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Application ANN Controller to APF to Improve Power Quality in DG System

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Article Info
Volume 83
Page Number: 10957 - 10962
Publication Issue:
May- June 2020

Article History
Article Received*: 19 November 2019*
Revised*: 27 January 2020*
Accepted*: 24 February 2020*
Publication*: 19 May 2020*

Abstract

Generally, Power Quality is the main concern in the present power system. It mainly effects due to sudden changes in load, other environmental conditions. Power Quality main effects on system voltage and current. To compensate the problems in system voltage a series active filter is proposed and also for mitigating system currents a shunt active filter is implemented. The gate signals required for series and shunt filters is designed with help of system parameters and dc-link voltage of filter. To get better quality and harmonic distortion, an artificial neural network is implemented to control the dc-link voltage of both filters. This system is verified in Matlab/Simulink and compared the results with conventional controller.

Keywords: *3-Level Inverter, ANN Controller, Series and shunt active Filters, Power Quality and Harmonic Distortion.*

I.INTRODUCTION

In the last decade, the plants related to fossil fuels such as coal, gas and petroleum plays a key role to meet the load demand. But the major concern with these plants is that, these plants may cause global warming, pollution and releases carbon di-oxide which is harmful to humans and plants. Renewable energy systems has the solution in power plants to overcome these problems. The most reliable DG systems are PV and wind as freely available in nature, high efficient and economical [1].

This distributed system is used to operate different load conditions. This variation of load changes mainly effects the power quality problems. These problems may be in-terms of voltage and current quality [2]. This paper concentrate to compensate power quality improvement by compensating harmonics in system currents effected by utilization of load changes. To compensate these problems, a custom power device called as active filters is implemented to grid connected DG system. The control diagram for these filters are designed with dc-voltage controller and reference three phase currents are generated with unit vector process. And also ANN Controller is used to regulate dc-voltage of CPD to improve the power quality [3]. For high-voltage and high-power applications, multi-level inverters plays a key role and have some advantages over conventional inverters. These inverters improves the voltage quality and also have capable to reduce the switching voltage stress. Presently multilevel inverters have become more attractive for researchers due to their advantages over conventional three-level Pulse width-modulated (PWM) inverters. Here, the series and shunt active filters are implemented in neutral-point clamped based multi-level inverter concept. To obtain proper switching pattern to NPC converter a PWM controller is designed.

Published by: The Mattingley Publishing Co., Inc.

TEST Engineering & Management

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ISSN: 0193-4120 Page No. 10957 - 10962

II.PROPOSED SYSTEM

Custom power device (CPD) is a combination of power electronic tool as a controller and a condenser as a compensator which is used to give a quality of power to consumers [8]. This power electronic converters is generally designed with voltage source converters, because these VSI has a capable of self-supporting of dc-bus voltage controller. CPD are classified into two types such as a) Compensating Type and b) Network Reconfigure Type.

Generally, power quality problems occur mainly due to variations of load, system parameters and switching conditions. Here, the proposed grid system with PV is applied to operate different load conditions such as, unbalanced and non-linear loads. The following are the classifications of compensating type CPD's a) Series Filter, b) Shunt Filter. To compensate the harmonics generated with non-linear load a Series and Shunt controllers [8] are proposed in this paper. The structure of proposed system is shown in figure 1.

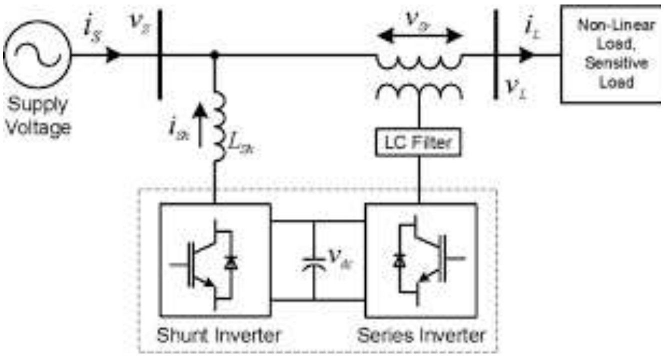

Figure 1: The topology of the NPC three-level

NPC Topology:

Figure 1 shows the topology of the NPC three-level inverter with LC channel at the yield side. Every leg has four IGBTs associated in arrangement. The NPC-3L inverter utilizes two split capacitors in arrangement for DC connection, and produces zero voltage level. In this manner, the voltage drop on the IGBT will be Udc/2 which is one-a large portion of that of the regular two level inverter, where Udc is the

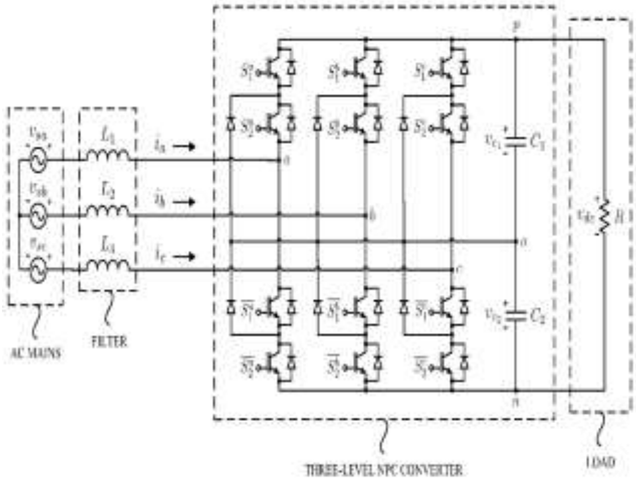

Figure 2: Topology of the NPC three-level inverter

Series Active Power Filter:

Figure 3, shows the structure of series active filter. This circuit consists of three level NPC, series injection transformer and dc-link capacitor. Neutral point converter is used to generate three level voltages and also control system voltages

under different conditions such as, sag, swell and voltage disturbances.

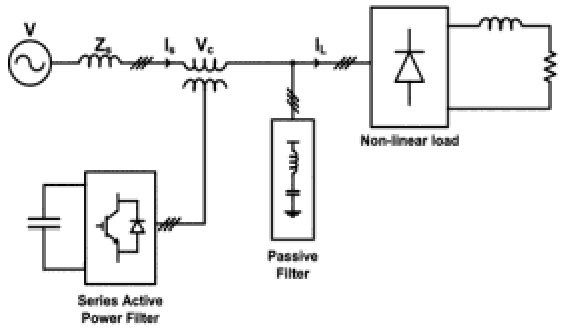

Figure 3: Structure of Series Active Filter

The series converter is used to control the fluctuations in system voltages such as sag, swell and disturbances. The control signals required for series converter is generate with the help of dc-link voltage of the APF and grid voltages. These voltages are transformed to two-phase coordinates i.edq-axis frame. And after making comparison of these applied to PWM converter to generate gate signals [8]. The structure of series active filter control diagram is shown in figure 4.

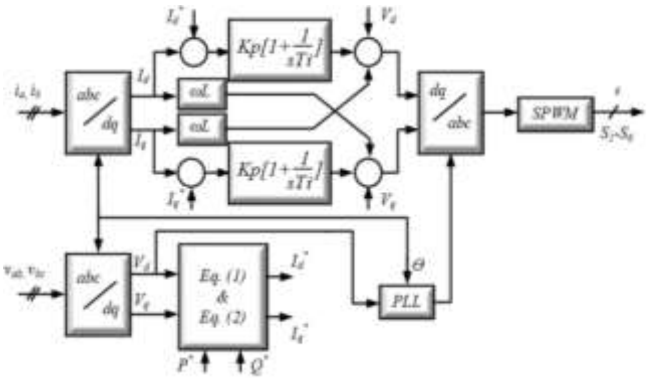

Figure 4: Structure of proposed PSO based GSC control diagram

Shunt APF controller

The Shunt APF is one of the member in Shunt controller family. It consists of VSI converter and Capacitor which are connected in parallel with existing system. The purpose of Shunt APF is used to compensate bus voltage sag by receiving or supplying reactive power in distribution system. The structure of Shunt APF is shown in figure 5.

all out voltage of DC connect. This element makes is progressively appropriate for the application with higher DC transport voltage. Furthermore, the NPC inverter has some other great highlights including lower basic mode voltage and lower yield current wave for a similar exchanging recurrence contrasted and the traditional two-level inverter. Thus, a littler yield channel is required contrasted with an equal evaluated two-level inverter.

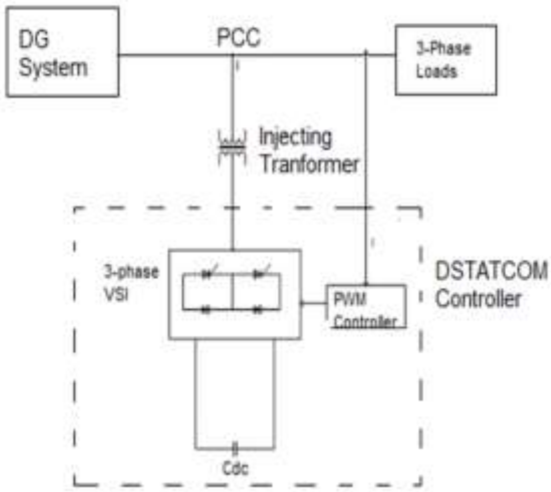

Figure 5: control structure of the shunt inverter

ANN CONTROLLER:

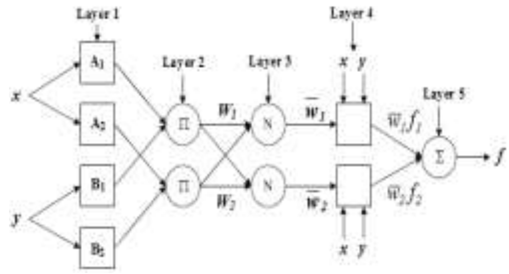

Figure 6: Architecture of Artificial Neural Network

Figure 6 shows the artificial neural network architecture. In this paper, feed forward neural network is chosen. This network basically consists of three stages namely input layer, hidden layer and output layer. The inputs of ANN is called neurons. Here, each input is divided into 5 neuron values named as {MP, SP, Z, SN, MN}. This neurons at input layer is occupied with weights and bias to generate outputs. The outputs at first stage is acts inputs to the second stage and then to third stage (output stage). After train the feed forward

Published by: The Mattingley Publishing Co., Inc.

May- June 2020
ISSN: 0193-4120 Page No. 10957 - 10962

network, the simulation block will generate with the help of 'gensim' command.

III.SIMULATION RESULTS &DISCUSSIONS

The proposed NPC based shunt and series converter distributed system shown in figure 1 is implemented in Matlab Environment under to controllers 1) PI controller 2) Fuzzy Logic Controller and 3) ANN Controller. And also simulation results are shown below.

Case-1: With PI Controller

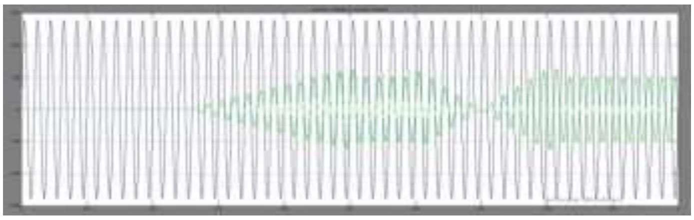

Figure 7: Source Voltage & Current with Three Level Series & Shunt Converter with PI Control System

Figure 8: Dc voltages of series & shunt converters

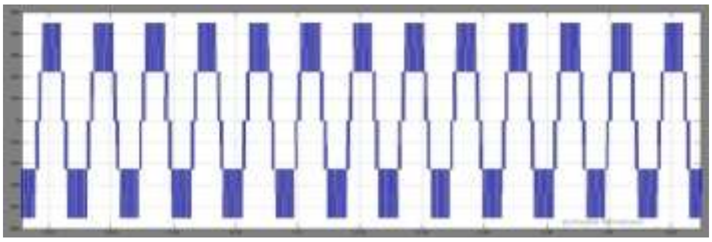

Figure 9: three level voltages of proposed converter

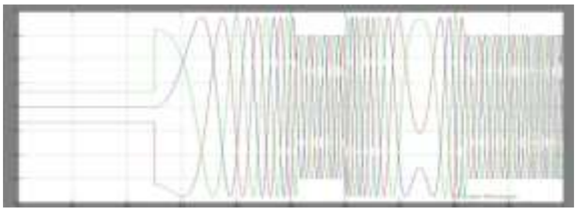

Figure 10: Unbalanced load voltages at motor using PI controller

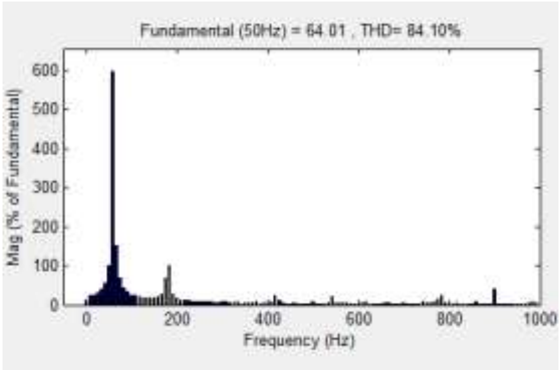

Figure 11: THD for NPC voltage using PI Controller

Case-2: With Fuzzy Controller

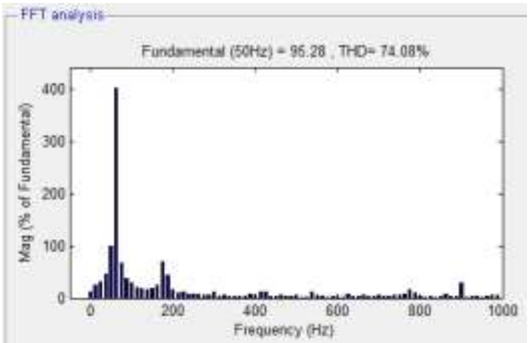

Figure 11: THD for NPC voltage using Fuzzy Controller

Case-3: With ANN Controller

Compared with conventional PI and Fuzzy

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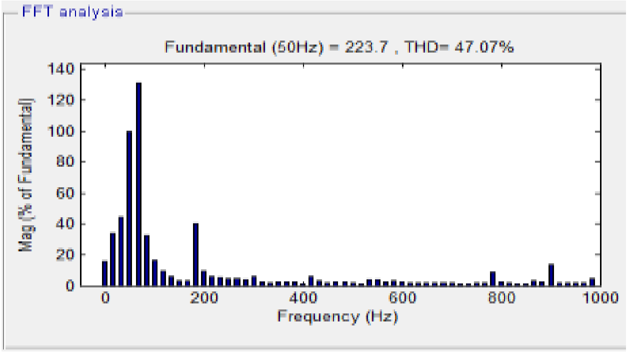

Figure 12: THD for NPC voltage using ANN Controller

IV.CONCLUSION

To improve the power quality of distributed system, an ANN based series and shunt active filters are implemented in this paper. To achieve improve voltage imbalances the series and shunt converters are designed by using 3-level neutral point clamped converters. The control diagrams for two filters are implemented using dc-link voltage and system parameters. To get better power quality of the proposed system the control diagrams are implemented by 1) conventional PI Controller 2) Fuzzy Controller and 3) ANN Controller. The simulation results shown under conditions.

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