International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 8 Aug. 2022, pp: 534-538 www.ijaem.net ISSN: 2395-5252

Passive Filter Optimization Processes In Order To Achieve Low Voltage and Current Harmonics

Rakesh Jajara, Kalpana Meena
[1,] Student, Rajasthan Institute of Engineering and Technology, Jaipur, Rajasthan,
[,2] Assistant Professor, Rajasthan Institute of Engineering and Technology, Jaipur, Rajasthan

---

Submitted: 01-08-2022 Revised: 11-08-2022 Accepted: 14-08-2022

ABSTRACT:Owing to their negative effects on both electronic products and service providers, harmonic problems in energy systems are now a significant concern for business users and energy distributors respectively. Customers can, irrespective of the current or voltage interference currently existing in the system and also aim to minimize harmonic emissions.The energy firms are continuously fighting to offer customers with the best services, offering reliability as well as potential impacts. The ideal option to these conditions is to incorporate renewable sources into distribution networks, and solar PV are among the second strongest and most efficient energy supplies.P.V. solar. Customer-side systems are placed to enhance the voltage profile of vehicles and to minimize transmission loss. This chapter gives a FA that could be used to minimize the induced harmonic distortions and calculate the device's output. Contrasted to other methods, the outcomes and FA have greater dominance.Comparison to the base paper approach, the proportion of reduction in real power failures achieved through the FA technique was also reported and an increase in the device power system was noted.

KEYWORDS: Power Systems, Harmonic, Firefly Algorithm, Passive Filter Optimization

I. INTRODUCTION

Power generation networks are now distributed over a large area and a wide range of applications are related to the energy grid. It is very essential to effectively evaluate the required values linked to the power system during development and preparation of energy systems. Thus, issues with the power grid, which could

It can happen, it could be pre-determined and changes could be made against it.Harmonics is now one of the most common problems in the power grid, particularly with the development of semi-conductor engineering. Readings of the harmonic impact of loads in the power grid have been carried out in this research and the relation of these flows to harmonic distortion has also been demonstrated. In addition, the influence of harmonics occurring in the power grid on the output of certain instruments was experiments analysed[2]. The study findings were addressed and proposals were given.

Harmonics could be characterized as calculations involving larger amounts of frequency elements with regular waveforms. Harmonics, one of the most important power quality concerns, have finally returned to attention, but they have been recognized since the initial periods of the AC power devicesin 1893, just eight months after the building of the first AC power plant, scientists carried out harmonic studies to define and cure the issue of motor heating[2]. An article that was published by E.J. A.E. and Houston One of the first publications in which the term harmonic is being used Kennely in 1894[3]. In particular, the aspects linked to harmonics became prevalent after electronic control tools were substantially entered into energy systems. In addition to improve the quality of energy and eradicate the harmful impact of pre amplitudes on the power grid, it is important to determine harmonic magnitude rates and to analyse harmonics as well. Transmission lines, Spinning Equipment, Power converters, Fluorescent Bulbs, Arcing Machines are also the various harmonic origins.

The rest of this paper is structured as follows: Section II discusses the Firefly approach. Explain literature review of FA algorithm and harmonic currents in Section III. The Proposed objectives and simulation findings are provided in Section IV and V. Section VI concludes the research of this paper.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 8 Aug. 2022, pp: 534-538 www.ijaem.net ISSN: 2395-5252

II. FIREFLY ALGORITHM

The Firefly Algorithm (FA) is a methodology of met-heuristic optimization developed by Xin-She Yang[4] that resembles a community of fireflies' social behaviours. These classes of fireflies interact by using rhythmic lights flashing produced through bioluminescence, and also drawing prey or seeking mates. Thus, the FA optimization is a swarm-based search approach with a collection of "fireflies" move within the solution space, every reflecting a fitness-selectable possible solution. Two main variables, variance of light intensity (brightness) and the composition of attractiveness, primarily direct the search procedures. By initializing a randomized swarm community, the optimization process starts. From the optimization problem given, the original swarm population of the fireflies, indicated by P0, is produced as

$$P_0(f) = (f_1, f_2, f_3 \dots f_n)^T \quad (1)$$

$$for\ f_i = (1,2,3 \dots n) \quad (2)$$

It is recognized that the light intensity, I, varies with the measure of the average velocity or radius defined by r:

$$I(r) \propto \frac{1}{r^2} \quad (3)$$

In contrast, the strength of light often depends on a coefficient, defined as the correlation of reflection, γ, in actual circumstances. Light intensity could be defined as intensity of light for a specific material with a defined light absorption factor γ.

$$I_i = I_0 e^{-\gamma r^2} \quad (4)$$

In which Ii is the light source at the ith iteration, I0 is the initial intensity of light; γ is the constants of light absorption, γ∈ [0, ∞]; and r is the radius among two fireflies. The sharpness of a firefly at location x, I(x) could be regarded equitable to the firefly's desirability. Therefore, to explain firefly attraction, indicated by β, the light intensity formula could be translated as follows:

$$\beta_i = \beta_0 e^{-\gamma r^2} \quad (5)$$

here $\boldsymbol{\beta i}$ represents the attractiveness at the ith iteration, and $\boldsymbol{\beta 0}$ is the attractiveness when r = 0 (in most situations β0 =1).

A firefly's brightness defines their motion. A far less bright firefly fi, as provided by the corresponding equation[5], will shift against a brighter firefly fj:

$$x_i(t+1) = x_i(t) + \beta_0 e^{-\gamma r_{ij}^2}\left(x_j(t) - x_i(t)\right) + \alpha\left(rand - \tfrac{1}{2}\right)$$

(6)

Here, at the (t) and (t+1) iterations, xi (t) and xi (t+1) indicate the location of the firefly i. By using Cartesian distance among two blinking fireflies, fi and fj, the travel distance could thus be determined on the basis:

III. LITERATURE SURVEY

Monem et al.,[6] has worked on a PF that is chosen to reduce the harmonics produced. There are 2 kinds of filters. The first is the use of three individual tuned PF to rising harmonics 5, 7 and 11. The second is the high pass filter 2nd order for harmonics equal and superior to 13th harmonics to be mitigated. To test the proposed approach, MATLAB simulation is performed. The actual THD could be decreased from 29.6 per cent to 1.5 per cent and the harmonic current supply voltage disruption from 3.25 per cent to 0.62 per cent, which is consistent with global standard and rises the voltage strength at voltage levels.

Aswal et al., [7] submitted the comparison with the uncontrolled three-phase rectifier and the load of the RL for passive and active filters for HM in the device. One of the two types of sensors in paper is a PF in which ST and DT filters are modeled to minimize the harmonics of the scheme from 20.41 per cent to 4.25 per cent, the other filter is an active filter intended to use p-q theoryand capable of reducing the THD of the same scheme to 2.88 per cent.

The newly developed SPP for PV devices under PSCs is suggested to improve the MPPT tracking approach depend on the FFA in **Hunag et al., [8]**. The proposed FFA is able to monitor global maximum power points (GMPPs) with high precision by merging the neighborhood FFA as well as SFA. The proposed SPP method also decreases the sampling event by eliminating redundant spreads and thereby speeding up monitoring speed and minimizing power losses and oscillations during the sampling cycle. MATLAB software was used to model the performance and speed improving of the proposed FFA and to test the mechanism using an evaluation method in hardware. The findings outcomes demonstrated the great accuracy and effectiveness of the suggested FFA algorithm for quick tracking speed. In addition, not only when implemented into the FFA, but also into another traditional FA approaches, the proposed SPP method will dramatically decrease sampling events.

With MATLAB, **Chaurasia et al., [9]**, successfully developed a simulation pattern focused on dynamic modeling and general management approach for a GCHW / PV DG. Easy and efficient, focused on solely on calculation of voltage or current and requiring no power calculation (viz. source power, load power and so on) is the overall control strategy on PCC and device frequency and for simultaneous extraction of the full power out of both RES, on DG. In the grid connected hybrid wind / PV distributed generation systems, the FA for optimization of controllers from certain conventional controllers, like PI, PID, has succeeded in implementing dynamic response tests and comparing case studies of dynamic responses from the two cases, which show that the design is the most important aspect.

In **Tukkee et al., [10]** an efficient firefly optimization algorithm (FA) was used to select the optimal position and length of solar P.V units mounted in a 33-bus IEEE test device. The chosen OF in terms of overall power loss was regarded to be adjusted to the average value for the test piece. As a result, a quick FVSI was suggested as a guidance for finding candidate buses to increase the voltage stability. Outcomes from the use of the IEEE 33-bus distributed generation revealed that the total real system failures can be efficiently minimized by installing solar P.V Units. In relation, a meta-heuristic feature selection was used to optimize the location and direction of the solar P.V. Components and a comparative analysis demonstrates an increase in the performance of the FA with regard to GA.

Olabode et al., [11] Supplied an optimal sitting and spacing of the shunt capacitor for true loss minimization on the RDS used by FA, using Nigerian 11-kV feeder as a research study. The method is two-stage; utilize of VSI to evaluate the optimal setting and the FA to identify the exact length of the shunt capacitor required. A duo-objective app – power loss economization as well as enhancement of bus voltage – was suggested for this task, with VSI being utilize to decrease the method search space in analysis to define the place(s) needed for the configuration of shunt capacitors, which contributed in a significant overall decrease in the total power loss of the scheme Smart selection of optimum values for the major criteria of the method has prompted to a convergence rate of methodologies without any small part.

IV. PROPOSED METHODOLOGY

- **Research Methodology**

The work flow of this dissertation is divided into different phases.

Phase 1: Initializing the form to be used for the calculations.

Phase 2: Generate harmonic calculation load and voltage rates.

Phase 3: To determine the efficiency of power systems, add the harmonics.

Phase 4: To measure waveforms, evaluate current and voltage distortions.

Phase 5: Add filters to analyze the effects and verify the output of calculated waveforms.

Phase 6: Perform firefly optimization to reduce the harmonic distortions produced and estimate the production of the device.

Phase 7: Compare results with a baseline approach to validate upgrades in terms of supply current and reduced harmonics.

V. RESULTS

The output of the experiments performed are given in graphical form along with discussion of results.Simulation is performed using MATLAB software. The below figures indicate the simulation results.

Figure 1: Voltage Harmonic Distortions

Figure 1 presents voltage harmonic distortions. The horizontal axis denotes the simulation time whereas vertical line shows the voltage harmonics percentage.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 8 Aug. 2022, pp: 534-538 www.ijaem.net ISSN: 2395-5252

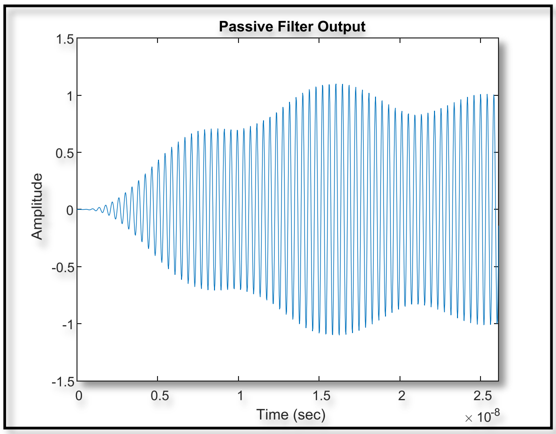

Figure 2: Passive Filter Output

The graphical representation for Passive Filter is represented in figure 2.The graph shows an x-axis and y-axis where x-axis and y-axis depicts time and amplitude respectively.

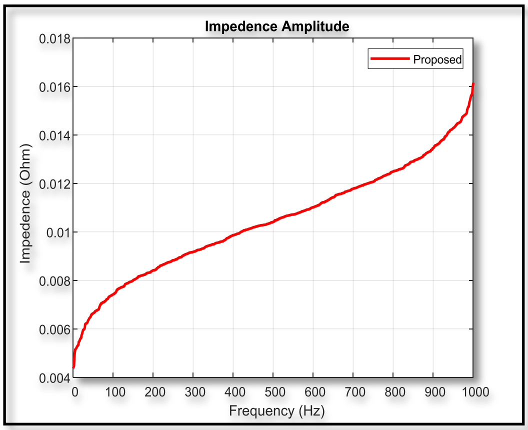

Figure 4: Impedance Amplitude

Figure 4 shows the filter impedance characteristics and the effect of the tuning frequencies to minimize the filter impedance using single tuned filters. As the frequency increases, the value for impedance also increases.

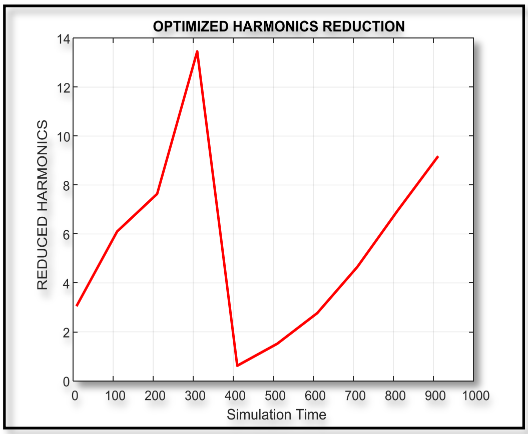

Figure 5: Optimized Harmonic Reduction

Figure 5 depicts the optimized harmonic reduction. The graph shows that the reduced harmonics is directly proportional to the simulation time. As the time increases the harmonics also increase and decrease gradually.

VI. CONCLUSION

A major focus of contention for computer programmers is Electric Grid Harmonics. Harmonics are different combinations of the energy device's basic frequency. In the electrical grid, these vibrations produce distorted voltages and currents. Voltage stability could be influenced by interference of capacitors. For simulation analysis of the work, MATLAB is used to estimate the production of the device and to compare the base paper for improved stability of the power systems. The outcomes present that the suggested firefly algorithm could minimize harmonics in the output voltage of a photovoltaic system. This method is effective in helping power distribution designers to research the electrical characteristics of the PV device. The key recommendations from the researcher for continuing out this work in the future are described below are the primary focus was given on the harmonic reduction in this work. The other issues with voltage stability could also be taken into consideration, in collaboration with Harmonic manufacturers as well, the system architecture of these custom power devices could be achieved and the price problems of the harmonic reduction could be applied. It is also possible to further perform the efficiency study of harmonic systems.

REFERENCES

[1]. Alkahtani, A. A., Alfalahi, S. T. Y., Athamneh, A. A., Al-Shetwi, A. Q., Mansur, M., Hannan, M. A., &Agelidis, V. G.,

"Power Quality in Microgrids Including Supraharmonics: Issues, Standards, and Mitigations," IEEE Access, Vol. 8, pp. 127104-127122, Jul. 2020.

[2]. Bozkurt and C. FadılKumru, "Harmonic Effects of Power System Loads: An Experimental Study",IEEE, 2013

[3]. Imtiaz Ahmed1, Mir Zayed Shames1, Md. MuksudulAlam , "An Overview of Harmonic Sources in Power System ",IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676,p-ISSN: 2320-3331, Vol. 7, Issue 3 (Sep. - Oct. 2013).

[4]. Teshome, D. F., Lee, C. H., Lin, Y. W., & Lian, K. L., "A Modified Firefly Algorithm for Photovoltaic Maximum Power Point Tracking Control Under Partial Shading," IEEE Journal of Emerging and Selected aTopics in Power Electronics, Vol. 5, No. 2, pp. 661–671, Jun. 2017.

[5]. Lindfield, G., & Penny, J., "The Firefly Algorithm," Introduction to Nature-Inspired Optimization, pp. 85–100, 2017.

[6]. Monem, O. A., "Harmonic mitigation for power rectifier using passive filter combination," IOP Conference Series Materials Science and Engineering, Vol. 610, Oct. 2019.

[7]. Aswal, J., & Pal, Y., "Passive and active filter for harmonic mitigation in a 3-phase, 3-wire system," 2nd International Conference on Inventive Systems and Control (ICISC), pp. 668-672, Jan. 2018.

[8]. Huang, Y.-P., Huang, M.-Y., & Ye, C.-E., "A Fusion Firefly Algorithm with Simplified Propagation for Photovoltaic MPPT under Partial Shading Conditions," IEEE Transactions on Sustainable Energy, pp. 1-11, Jan. 2020.

[9]. Chaurasia, G. S., Singh, A. K., Agrawal, S., & Sharma, N. K., "A meta-heuristic firefly algorithm based smart control strategy and analysis of a grid connected hybrid photovoltaic/wind distributed generation system," Solar Energy, Vol. 150, pp. 265–274, 2017.

[10]. Tukkee, A. S., Alali, M. J., &Zarkani, M. K, "Applying a Firefly Algorithm for Optimum Allocation of Solar Photovoltaic Units in a Distribution System",IOP Conference Series:Materials Science and Engineering, Vol. 671, 2020.

[11]. E.o., O., T.o., A., I.k, O., &O.o., A.-I., "Optimal sitting and sizing of shunt capacitor for real power loss reduction on radial distribution system using firefly

[12]. algorithm: A case study of Nigerian system", Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, pp. 1–13, 2019.

[13]. K. Meena and D. K. Palwalia, "Voltage Control of Dual Active Bridge Converter for CO-Amorphous Core Material Based Solid-State Transformer Application," Ijireeice, vol. 8, no. 10, pp. 33–39, 2020,

[14]. K. Meena, K. Jayaswal, and D. K. Palwalia, "Analysis of Dual Active Bridge Converter for Solid State Transformer Application using Single-Phase Shift Control Technique," Proc. 5th Int. Conf. Inven. Comput. Technol. ICICT 2020, 2020,