Power Quality Improvement in Distribution System using SAPF with Feed Forward Neural Network and PQ theory

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Abstract- This article focuses on the Feed Forward Neural Network (FFNN) controller based on the Shunt Active Power Filter (SAPF) to reduce the harmonics of the distribution system. Electronic power loads are connected to distributed power plants using power converters, and these converters and electric power are a harmonic and active source of power that affects the operation of the power system network. The proposed method works mainly according to the capacitor power principle to maintain the DC switching power of the integrated filter and thus reduce the short response time in the event of a sudden difference in load. A complete model of the power system blocks of the proposed system was developed in MATLAB/Simulink.

Keywords - Active Power Filter, Power Quality, Feed Forward Neural Network

1 Introduction

Replace compensation called active filters or power conditioners that provide additional functionality for standard LC filters, as they can compensate for more harmonic orders and are not affected by significant changes in network signals, reducing the risk of noise between the filter and avoiding network impedance and compaction, and is stronger than traditional artificial compensation.

In recent years, with the advent of energy semiconductor technology, in various areas [1] power-based electronic devices, such as variable speeds, furnaces, switches, uninterrupted power supply. Some of these converters not only increase the active currents but also produce harmonics from the current source. to soften harmoniously; various solutions are suggested and used by researchers in texts, such as line editors, synthetic filters, functional filters, etc. [2]. First, a standard synthetic filter is used to eliminate harmonics; but this idle filter has some flaws; such as large size, fixed harmonic compensation, weight, and resonance. The above negative filters performed can be overcome in the sense of an effective power filtering method. A powerful Shunt type filter (SAPF) is used to eliminate current harmonics [3]. The SAPF topology is similarly linked to the current harmonic compensation. The shunt-active force filter can keep the current balance. even if the load is not linear and unbalanced or unbalanced. Recent technological advances in switching devices and the availability of inexpensive control devices, e.g. The DSP field-centered system designed for the hole, offers a flexible power line adjustment, a natural option for charging harmonics. The controller is the heart or main component of the SAPF system [4] [5].

Standard PI and PID controls are used to discharge the basic part of the load current, which helps to reduce harmonics and at the same time control the DC-side capacitor voltage of the main probe. Neural networks are systematically used in electrical engineering. This approach is considered to be a new tool for designing SAPF control circuits. Neural networks provide two key elements: it is not necessary to establish certain input-output values but is done through a learning process. In addition, the corresponding computer structure increases system speed and reliability [6].

In this paper, a new FFNN-based SAPF management approach will be introduced. Loads and currents are audible, the control blocks determine the regional power control signals from the reference compensation streams, and the power circuit injects the current compensation into the energy system. The article focuses mainly on the system using the FFNN system and similar results are discussed. In this paper, the shunt APF with hysteresis band control is used to compensate for indirect loads [7]. Now, these converters and electric power sources are sources of harmonics and active power that greatly affect the performance of the power system network, as using indirect loads, varying over time will distort current and energy power and demand for excessive power on ac mains. The presence of harmonics on power lines creates significant power losses in the distribution system, disruption problems in many communication systems, and, in some cases, failure of electrical and electronic equipment, which is particularly critical as it incorporates microelectronic control systems, operating at low power levels. Because of these problems, the topic of energy quality delivered is a much bigger thing than ever before. Functional energy filters have become very popular due to their excellent performance in reducing harmonic and functional energy problems [8-10].

2 Shunt Active Power Filter

This filtering phase is the most important type and is widely used in active filtering. Active shunt filter is a filter that now compensates for the power line to cancel harmonic currents on the source side, a grid area where energy quality is important. It is widely used to eliminate current harmonics, compensate for active energy, and to balance unequal currents with additional current injections (drawing) [1, 2,11].

3 Harmonic mitigation using SAPF

Harmonics are reduced by Active Power Filter in shunt mode which can be controlled by Artificial Neural Network (ANN). There are three types of filters for the purpose of minimizing harmonic, functional, idle, and hybrid filters. Among the three, the active filter in the shunt mode effectively removes the harmonic, with the current compensation output, equal in size but in the opposite direction to the harmonics. And it will not affect the stability of the power system. An active power filter developed by the static compensator (STATCOM), the active energy compensation can be obtained by STATCOM. Following the figure is indicated by the basic principle of the active power filter[12].

4 Configuration of shunt active power filter (SAPF) and estimation of compensating current

The active shunt power filter consists of a three-phase source, universal bridge, loading, and active filters. The SAPF will now generate compensation. The linear load is the current source of the source and the harmonic current. The aim is to obtain a balanced current supply in addition to the harmonic and active elements. The appropriate current is assigned by the SAPF corresponding to the current load. SAPF is built by an FFNN. The proposed controller, which controls the electrical control of THD and DC, the controller has a fast and powerful response in the event of a current load deviation. Proper operation of the controller results in the construction of 3-phase inverter gate signals which are also responsible for producing compensating currents.

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5 Simulations

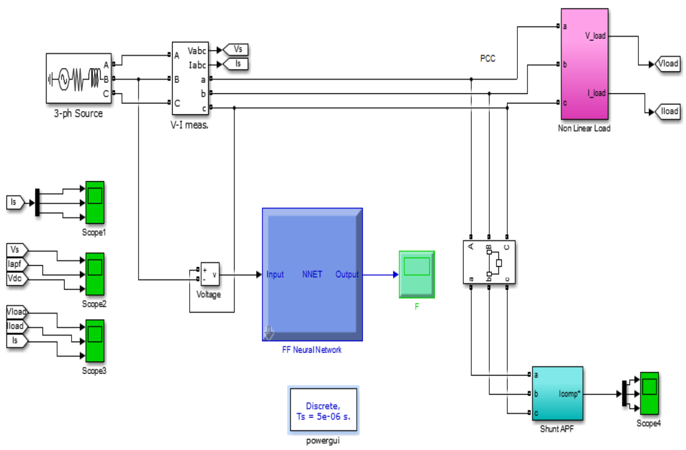

Figure 3 MATLAB/Simulink Model

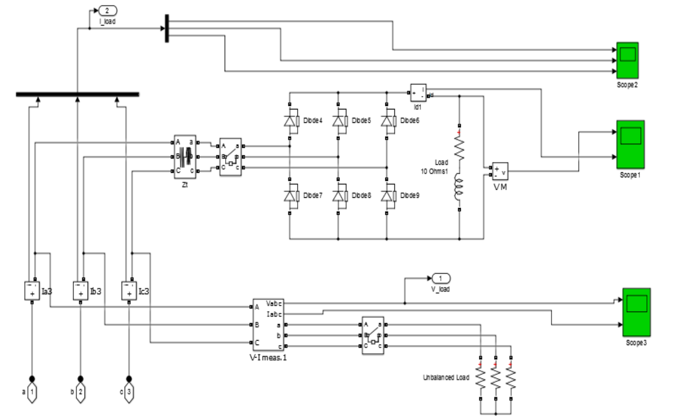

Figure 5 Non linear load model

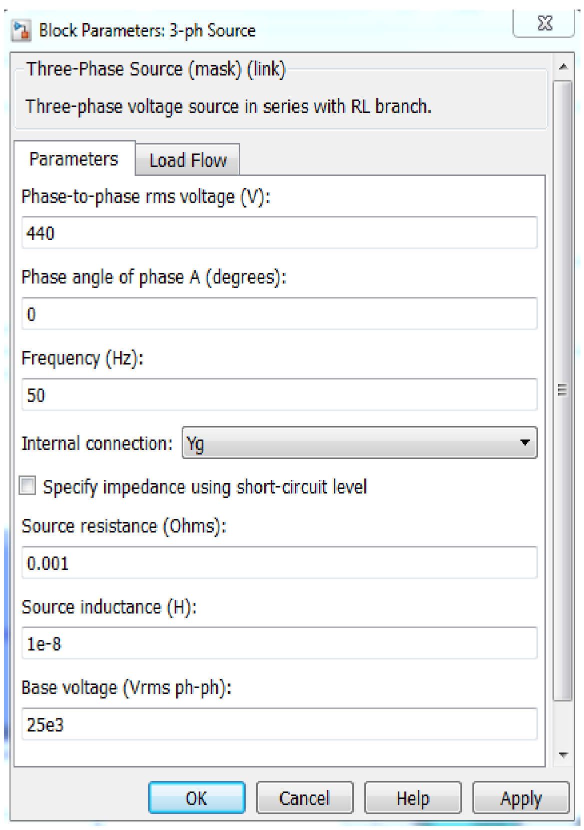

Figure 4 Input Power Supply

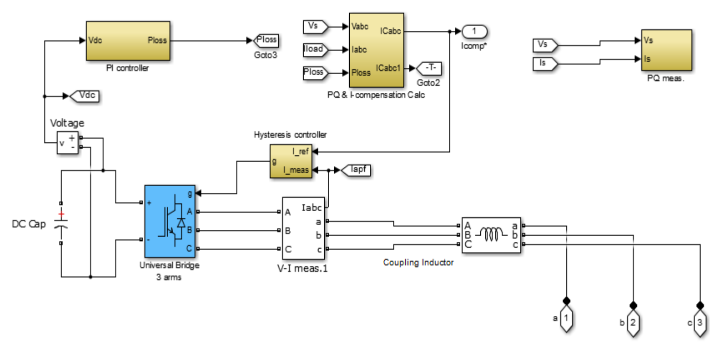

Figure 6 Shunt Active Power Filters with PQ & I-compensation

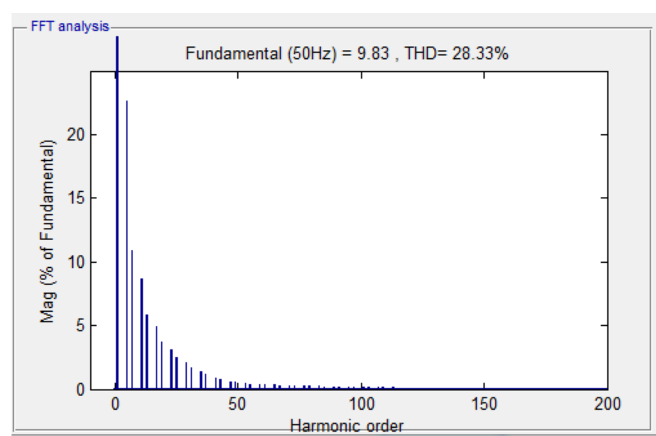

Figure 7 Total Harmonic Distortion (THD) without using Feed Forward Neural Network

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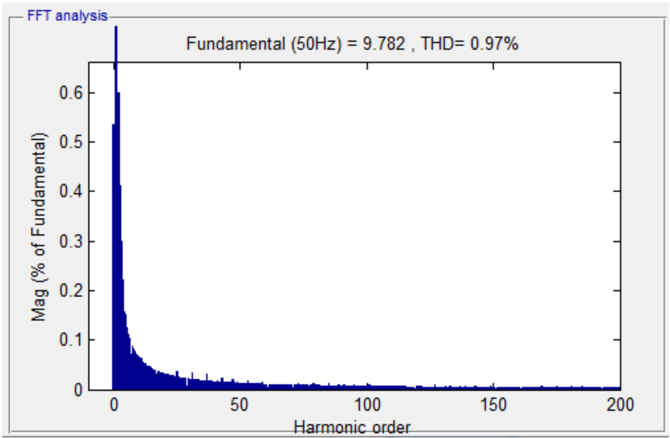

Figure 8 Total Harmonic Distortion (THD) Feed Forward Neural Network

6 Conclusions

In this paper, a detailed analysis of the Shunt Active Power Filter and Feed Forward Neural Network controller (FFNN) has been suggested to reduce the harmonics of the three-phase distribution system. The results obtained reflect the simplicity and functionality of the proposed control under offline loading conditions. From the results, it was seen that the complete current harmonic disturbance is best reduced with an active FFNN-controlled filter. The main purpose of this proposed approach lies in the controller using the FFNN used to determine the current source sent by the SAPF system. The proposed method was used in the MATLAB/ Simulink software. The simulation was performed using MATLAB, noting that% THD was reduced to 0.97% from 28.33% by an FFNN-controlled filter.

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