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An Investigation Into The Design Of Dft- Based Controller For Reducing Harmonic Content In Active Power Hunt Filters

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ABSTRACT

Selective harmonic compensation is essential for power quality evaluation, harmonic restoration, and other applications. There are many methods for correcting harmonics in a network, but discrete Fourier transform (DFT)-based solutions have gained popularity because of features including their ease of use and exceptional capabilities for selective filtering. For signals known only at N instants separated by T sample durations, the discrete Fourier Fourier transform (DFT) is equivalent to the continuous Fourier transform. In this work, a discrete Fourier transform (DFT)-based controller coupled with an active power filter (APF) is used for selective harmonic removal. The transient performance of the APF and the modeling approach are given careful, suitable design.

Keywords: closed-loop, Active power, controller, compensation,

I.INTRODUCTION

Current harmonics in the power system network are mostly compensated for by active power filters. Harmonics exist because non-linear loads are present in the power system network. Peak overshoot, imbalanced loading conditions, and reactive power support are some issues that APF is utilised to control. Several studies explore the design and development of active power filters (APFs). Due to its comparatively poor performance, the network-side shunt-connected DVR (NSSC-DVR), one of the four basic dynamic voltage restorer (DVR) topologies, is evaluated in this study. A unique configuration is suggested and put into use to enhance the ability of the NSSC-DVR to reduce voltage harmonics and compensate for (un)symmetrical deep and prolonged voltage sags [1]. Because the control process of APF plays an vital task to compensate for the harmonics present in the system. In [3] there are various filters used to compensate harmonics currents, the EMI filters and APF are discussed briefly. A brief control strategy of APF used in multiple voltage source PWM converters. From the utility side, the main problem is the interference of adjustable speed drive (ASD) with APF.

To reduce the current harmonics in the ASD a proper design and implementation [2]. Before injecting the compensationcurrent in the system, we know the distorted current present in the load.

To provide hints and advice for the digital logic, a sliding discrete Fourier transform thatis precise and guaranteed constant is provided (DSP). There is discussion of the SVFT-Based control approach. In order to remove low harmonic content utilized in DSP-based repeated control method, this offered a programmable based efficiency in an AC power supply. Internal models for controllers with many linear variables [3]. Active filters with a sinusoidal internal structure are examined and a current-tracking technique is applied. It is simple to grasp how the active shunt filters' frequency-domain and time-domain control schemes compare.

Selective harmonic elimination is a crucial task in the operation of active power filters. The APF is used in many applications to reduce both current-based, and voltage-based harmonics presents in the network. The application issues of APF are discussed in [4]. grid-synchronization linked rectifiers being used in a motor drive system to charge an electric motor. The removal of harmonics in a radial power distribution system using an active shunt filter based on voltage detection is suggested in [5]. To get rid of voltage harmonics, the synchronous frame harmonic isolator uses a series filter. For high power hybrid active filter systems, a square-wave inverter control approach was presented in. Real-time testing has been done on a prototype configuration in both steady-state and transient conditions. The voltage phasors are calculated using a 64-point discrete Fourier transform (DFT), and they have a minimal mean square error (MSE). Utilizing low-cost microcontrollers and open-source software, this prototype was created [6]. Additionally, selective harmonic compensation for active filters is eliminated using the feedback loop. For APF applications, a variety of harmonics approaches are employed to identify the selective harmonic removal. For active power filters, suggested reference current calculation methods are employed in. The frequency domain accuracy check is completed.Every utility business now needs to automate substations in order to maximise efficiency and boost the calibre of power being delivered as the complexity of the distribution network has expanded. The proposed technology, which is IOT-based substation control, will help utility companies cut the length of intensity intrusion by ensuring that local-substation issues are immediately discovered and notified to the proper departments [7].

Data analysis is used in the validation approach described in this study to identify the source of atypical data indicative of a microgrid's behaviour. Information from a standalone PV microgrid in Bhutan is used in the investigation. The waveform aberrations of the data were investigated. Using the explicit Fourier transform and the Hilbert-Huang Transform (HHT) (DFT). A time-varying frequency that is new to electrical systems is revealed by HHT [10]. Y.W. Li and J. He, they proposed an overview of DG-interface inverters and to compensate the harmonic presents in the distribution system. A grid harmonic and fundamental element identification approach for single-phase systems was put forward in. As stated in, switching devices without power storage elements use immediate reactive power converters. In, it is addressed how to detect the harmonic and fundamental elements of voltage level by a Kalman filter and generalized averaging [8].There are various references the current generation are produced in both traditional and modern methods. The conventional techniques are based on frequency domain and time domain applications. Time domain represents P-Q theory and SRF theory. Frequency domain the fast Fouriertransforms (FFT), Sliding Discrete Fourier transform (S-DFT), R-DFT, and wavelettransform. Excellent accuracy and fast dynamics are achieved in frequency domain techniques. In modern techniques, the soft computing techniques areused. Artificial neural networks and adaptive filtering are used [9]. To implements, theDFT based controllers in APF plays a significant role in removing the selective harmonics in the grid. In proposed an update tosliding DFT (S-DFT).

II. APPLICATION OF ACTIVE POWER FILTERS

Figure 1. depicts the design of shunt active power filters (SAPF). It shows the ACsource is directly connected to the load. The non-linear loads are connected in the utility side produced harmonics and draws reactive power from the grid [16-19] Thus the active power filters have the following components present in the circuit they are (i) Directive current operational circuit, (ii) Current tracking control circuit, and (iii)the Main circuit. First, we know thedistorted current value in the grid for compensation procedure.

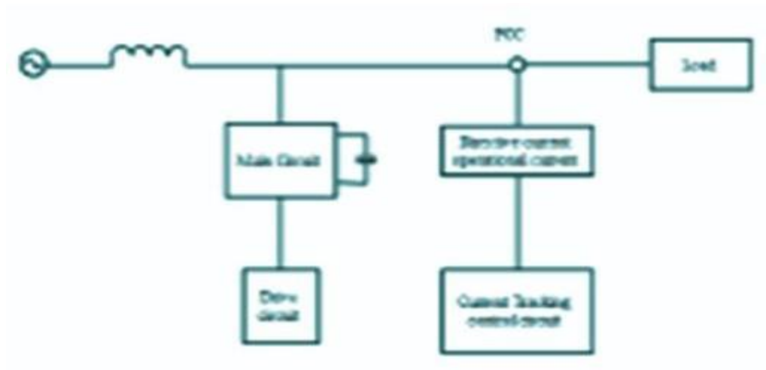

Fig.1: Schematic diagram of Shunt active powerfilter system

To detect the distorted current or voltage value, the directive current operational currentblock is directly coupled to the Point of Common Coupling (PCC). The compensating current entering the circuit is managed by the current tracking control circuit. It regulates a dynamic operational condition's flow. A microinverter uses the rive circuit to operate in grid synchronisation. As a result, the main circuit is used to directly feed the grid with the compensating current. Inversion is the primary function of the main circuit. Additionally, the APF is employed to correct typical voltage-based power quality issues.

2.1 Basic Components of SAPF

Control circuitry: The primary function of the control circuitry is to control the problems that are based with power quality. In this paper, PI controller is used as a controller to reducing the harmonics in the system. The control circuit may also do the following functions:

1. Voltage control.
2. Current control.
3. Reference current generation.
4. Reactive power support.
5. Harmonic elimination

Firing angle generator: The firing angleis used to produce a gate pulse for operating voltagesource inverter (VSC). It is mainly used to control the switches in VSC.

Voltage source Inverter: The VSC isused as a pulse width modulation (PWM) for controlling current and voltage waveforms. The performance of VSI depends on the current reference generation, dc bus voltage, and storage devices.

2.2 Reference current generation

The current reference generation is mainly classified into two types. One is traditional, and another one is modern. In conventional control method, the time and frequency domain are initialized. In the frequencydomain, the Fourier transform based control is handled.[20-21] Thus, it can be classified into four major groups (i)FFT, (ii) S-DFT, (iii) R-DFT and (iv) wavelet.

2.3 Discrete Fourier Transform

When only an instant of a signal is available, the continuous Fourier transform is replaced by discrete Fourier transform (DFT). Assume that the data's source is a continuous signal. Samples shouldbe indicated.

The original signal's Fourier Transform would be

$$F(j\omega) = \int_{-\infty}^{\infty} f(t)e^{-j\omega t}dt$$

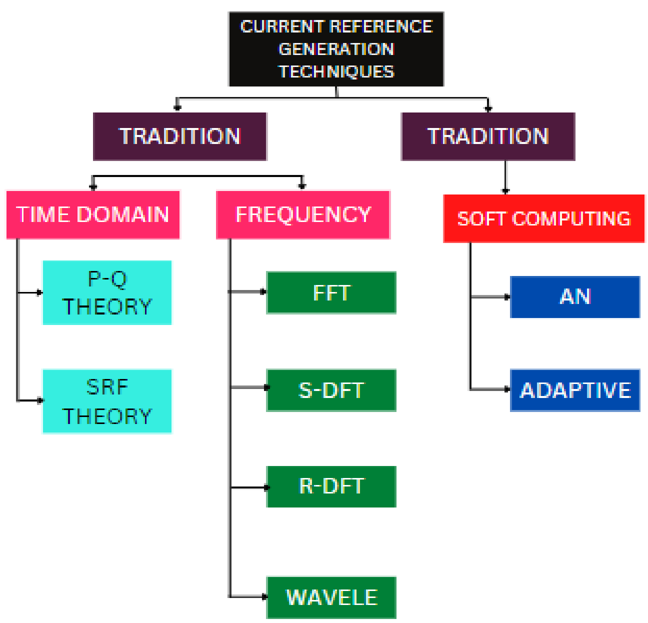

Fig.2: Classification of reference current generator techniques

Each sample could be thought of as an area-containing impulse. Since the integrand only leaves the points, we might theoretically assess this for any, but with only final outcomes to work with, only those will have any real meaning. You might recall that if the waveform was regular, the continuousFourier transform might be performed across the most recent interval rather than from to. The DFT similarly analyzes the data as though it were regular since there are a finite amount of points of input data.

III. PROPOSED SYSTEM

General topology of the system is explained in Fig.3. Thus forward to propose a DFT-controller we know about the general behavior of the SAPF. It compensates the current-based harmonic problems presents in the grid. The inductor Lf is used for smoothing operation because due to some disturbance in the grid, the peak overshoot occurs. The inductor Lac is used for line inductor connected to the non-linear load. This paper proposed a new technique DFT-based controller used in SAPF for selective harmonic elimination. In the proposed DFT-based controller have the following components.

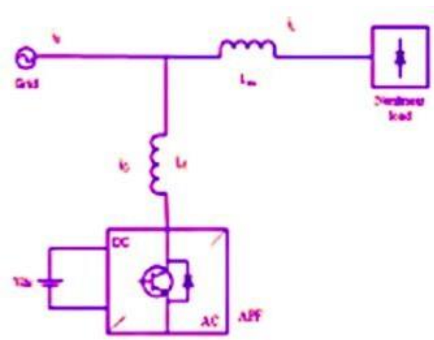

Fig -3 General topology

The first is a DFT-based controller, the second is a PI controller, the third is a present control loop, and the fourth is a voltage regulation loop. A DFT-based controller was employed for either leading or trailing frequency adjustment in order to increase stability of the system. a DFT-based control framework for precise tracking even with recurring disturbances The suggested solution, nevertheless, is more effective and durable. The suggested controller's complexity is unaffected by the number of harmonics that need to be adjusted for and by its reduced sensitivity.

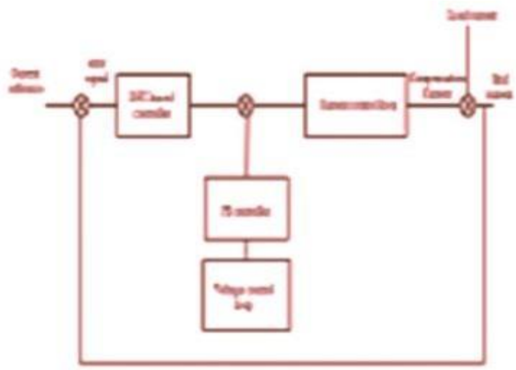

Fig.4: Proposed DFT-based controller

DFT may be used to pick the desired harmonics as a digital signal. The trial findings on hardware with a lower rating attest to the effectiveness of the suggested fix. The suggested controller was built on sliding DFT to lessen the load of calculation and make it simple to choose the various harmonics, accordingly. The DFT analyzes the information as if it were cyclic at certain points.

IV. RESULTS ANALYSIS

Utilizing MATLAB software, the shunt active power filter's performance is evaluated. The resistive rectifier load and the inductive rectifier load are two different types of loads that have been considered as nonlinear loads in the proposed system. Figure 6 illustrates the effectiveness of the shunt active power filter under a restive rectification load. Harmonic Current Deviation of the current waveform in this instance was 28.9 % before the shunt active power filter was inserted, and it decreased to 2.34% after that. Similar to this, the THD of the source power for an inductive converter load decreased from 26.32 % to 3.45% after the addition of a shunt active filter. Fig.
8. displays the source current's outcome for this scenario..

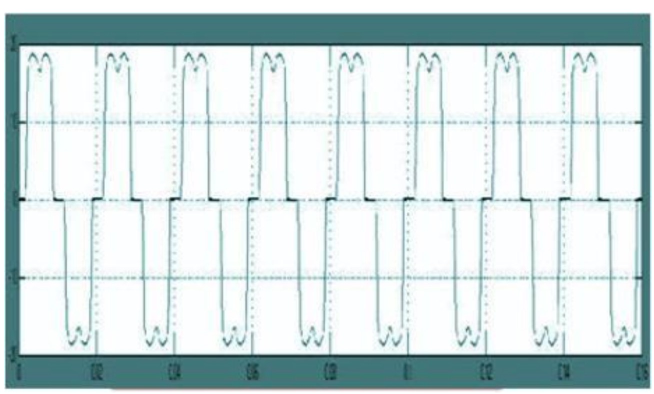

Fig. 5 current source

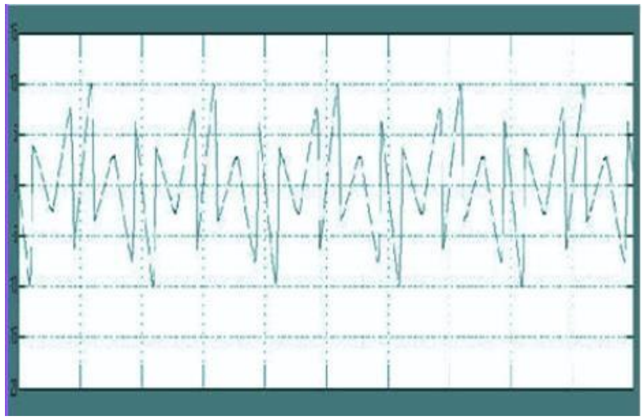

Fig. 6 Compensating current

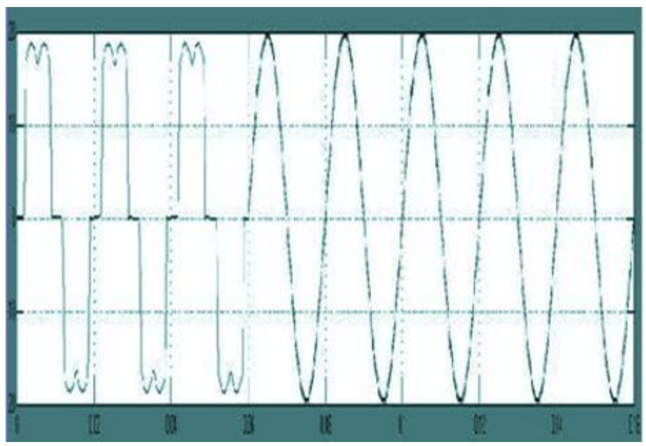

Fig. 7 Load current

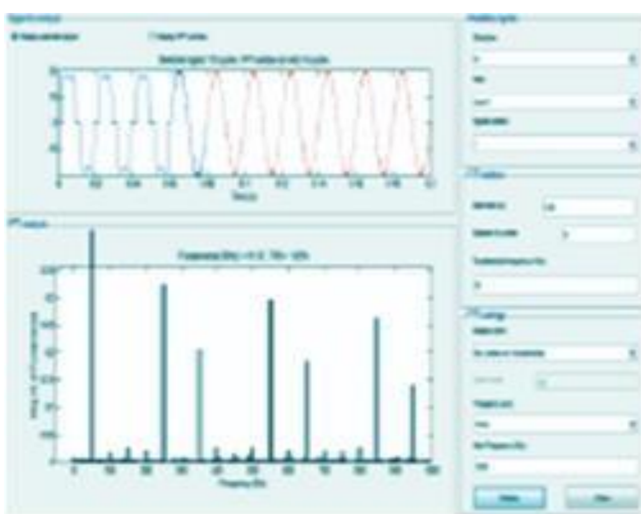

Fig. 8 Individual harmonic comparison for Rectifier R load

V. CONCLUSION

According to the frequency features of the system at each harmonic, the DFT-based controller receives a selective harmonic removal in the system. The suggested controller is improving power quality issues that are voltage- and current-based.Hence it is also supporting reactive power and achieve a very precise tracking the current in the periodic disturbance. To prove the concept of the proposed controller have been verified using Atmega 328 microcontroller by the experimental results. The results show better compensation for selective harmonic elimination inthe grid system.

REFERENCES

1. Mr.A.Balamurugan An improving power quality in load side dvr based compensation using versatile nonlinear modulation strategy Journal of Applied Science and Computations 6 (V), 568- 578.
2. Mr,A.Balamuruganperformance analysis of unified power quality conditioner in a grid connected wind generation system ,Journal of Applied Science and Computations 6 (V), 2262-2270.
3. A.Samydurai, Abel Rathan Jacob, Balaji.S and BalaMurugan.V, “Automated Alert Response And Monitoring System Using Smart City Principles”, Journal of Computational and Theoretical Nanoscience, 2019
4. A.Balamurugan, K. Thenmozhi, Design and Implementation of Transformer less Micro Inverter for PV-Grid Interface International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-9, July 2019.pp.1748-1752.
5. A. Samydurai and Vasuhi S, “An Enhanced Fault-Tolerance Based E-Content Delivery System Using Range Queries on Peer-to-Peer Networks”, 2016. Asian Journal of Information Technology, 15: 211-216
6. Karn, Shalini, Arpan Malkhandi, and T. Ghose. "Laboratory prototype of a phasor measurement unit using FPGA based controller." In 2016 International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), pp. 2029-2034. IEEE, 2016.
7. A. Balamurugan, R. Bhavya, K. Radhakrishnan, M. Kannan, N. Lalitha Substation Monitoring and Control based on Microcontroller Using IOT,International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7, Issue-5S3, February 2019.pp.581-585.

8. A Balamurugan, R Sumathi,Renewable Energy Based Grid Connected Inverter to Improve Power Quality,International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249- 8958, Volume-8 Issue-5, June 2019.pp.2652-2656.
9. Pandey, V. K., Upadhyay, R. K., Kargeti, H., & Tripathi, A. A. (2020). Impact of Hindu mythology on happiness with mediating effect of quality of life at the workplace. International Journal of Work Organisation and Emotion, 11(1), 77-88.
10. Chen, Hao, Huawu Liu, Yan Xing, and Haibing Hu. "Enhanced DFT-based controller for selective harmonic compensation in active power filters." IEEE Transactions on power electronics 34, no. 8 (2018): 8017-8030.
11. Mandakini: Gupta, I., Jha P., (2016). Gender and Space in the Paintings of Raja Ravi Verma and Amrita Sher-Gill, 'Understanding Built Environment: Discussion of Architectural Advances and Sustainable Urban Regeneration", (Ed.). Fumihiko Seta F.,, Arindam Biswas A., Khare A., Sen J.,Transactions in Civil and Environmental Engineering published by Springer vol-1, 2016 (ISBN 978-981-10-2138-1).
12. Kulia, G., Molinas, M., &Lundheim, L. (2016, October). Tool for detecting waveform distortions in inverter-based microgrids: a validation study. In 2016 IEEE Global Humanitarian Technology Conference (GHTC) (pp. 525-531). IEEE.