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"Comparison of D-Q, IRPT, ANN and ANFIS based Control Algorithm for Power Quality Improvement"

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Abstract
The main aim of this Paper is to satisfy the customer by improving the Power Quality issues at the utility end. Now a days Power quality get close due to large Scale use of semiconductor switches, Inductive capacitive loads which injects the Current and Voltage Harmonics in the feeder . These Problems shows the power loss in distribution system at source side By using Different control methods reduced the injected harmonics in the feeder the Control Methods D-q , IRPT,ANN and ANFIS are modeling & simulated in the Matlab2016b. The result observed that among all controlling method the ANFIS is effective method compare to other control methods. It reduces the current harmonics, improves the active Power by reducing reactive Power and also improved the transient response.
Keywords: DSTATCOM, IRP Theory, ANN and ANFIS control Technique**.**

Introduction

All electrical types of equipment suffer from power quality issues when connected to a distribution system. So this leads to currents distortion and voltage unbalance resulting in poor performance of the equipment and power losses. Due to rapid growth in the usage of electrical power in distribution, the conventional strategies offer degraded performance, which gave the direction for better-compensated strategies. Distribution Static Synchronous Compensator (DSTATCOM) is dynamically implemented to improve the power quality (PQ)problems. Among all controllers, the Distribution compensator is the most effective and powerful device to tackle the issues related to power quality. This paper discusses the various control methods required to improve power quality .D STATCOM mainly consists of three main parts, those are Voltage source converter (VSC), a set of coupling reactors and a controller. The basic principle of a DSTATCOM in a power system is the generation of a controllable AC voltage source by a Voltage source inverter connected to a dc capacitor. The AC voltage source appears behind a transformer leakage reactance.

It is well known that shunt reactive power injection may be used to control the bus voltage. In the simple strategy, both the regulators are proportional- integral (PI) type controllers. The control algorithms are obtainable for at most generations of reference sources current designed for the control of VSC based DSTATCOM is Instantaneous reactive power theory (IRP), Synchronous Reference frame theory (SRF), Sliding mode controller (SMC), Model predictive controller (MPC) and Adaptive Neuro- fuzzy inference system (ANFIS).

D-STATCOM TOPOLOGY

The DSTATCOM Topologies can be classified based on the number of switching devices, use of transformers for isolation, use of transformers for neutral current compensation, etc. These DSTATCOMs are developed to meet the requirements of multiple applications such as three- phase three-wire and three-phase four-wire distribution systems.

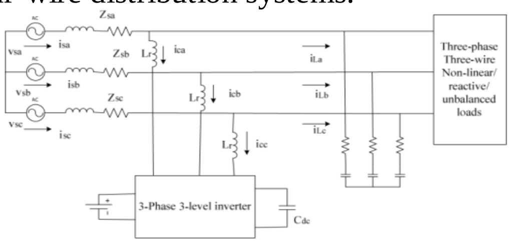

Fig.1.DSTATCOM Topology CONTROL ALGORITHMS

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INSTANTANEOUS REACTIVE POWER THEORY

Instantaneous reactive power theory has been initiallyproposed by Akagi in 1983. The hypothesis is based on the conversion of three-phase quantities to two- phase quantities in α –β frame and the estimate of instantaneous active and reactive power in this frame. In IRP method real and reactive power components arerequired. This control algorithm is utilized to assess reference signals and with the assistance of reference signals heartbeats will be delivered and these heartbeats utilized for exchanging. By utilizing Clarkechange, 3-stage signals are changed over to 2-stage segments, and these 2stage current and voltage segments are utilized to appraise P&Q segments.

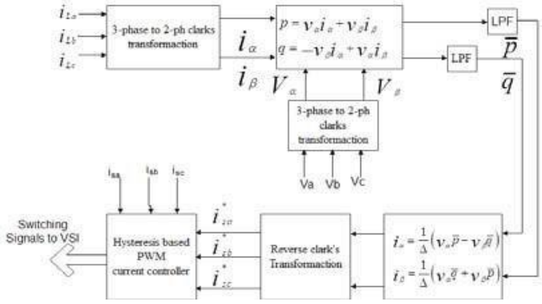

Fig. 2. Instantaneous Reactive power Theory

ARTIFICIAL NEURAL NETWORK

A three phase VSC based DSTATCOM has been implemented for compensation of nonlinear loads using BPT control algorithm to verify its effectiveness. The proposed algorithm has been used for extraction of reference source currents to generate the switching pulses for IGBTs of VSC of DSTATCOM. These results show satisfactory performance of the BP control algorithm for harmonics elimination according to IEEE-519 guidelines in order of less than 5%. The DC bus voltage of the DSTATCOM has also been regulated to rated value without any overshoot or undershoots during load variation. Large training time in the application of complex system, selection of number of hidden layer in system is the disadvantage of this algorithm.

ADAPTIVE NEURO-FUZZY INTERFERENCESYSTEM

To moderate the current related Power quality issues executed a control method based on the Adaptive Neuro fluffy derivation framework least mean square (ANFISLMS) for a three-stage conveyance static compensator (DSTATCOM). This calculation is shown for different elements of DSTATCOM, for example, solidarity power factor, load adjusting, music remuneration and voltage guideline. The key dynamic and receptive force segments from non- sinusoidal burden flows are assessed to reference supply flows from ANFIS-LMS based control calculation. The VSC comprises six protected entryway bipolar semiconductors (IGBTs) switches against equal diodes. The non-direct burden is displayed with an uncontrolled rectifier series R-L branch. The DSTATCOM is associated at PCC with the assistance of interfacing inductors (lf), associated with channel compensator flows.

HYSTERESIS CONTROLLER

The three phase load currents shown in Fig. 2, have already been transformed to the synchronous reference frame (a-b-c to d-q-0 transformation). A high pass filter is used to extract the dc component representing the fundamental frequency of the currents. The coordinate transformation from three-phase load currents (Ila, Ilb, Ilc) to the synchronous reference frame based load currents (Ild, Ilq, Il0). The high pass filter to remove the dc component of load current should only be applied to the Ild current. Q axis current (Ilq) is applied to inverse transformation to compensate reactive power. Zero axis current (Il0) must be used when the voltages are distorted or unbalanced and sinusoidal current are desired. In this study, it is not investigated.

The dc side voltage of APF should be controlled and kept at a constant value to maintain the normal operation of the inverter. Because there is energy loss due to conduction and switching power losses associated with the diodes and IGBTs of the inverter in APF, which tend to reduce the value of Vdc across capacitor cdc.

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Simulation Diagrams

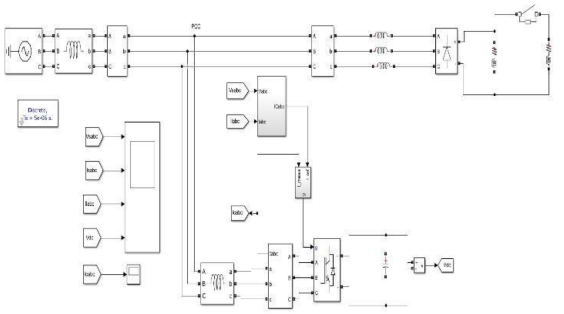

Fig.3.Simulation model of IRPT based control algorithm for shunt compensation in grid connected system

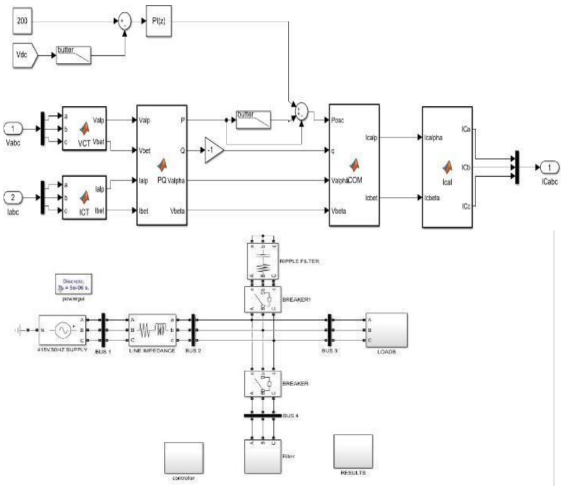

Fig.4.Subsystem model of IRPT based control algorithm for shunt compensation in grid connected system

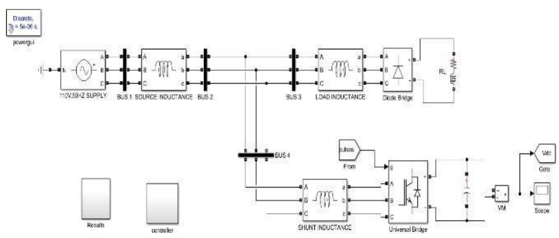

Fig.5.Simulation model of ANN based control algorithm for shunt compensation in grid connected system

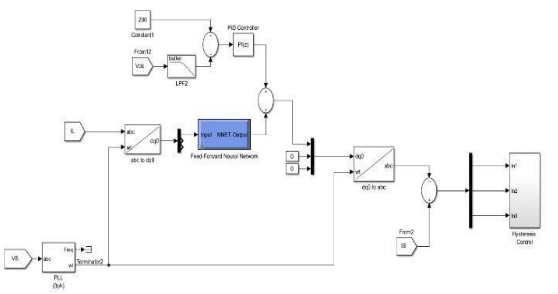

Fig.6.Subsystem of ANN based control algorithm for shunt compensation in grid connected system

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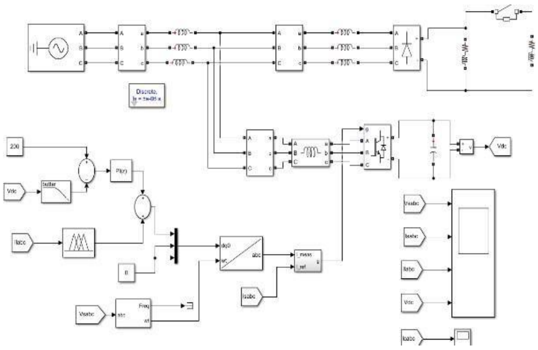

Fig.7.Simulation model of ANFIS based control algorithm for shunt compensation in grid connected system

Simulation Results

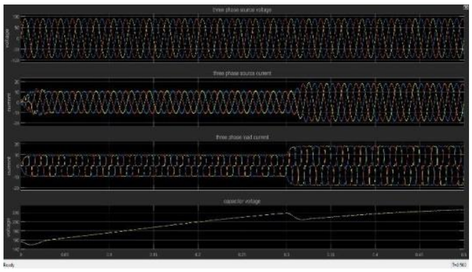

Fig.8.Output results of IRPT based control algorithm for shunt compensation in grid connected system

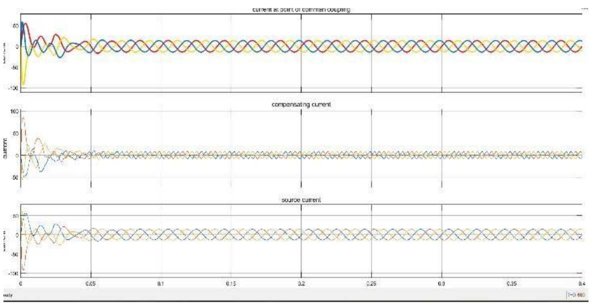

Fig.9.Output results of ANN based control algorithm for shunt compensation in grid connected system

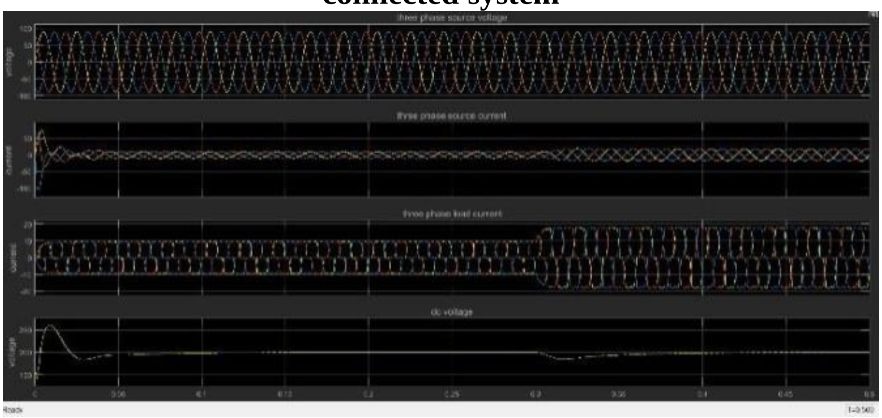

Fig.10: Output results of ANFIS based control algorithm for shunt compensation in grid connected system

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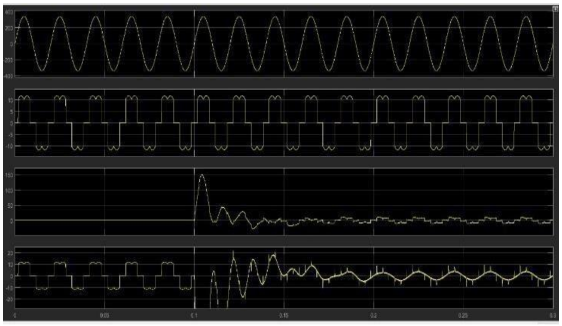

Fig. 11. Output results of D-Q based control algorithm for shunt compensation in grid connected system

CONCLUSION

This paper demonstrates the comparative analysis of IRPT (Instantaneous Reactive Power Theory), ANN (Artificial Neural Network), D-Q and Adaptive Neuro Fuzzy Inference System based (ANFIS) method and the demonstration is carried under dynamic load condition. The fundamental component of current of IRPT, ANN and ANFIS are extracted and compared. A comparative analysis of dc link capacitor voltage is also done. THD in case of IRPT, ANN and ANFIS is analyzed and the result demonstrates that THD in ANFIS is 1.06% which is better when compared to IRPT and ANN.

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