such functions (where members of the class are obtained by varying parameters, connection weights, or specifics of the architecture such as the number of neurons or their connectivity).

The word network in the term 'artificial neural network' refers to the inter–connections between the neurons in the different layers of each system. An example system has three layers. The first layer has input neurons which send data via synapses to the second layer of neurons, and then via more synapses to the third layer of output neurons. More complex systems will have more layers of neurons, some having increased layers of input neurons and output neurons. The synapses store parameters called "weights" that manipulate the data in the calculations.An ANN is typically defined by three types of parameters

- The interconnection pattern between the different layers of neurons
- The learning process for updating the weights of the interconnections

Employing artificial neural networks

Perhaps the greatest advantage of ANNs is their ability to be used as an arbitrary function approximation mechanism that 'learns' from observed data. However, using them is not so straightforward, and a relatively good understanding of the underlying theory is essential.Choice of model: This will depend on the data representation and the application. Overly complex models tend to lead to problems with learning.

Learning algorithm: There is numerous trades-offs between learning algorithms. Almost any algorithm will work well with the correct hyper parameters for training on a particular fixed data set. However, selecting and tuning an algorithm for training on unseen data requires a significant amount of experimentation.

Robustness: If the model, cost function and learning algorithm are selected appropriately the resulting ANN can be extremely robust. With the correct implementation, ANNs can be used naturally in online learning and large data set applications. Their simple implementation and the existence of mostly local dependencies exhibited in the structure allows for fast, parallel implementations in hardware.

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III.PROPOSED SYSTEM CRICUIT DIAGRAM

The proposed system is same as the existing system but the controlling technique and modulation techniques are replaced.Instead of PI control, artificial neutral network control system is implemented. And then SVPWM modulation is proposed in order to get the proper pulse for gate driver by sensing the load current and voltage.

The UPQC consists of two voltage source inverters connected back to back with each other sharing a common dc link. The basic configuration of the unified power quality Conditioner. The shunt converter Of the UPQC must be connected as close as possible to the non-linear load, instead of the network side. The UPQC approach is the most powerful compensator for a scenario as depicted, where the supply voltage Vs is itself already unbalanced & distorted &is applied critical load that require high power quality

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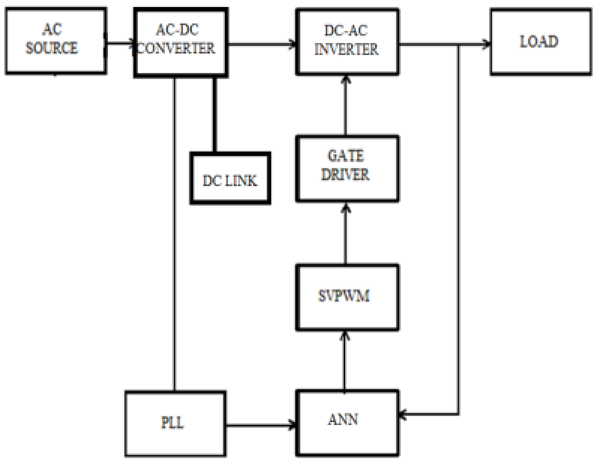

Fig 2 Block diagram of the proposed system

On the other hand, part of the total load includes nonlinear loads that inject a large amount of harmonic current into the network, which should be filtered. Current represents all nonlinear loads that should be compensated. The shunt active filter of the UPQC can compensate all undesirable current components, including harmonics, imbalances due to negative- and zero sequence components at fundamental frequency, and the load reactive power as well.

The same kind of compensation can be performed by the series active filter for the supply voltage, hence, the simultaneous compensation performed by the UPQC guarantees that both the compensated voltage VL at load terminal and compensated current is that is drawn from the power system become balanced, so that they contains no unbalance from negative and zero sequence components at fundamental frequency. Moreover, they are sinusoidal and in phase, if the load reactive power is also compensated.

Additionally, the shunt active filter has to provide DC link voltage regulation, absorbing or injecting energy from or into the power distribution system, to cover losses in converters, and correct eventual transient compensation errors that lead to undesirable transient power flows into the UPQC. It might be interesting to design UPQC controllers that allow different selections of the compensating functionalities.

BLOCK DIAGRAM EXPLANANTION

It is demonstrated that the dc-link capacitor could be removed through bidirectional implementation and proper control of the rectifier. An algorithm for achieving sinusoidal input currents and significantly extending the input reactive power control range without lowering the voltage transfer ratio is developed, and mathematical proof of the correctness of the In existing system, the functionality and performance of the third harmonic injection two-stage matrix converter (3TSMC) are investigated systematically.

It is demonstrated that the DC-link capacitor could be removed through bidirectional implementation and proper control of the rectifier. An algorithm for achieving sinusoidal input currents and significantly extending the input reactive power control range without lowering the voltage transfer ratio is developed, and mathematical proof of the correctness of the algorithm is also provided. Algorithm is also provided

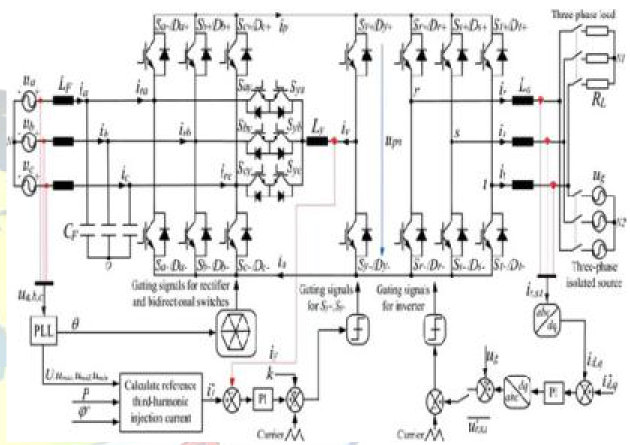

Fig 3Circuit diagram of the proposed system

IV. SIMULATION OF THE PROPOSED SYSTEM

The overall simulation of the proposed diagram is shown in the Fig.4. The reference speed and the predictive speed is compared in error detector and by based on the error speed we can use that as estimated current and the reference current is compared in artificial neural network it gives the output of controlled current output and efficient speed values.it gives a numerical value and it will be converted as pulse waveform by using pulse width modulation. Then the pulse output is given to the insulated gate bipolar transistor. And also it receives the ac supply voltage which is converted into dc source by using dc to dc converter. Then the output of insulated gate bipolar transistor is given to the induction motor. Then the speed of the motor will be controlled.

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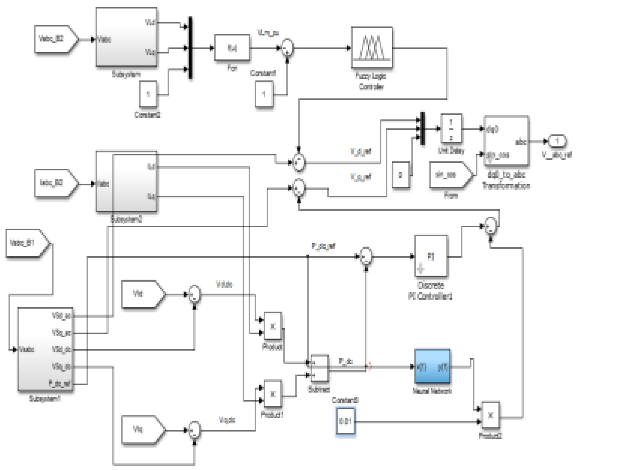

Fig. 4 .Simulation diagram of proposed system

V.SIMULATION RESULTS

The actual and estimated rotor speed is shown in fig 5. And the simulation results of speed control and torque control is shown in fig 6. And the output speed and the torque will be controlled by using artificial neural network. And the pulse width modulation is used to control the amplitude of the waveform and also it removes the unwanted harmonic wave forms. The input dc source will be controlled by using the dc to dc converter.

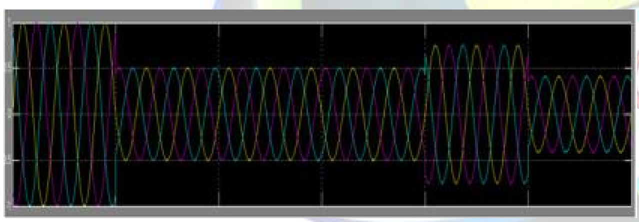

Figure Simulation Result for voltage performance

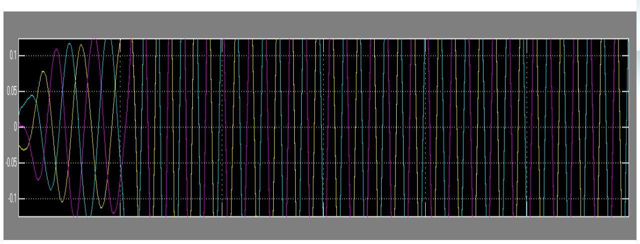

Figure Resultant waveform for harmonic injection

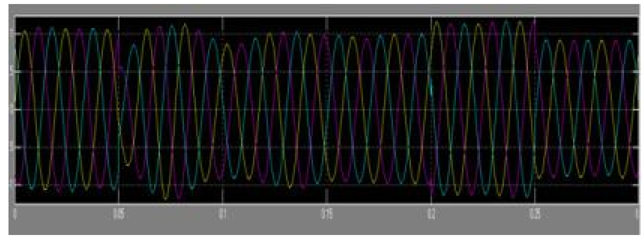

Figure Resultant diagram for overall current flow performance

VI CONCLUSION

UPQC performance mainly depends upon how accurately and quickly reference signals are derived. The simulated result shows that it has considerable response time for yielding effective compensation in the network. Using conventional compensator data, artificial neutral network (ANN) is tuned with large number of data points. Then conventional compensator was replaced with artificial neutral network controller and simulated using Matlab/simulink.

Artificial neutral network system is developed, which addresses the disadvantage of limited capability of generating the input reactive power than conventional PFC algorithm. Thus, the input reactive power control range is extended significantly by considering both the current ripple and current tracking performance; the design criteria of the third-harmonic injection inductor are discussed. The simulation results have shown that the UPQC perform better with ANN proposed scheme eliminates both voltage as well as current harmonics effectively.

REFERENCES

[1] IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, IEEE Standard 519, 1992.

[2] A. Kuperman, U. Levy, J. Goren, A. Zafranski, and A. Savernin, “High-power Li-ion battery charger for electric vehicle,” in Proc. 7th Int. Compatibility Power Electron. Conf. Workshop, Jun. 2011, pp. 342–347.

[3] P. D. Ziogas, Y. G. Kang, and V. R. Stefanavic, “Rectifier-inverter frequencychanger with suppressed DC link components,” IEEE Trans. Ind.Appl., vol. IA-22, no. 6, pp. 1027–1036, Nov. 1986.

[4] S. Kim, S. K. Sul, and T. A. Lipo, “AC to AC power conversion based on matrix converter topology with unidirectional switches,” in Proc. IEEEAppl. Power Electron. Conf., Feb. 1998, pp. 301–307.

[5] J. Holtz and U. Boelkens, “Direct frequency convertor with sinusoidal line currents for speed-variable AC motors,” IEEE Trans. Ind. Electron,vol. 36, no. 4, pp. 475–479, Nov. 1989.

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[6] L. Huber and D. Borojevic, “Space vector modulated three-phase to threephasematrix converter with input power factor correction,” IEEE Trans.Ind. Appl., vol. 31, no. 6, pp. 1234–1246, Nov. 1995.
[7] P. Wheeler, J. Rodriguez, J. Clare, L. Empringham, and A. Weinstein,“Matrix converters: A technology review,” IEEE Trans. Ind. Electron.,vol. 49, no. 2, pp. 276–288, Apr. 2002.
[8] P. Zwimpfer and H. Stemmler, “Modulation and realization of a noveltwo-stage matrix converter,” in Proc. Brazilian Power Electron. Conf.,2001, pp. 485–490.
[9] L. Wei and T. A. Lipo, “A novel matrix converter topology with simplecommutation,” in Proc. IEEE Ind. Appl. Soc. Annu. Meeting, 2001,pp. 1749–1754.
[10] L. Wei and T. A. Lipo, “Matrix converter with reduced number of switches,” in Proc. Record 20th W’EMPEC Anniversary Meeting, Oct.2001, pp. 580–586.
[11] J.W. Kolar, F. Schafmeister, S. D. Round, and H. Ertl, “Novel three-phaseac-ac sparse matrix converters,” IEEE Trans. Power Electron., vol. 22,no. 5, pp. 1649–1661, Sep. 2007.
[12] R. Cardenas, R. Pena, P. Wheeler, J. Clare, and G. Asher, “Control of the reactive power supplied by a WECS based on an induction generator fed by a matrix converter,” IEEE Trans. Ind. Electron., vol. 56, no. 2,pp. 429–438, Feb. 2009.
[13] J. Monteiro, J. Silva, S. Pinto, and J. Palma, “Matrix converter-based unified power-flow controllers: Advanced direct power control method,”IEEE Trans. Power Del., vol. 26, no. 1, pp. 420–430, Jan. 2011.
[14] F. Schafmeister and J.W.Kolar, “Novel hybrid modulation schemes significantly extending the reactive power control range of all matrix converter topologies with low computational effort,” IEEE Trans. Ind. Electron, vol. 52, no. 1, pp. 194–210, Jan. 2012.
[15] M. Rivera, J. Rodriguez, J. Espinoza, T. Friedli, J. Kolar, A. Wilson, and. Rojas, “Imposed sinusoidal source and load currents for an indirect Matrix converter,” IEEE Trans. Ind. Electron., vol. 59, no. 9, pp. 3427– 3435, Sep. 2012.