Study about Power Filters in Power System Quality and Stability Enhancement

Rajesh Raghuvanshi
M.Tech Scholar
Truba College of Science and Technology
Bhopal (MP), India
raghuwanshirajesh27@gmail.com

Mithlesh Gautam
Assistant Professor
Truba College of Science and Technology
Bhopal (MP), India
mithlesh.gautam1@gmail.com

Abstract: **The excessive power electronics devices in the distribution systems have evolved the problem of power quality. Arc Furnaces, Variable Frequency Drives (VFD), Computer power supplies play a major role in the deterioration in the quality power by injecting harmonics in the utility supply source. Extensive use of non-linear loads leads to a multitude of unwanted harmonics in the operation of the electrical system. Of these, the harmonics of current and voltage are the most significant. in this paper presented is the power quality and the Shunt Active Power Filter and the description of the Harmonics and Its Effects.**

Keywords: VFD, harmonic function, active pass filter, power quality.

I. INTRODUCTION

Extensive use of non-linear loads leads to a multitude of unwanted miracles in the operation of the electrical system. Of these, the harmonics of current and voltage are the most significant. Generally, an active filter was used to attenuate the harmonics of the mains current. However, they introduce resonance into the system and tend to be bulky. In this sense, active power filters are better known than passive filters because they simultaneously compensate for reactive power and harmonics.

The active power filter topology can be switched in series or shunt or a combination of the two. Active shunt filters are better known than series active filters because the vast majority of sectors require harmonic current compensation. Different types of active filters have been proposed to improve the quality of the electrical system. The characterization depends on the following measurements.

- System parameters to compensate (eg harmonic currents, power factor and harmonic voltages)
- Base current and voltage evaluation technology.

Inverters with a current controlled voltage source can be used with a suitable control system to effectively operate the active power filter.

II. LITERATURE REVIEW

Abdul Kahar et al. [2] the point of this investigation is to locate the ideal size boundaries of the single opened coupled channel in the non-sinusoidal system utilizing another strategy called Optimization of the appropriated subterranean insect state in blended numbers. The inductance and capacitance estimations of the channel are acquired for every model in which the force factor is boosted, the force dispersal in the venin resistor is limited or the transmission proficiency is expanded as per the specialized and viable limitations dependent on IEEE Std. 519-2014 and IEEE Std. 18-2012. An inside and out examination was made and talked about in which the general least and greatest qualities are reached after non-direct loads, the estimation of the channel that would present reverberation, the complete consonant contortion of the voltage, a result of the venin impedance on the charging voltage and practice capacitor esteems were considered.

Arunsankar et al. [3] This paper proposes a proficient mixture approach utilizing SHAPF to lessen sounds to keep up PQ in the dispersion system. A successful mixture approach is the joint execution of an EGOA and an ANN called EGOANN. The fundamental target of the proposed system is to improve energy quality by decreasing sounds exposed to the base THD. With the proposed approach, EGOA upgrades the informational collection of essential and consonant circle boundaries, for example, terminal voltage and DC voltage present in the SHAPF dependent on the variety of the heap and the variety of the system parameters.The reproduction result shows that symphonious mutilation in response to stack variety or force system boundary variety can be diminished to an adequate level by the proposed EGOANN half and half innovation. The proposed strategy is likewise more effective

with less figurings and decreases the intricacy of the calculation.

Buch et al. [4] This paper gives an enhanced butterfly fire advancement (AMFO) calculation to viably settle Optimal Power Flow (OPF) issues. The possibility of Moth Flame Optimization (MFO) is driven by the development of the moth towards the moon. AMFO basically centers on the term MFO, which is the place where the bearing of the moths is changed adaptively around the fire. The recreation aftereffects of the proposed calculation are contrasted and those of other known enhancement techniques. The outcomes acquired show the limit and strength of the AMFO way to deal with tackle OPF issues. The outcomes show that the AMFO calculation can accomplish exact and improved OPF arrangements over different techniques. An examination of the union characteristics of the AMFO and the various strategies shows that the AMFO prevails to accomplish the ideal current stream arrangement with quick combination.

Jiale Zhou et al. [5] To evade short-circuits between the upper and lower switches of converters accepting overcurrent assurance, dead time in the exchanging control signal for voltage source converters is compulsory. To begin with, the impact of dead time is investigated, considering variables, for example, the zero square marvel, voltage drops among diodes and semiconductors and the heap boundaries of inverters, and the parasitic idea of switches Semiconductor. Second, this article presents the most recent personal time remuneration calculations. Third, the preferences and burdens of existing calculations are talked about, just as future patterns in personal time remuneration calculations. This article furnishes an exhaustive personal time pay situation with voltage source converter control techniques that scientists can use to distinguish suitable arrangements dependent on need and application.

III. Power Quality

The PQ problem is defined as "any event that manifests itself as voltage, current or frequency deviations and results in damage, malfunction, failure or malfunction of terminal equipment". Almost all PQ problems relate to almost every aspect of commercial, domestic and industrial application closely related to PE. Devices that use power electronic devices are household appliances such as televisions, PCs, etc. Business and office devices such as copiers, printers, etc. The power quality (PQ) problem can be identified by one of the following symptoms, depending on the nature of the problem.

- Lamp flickers
- Frequent failures
- Frequent neglect in sensitive devices
- Unexpected ground voltage
- Communication problems
- Overheated items and devices.

PEs are the main cause of harmonics, inter harmonics, notches and neutral currents. Harmonics are generated by rectifiers, ASDs, soft starters, electronic ballasts for gas discharge lamps, switching power supplies and HVAC systems with ASD. Devices affected by harmonics include transformers, motors, cables, circuit breakers, and capacitors (resonance). The notches are mainly made by converters and mainly affect electronic control units. Neutral currents are generated by devices using switching power supplies such as personal computers, printers, copiers, and triplet generators. Neutral currents significantly affect the temperature of the neutral conductor and the performance of the transformer. Inter harmonics are generated by static frequency converters, cyclo converters, induction motors and electric arc devices.

IV. Harmonics and Its Effects

Power systems are designed for frequencies of 50 or 60 Hz. However, some loads can generate voltages and currents with frequencies above the fundamental frequency of 50 or 60 Hz. Electrical pollution, or harmonic distortion, can be caused by these frequency components highest. There are two types of harmonics in an electrical network:

- Synchronous harmonics
- Asynchronous harmonics

Musicians are as aware of harmonics as the nuances of an instrument. These are whole number products of the basic recurrence of the instrument, which are framed by a progression of standing floods of expanding request. Exactly the same process occurs in electrical circuits where non-linear loads generate harmonic currents that are integer multiples of the base supply frequency. Joseph Fourier introduced the concept of harmonics in the early 19th century. Fourier showed that all non-sinusoidal periodic signals can be represented by an infinite series of sine waves with discontinuous frequencies, as indicated by the equation.

$$i(t) = I_0 + \sum_{h=1}^{\infty} I_h \cos(h\omega t + \varphi_h)$$

The I_0 component of the Fourier series is the direct component. The first term of the sum of the index h = 1 is the fundamental of the signal. The other components of the series are called harmonics of the h range.

V. Shunt Active Power Filter

The active power filter connected in shunt with a self-monitoring DC bus has a topology similar to a static

compensator (STATCOM), used for reactive power compensation in power transmission systems. The shunt active power filters compensate the harmonics of the load current by providing the compensation current of the same opposite harmonics. In this case, the active power shunt filter functions as a current source, which supplies the harmonic components generated by the load, but is 180° out of phase.

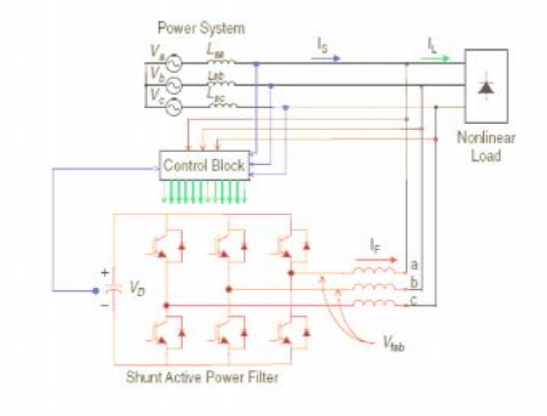

Fig. 1 Shunt active power filter topology

VI. Artificial Neural Network (ANN) Controller

The ANN (Artificial Neural Network) controller is often used in various fields of technical and non-technical applications. ANN has aroused great interest in feeding systems applications due to its simple structure, simple forming process, fast response, high performance and flexibility. ANN has clever speculation or the thought of making the decision based on the information, tilt and adjustment procedure prepared all around. The ANN controller has been split and classified as "ADALINE",

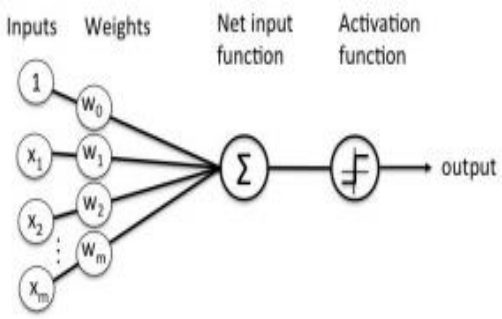

Fig. 2 Schematic diagram of ADALINE network

Adaptive Linear Element, MADALINE, Widrow-Hoff, Perceptron, Radial Basis Function (RBF), Hebbian, Back propagation (BP), Competitive Grossberg and Hopfield ". In the power supply system, ANN controllers are well known for their ability to reduce harmonics. In the proposed ADALINE model system, the ANN controller structure is used in an active shunt filter, which compensates for the current regulation with its simple and simple structure and quick response. Using the ANN controller provides quick response by reducing the rise time by approximately 33% compared to the PI controller.

This schematic diagram consists of two levels, called an input level with a number with n inputs and an output level with two outputs, and a multilayer direct acting ADALINE neural network is used. The ANN learning process is very different and takes place through supervised learning and unsupervised learning or self-learning. The ADALINE neural network performs weight correction based on the value of the output error.

VII. Conclusion

In this paper presented is the power quality and the Shunt Active Power Filter and the description of the Harmonics and Its Effects. The active power filter topology can be switched in series or shunt or a combination of the two. Active shunt filters are better known than series active filters because the vast majority of sectors require harmonic current compensation. Artificial intelligence based controllers are being described in this paper.

References

[1] V Taraka Rama Reddy, T Siva Sai “Harmonic Mitigation and Power Quality Enhancement Using PV Fed Series Active Filter for Grid Systems” international journal of scientific & technology research volume 9, issue 01, january 2020.

[2] Abdul Kahar, N, Zobaa, A (2019) “Application of mixed integer distributed ant colony optimization to the design of undamped single-tuned passive filters based harmonics mitigation”. S and E Computation 44:187–199.

[3] Arunsankar, G, Srinath, S (2019) “Optimal controller for mitigation of harmonics in hybrid shunt active power filter connected distribution system”: An EGOANN technique. Journal of Renewable and Sustainable Energy vol 11, issue 2, 1–16.

[4] Buch, H, Trivedi, I “An efficient adaptive moth flame optimization algorithm for solving large-scale optimal power flow problem with POZ, multifuel and valve-point loading effect”. Iranian Journal of Science and Technology, Transactions of Electrical Engineering 43(4): 1031–1051, 2019.

[5] Jiale Zhou, Yong Yang “Control Strategies of Mitigating Dead-time Effect on Power Converters: An Overview” Electronics 2019, 8(2), 196.

[6] A.Sivakumar, N.B.MuthuSelvan Reduction of source current harmonics in ANN controlled induction motor, Alexandria Engineering Journal, Volume 57, Issue 3, September 2018, Pages 1489-1499.

[7] Biswas, P, Suganthan, P, Amaratunga, G “Minimizing harmonic distortion in power system with optimal design of hybrid active power filter using differential evolution”. Applied Soft Computing 61: 486–496, 2017.

[8] NareshMalla, Dipesh Shrestha “Online Learning Control for Harmonics Reduction Based on Current Controlled Voltage Source Power Inverters” IEEE/CAA Journal of AutomaticaSinica, Vol. 4, No. 3, July 2017

[9] Das, S, Ray, P, Mohanty, A “Improvement in power quality using hybrid power filters based on RLS algorithm. Energy” Procedia 138: 723–728, 2017.

[10] Rangarajan, S, Collins, E, Fox, J "Efficacy of a smart photovoltaic inverter as a virtual detuner for mitigating network harmonic resonance in distribution systems". Electric Power Systems Research 171: 175–184, 2019.