

POWER QUALITY OPTIMIZATION FOR MULTI MACHINING SYSTEM IN IEEE 57 BUS SYSTEM WITH INTER CONNECTED FACTS

Lavanya Sanagari¹, Bandari Haritha², Busaramoni Shiva Sai Prasad³, Banoth Anil Kumar⁴, Shaik Rahamathulla⁵

¹Assistant Professor, Department of Electrical Engineering, Teegala Krishna Reddy Engineering College hymalavi7@gmail.com
^{2,3,4,5}, Graduate Students, Department of Electrical Engineering, Teegala Krishna Reddy Engineering College.

Abstract: Distributed generation (DG) plays a crucial role in enhancing power quality in distribution systems. By strategically placing DG units throughout the network, it helps to reduce voltage sags, voltage flicker, and other power quality issues. DG units act as localized power sources, providing backup power and reducing the load on the main grid, resulting in improved power stability and reliability for industries and residential zones. It compensates by adding fact devices. Some FACT (Flexible Alternating Current Transmission) devices that can be used for power optimization include DSTATCOM. Optimizing power quality in IEEE57 bus systems for multi machining connected can lead to improved reliability and efficiency of the distributed system. By using nature-inspired hybrid algorithms, the accuracy of power quality optimization can be significantly enhanced, resulting in reduced power losses, minimized voltage fluctuations, and enhanced overall system performance. Present work focusing on DG attached with fact devices and optimized the power quality using Integrated BO with AGWO for shunt DSTATCOM with controlled PID. The work has been compared with existing MBO approach to check the improvement in present work. THD decreased compared to existing and swag, swells are compensated in minimal time. A quick compensation possible with proposed algorithm power quality management customization with cost evaluation of supply problems with direct load implementation for the selected design checked with supply chain management technique.

Keywords: ANFIS Controller, Harmonic Distortion, Grid-Connected PV Systems

1. Introduction

In recent times, the installation of energy-efficient hybrid energy systems in remote areas is one of the most challenging tasks. Especially, such installations have created more prominent PQ issues, thus it becomes paramount for researcher to optimally select the size, and control approach for this dependable, and cost-effective alternative energy. Basically, power quality disturbances can have many and varied reasons. On the other hand, the mechanism of effect and disruption in the network and consumers can be different depending on the nature of the disturbance. For this reason, in the studies of power quality and the compilation of relevant standards, it is tried to categorize the aforementioned disturbances based on their nature with the development and advancement of technology in the field of power electronic devices, a variety of non-linear loads with non- sinusoidal nature have appeared in the power

network. The presence of these loads causes the waveform to deviate from the ideal state at rated frequency and causes power quality distortion. On the other hand, nowadays many loads are controlled by sensitive electronic and microprocessor systems. These systems are susceptible to network disruptions and their performance might be quickly disturbed Power quality is an indicator for evaluating distortion in voltage, current and frequency



quantities. Nowadays, due to the increase in the sensitivity of electrical equipment, the increasing importance of improving the overall efficiency of the power system, power quality has been more and more considered. In order to monitor the quality of electrical power, standards for power quality indicators have been defined, which can be referred to the international standards of IEC, IEEE and ANSI. The problem of voltage unbalance is mainly due to the unbalanced distribution of single-phase and nonlinear loads. This phenomenon occurs for various reasons, including the occurrence of unbalanced short circuit in the network and unbalanced connection of single-phase loads in different phases of the network.

1.1 Distributed generation (DG)

Distributed generation includes the solar panels, photovoltaic cell, micro turbines, wind turbines, combustion gas turbines, biomass and various other small generation units which are based on renewable energy sources. The distributed generation is a technology which has evolved in the present time and has become one of the major fields of interest for the researchers. The distributed generation has the advantage over the conventional methods of power generation that they can be installed at the sites where the power requirement has increased and also it is not possible to set up a new power generation station at every few kilo meter distance. Other advantage which it possesses is that this technology is environment friendly which means it does not produce harmful by-products which in a direct or indirect way affects the environment.

1.2 Flexible AC Transmission System (FACTS) Controllers Undergrowth reduces insulation clearances and lightning discharges are both highly coupled with transmission networks and prone to errors. By using Kirchhoff's laws the power flow in transmission line can be determined for specific power injections at different nodes. In general, the loads on the power system vary from time to time in a day and they are also subjected to deviations caused by atmosphere and also by other erratic factors. In a deregulated environment the generation arrangement tends to be variable. Under normal and steady state conditions the power flow in a transmission line will vary. Due to incidence of a contingency results in a sudden change in the power flow. Eventually results in overloading of line consequently threatens the system security.

1.3 Significance of work

DG connected Fact devices are important in IEEE bus systems because they help to ensure that the power load is balanced across the bus. The devices also provide an early warning of any power system issues, which can help prevent system blackouts. Voltage imbalances can lead to inefficient operation and increased losses in the system. They can cause equipment such as motors and transformers to overheat and degrade faster, leading to potential failures. Additionally, voltage imbalances can result in poor power quality, which can affect the performance of sensitive electronic devices. DG connected Fact devices in IEEE bus systems provide a better power system stability and improved power system security. They also provide the ability to better balance the power demand and supply, and provide the ability to better manage the power system in real-time. They can also help to reduce the amount of reactive power needed, which can result in decreased energy costs. Additionally, they can also provide better voltage stability and improved system reliability.

1.4 Objectives

- Load flow and DG placement referred from literature to check the FACT interconnection
- Advanced hybrid algorithm with PID controller used for mitigation of voltage and harmonic in balances.

2. Related Work

Recent advancements in power quality research have focused on the integration of renewable energy sources and their impact on the stability of power grids. Improved monitoring techniques using smart grid technology have also been developed to quickly identify and mitigate power quality disturbances. Additionally, new algorithms for

real-time data analysis are enhancing the ability to predict and address potential issues before they escalate. A detailed literature review about the advancements in power quality enhancements and optimization

Su et al. [1] have suggested different control methods for micro grid DG sorting. Due to the high impedance ratio of the low voltage micro grid, A virtual generator and virtual impedance are used to control droop. The simulation shows that the newly integrated control strategy can maintain the output voltage of DG units in grid and island mode while also allowing for a quick transition between the two modes. Ganguly [2] has suggested a design technique for UPQC, called sag based phase-angle control design. To change the load voltage phase angle, the series inverter in UPQC is used, keeping its magnitude the same. Due to this phase shift, the reactive power compensation is provided by the series inverter. This greatly lowers the VA rating of the shunt inverter and the total VA rating of the systems converters of UPQC to handle reactive power. Wang et al. [3] focused primarily on controlling grid-connected power converters, such as the need for fast, precise, and robust methods of synchronization for photovoltaic generation systems, Especially during faults and when operating in highly disturbed environments. This paper presents a method for estimating the frequency, amplitude, and phase of the positive and negative series components individually. In a revolving reference frame, a new filtering stage is created based on denying the most

critical disruptions, such as voltage sags. Vimal Katiyara [4] In their study to design a MLDG IEEE 33- bus system for rural location of United Kingdom of Saudi Arabia with reduced power loss and improved voltage profile with economic benefits. In this proposed model DGs (distributed generators) are placed at multiple locations to enhance the performance of hybrid solar system with respect to improve power quality and reduced power losses. M. Chiranjivi [5] In their study a new technology was introduced as a Monarch Butterfly Algorithm which will be observed as the best algorithm that gives one of the good results when with that of heuristic algorithms currently used in the classification of OPF on IEEE 57-bus test system. All the possible optimal locations are verified by the new MBO algorithm and found to be a very perfect algorithm. K. Teeparthi and D. M. V. Kumar [6] A review of the literature has shown that the research on OPF incorporating RESs is indeed encouraging. Although some attempts have been made to address the OPF with the incorporation of RES into power grids, previous research typically only investigated the problem with the single objective function of optimal generation cost or the two-objective function of generation cost and emission S. S. Reddy [7] This paper proposes a new strategy for the optimal power flow problem taking into account the impact of uncertainties in wind, solar PV and load forecasts. The simulation results for IEEE 30 bus system with genetic algorithm (GA) and two-point estimate method have been obtained to test the effectiveness of the proposed optimal power flow strategy. Akanit Kwangkaew, Siriya Skolthanasat [8] This research proposes Load Disabling Nodal Analysis for Robust Voltage Stability (LDNA-RVS), a method that determines the optimal location and size of RDGs and aims to improve robust voltage stability by considering reactive compensation while enhancing the loss reduction efficiency (LRE) of the RDG integration. R. K. Beniwal et al [9] The paper presents comprehensive and critical review of the techniques used in PQ analysis. This survey paper facilitates the researchers to select the appropriate method to carry forward the research work in the concerned area. Smart grid evolution and distributed generation further increase its relevance. B. Singh,

C. Jain et al [10] This paper deals with the design, modeling, and implementation of a photovoltaic (PV) array interfaced with a DC–DC boost converter feeding three-phase grid-tied voltage source converter. The system uses an Instantaneous Reactive Power Theory-based control algorithm and is operated in unity power factor mode. O. A. Alimi

[11] In recent times, power system security and stability has been a major concern to all energy stakeholders especially the operators. Operators must be well equipped in timely recognition of potential intrusion, attacks, disturbances, and situational awareness. Mukherjee, R., De [12] a novel method of “power system dynamic security assessment” using “decision tree (DT) classifier”. The standard “pattern recognition framework”, has been followed in the research work presented in this paper, in order to ensure that real-time implementation of the proposed framework is feasible. With the aim of recognizing the “degree of criticality” associated with various “pre-contingency operational circumstances,” the “DTSC” was created and taught offline. Gitizadeh and Kalantar [13] investigated a simulated annealing based optimization method for placement of flexible AC transmission systems (FACTS) devices

in order to relieve congestion in the transmission lines while increasing static security margin and voltage profile of a given power system used sensitivity analysis and extended equal area criterion to find the optimal location and capability of FACTS in a power system for enhancing static voltage and transient stability. Mandala and Gupta [14] proposed a method to determine the optimal location of thyristor controlled series compensators (TCSCs) for congestion management. The optimal location is determined based on real power performance index and also on reduction in total system active power and reactive power losses. Reddy et al. [15] has presented the optimal location of FACTS controllers considering branch loading (BL), voltage stability (VS), and loss minimization (LM) as objectives using genetic algorithm for management of congestion. Acharya and Mithulananthan [16] propose two new methodologies for the placement of series FACTS devices for congestion management. The overall objective of FACTS device placement can be either to minimize the total congestion rent or to maximize the social welfare. Zhang et al. [17] presented an optimal power flow (OPF) control in electric power systems incorporating IPFC with the minimum total capacity of the converters of IPFC and minimizing the total active power loss of the system for reducing congestion in the lines. Mohamed et al. [18] has compared three variants of PSO, namely, basic PSO, inertia weight approach PSO, and constriction factor approach PSO considering a single objective, i.e., to minimize the transmission line loss. Swarnabala Upadhyaya [19] In this work wavelet transform has been implemented for analysis of PQ disturbances. PQ disturbances have been generated by changing load in IEEE-14 bus system and decomposed

utilizing wavelet decomposition algorithm for localization of disturbances. Mohit Bajaj¹, Amit Kumar Singh [20] In present work, an analytic hierarchy process (AHP) inspired methodology is proposed for PQ assessment of distorted distribution power systems under the presence of renewable- based DGs. The proposed PQ assessment approach is based on formulating a unified power quality index (UPQI) for assessing the overall PQ performance of individual buses of the network along with the entire distribution network (DN) considered taking four PQ phenomena, viz..

3. DG Allocation With-FACTS in IEEE 57 BUS SYSTEMS

Compared to power transmission networks the power losses are relatively high in distribution systems. As a result, one of the Distribution network operator (DNO)'s original goals is to reduce power loss. Managing node nominal voltages has been one of the top goals. Additionally, when a reliable and efficient energy source or component is present in power networks, the aforementioned goals can be best achieved. It has been difficult to determine the best DGs based on RES control and demand that changes for distribution networks. High renewable energy production during light load hours has the potential to reverse the flow of power entering the grid upstream. Therefore, the major grid might be seen as a goal at the time of RES implementation. Reverse flow of electricity has been built conventionally as a result. The objectives of the proposed work include minimum power losses, voltage profile, backward power flow into a grid, and simultaneous optimal RES base PV and DG setup. The major part of the distribution system losses is widely seen in the overall losses that occur in the power system. The losses will be more due to poor erection of conductors, protection equipment life overdue, current flow not being constant, voltage variations, improper handling of the system and abnormal voltage flow between the conductors by poor mechanical design.

An IEEE 57 Bus test system with its standard data has selected for this purpose. Then we have designed the single line diagram of IEEE 57 Bus system in to a psat in a MATLAB platform.

Load Flow Analysis:

The direct approach for distribution load flow is used to find the power losses and also the voltage at each branch The single line diagram of a sample

distribution system is shown in Figure 1. The voltage at node m+1 is given by

$V_{m+1} = V_m - I(R_{m,m+1} + jX_{m,m+1})$ (1) Where V_{m+1} is the voltage magnitude of the bus m+1, V_m is he voltage magnitude of the bus $R_{m,m+1}$ is the resistance of the line between m and m+1, and $jX_{m,m+1}$ is the reactance of the line between m and m+1.

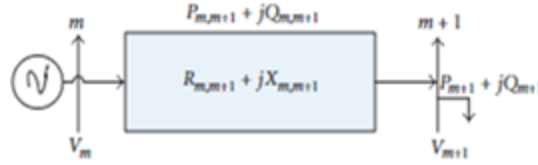


Figure:1 Sample distribution system

3.1 Problem formulation

The objective function is formulated to minimize the total real power loss in distribution system and is given by: (i) Minimizing Real Power Loss

$$I=[\text{BIBC}] [i] \dots \quad (2)$$

where I is the branch current. BIBC is the bus current injection to branch current matrix. Subjected to

$$I_m = \frac{(P_{m+1} + jQ_{m+1})}{V_m} \dots \dots \dots (3)$$

$$P_{Loss}(m, m+1) = \frac{(P_{m,m+1}^2 + Q_{m,m+1}^2)}{|V_m|^2} R_{m,m+1} \dots \dots (4)$$

$$Q_{Loss}(m, m+1) = \frac{(P_{m,m+1}^2 + Q_{m,m+1}^2)}{|V_m|^2} X_{m,m+1} \dots \dots (5)$$

Summarizing all the branch power losses gives the total real and reactive power losses of the system it is formulated as

$$P_{T, Loss} = \sum_{m=1}^{nb} P_{Loss}(m, m+1) \dots \dots (6)$$

Where nb is the number of branches

The objective function (of the proposed work) is formulated to minimize power losses in the system. The mathematical formulation of the objective function is given by

$$\text{Minimize}(F) = \min(P_{T, Loss}) \dots \dots \dots (7)$$

The voltage limit is formulated as follows

$$V_{m, \min} \leq |V_m| \leq V_{m, \max} \dots \dots \dots (8)$$

The real power calculated by using the formula 9

$$P_{Dm}^{\min} \leq P_{Dm} \leq P_{Dm}^{\max} \dots \dots m=1, \dots, N_B \dots \dots (9)$$

The reactive power compensation given in the formula 10

$$Q_{cm}^{\min} \leq Q_{cm} \leq Q_{cm}^{\max} \dots \dots m=1, \dots, N_B \dots \dots (10)$$

The objective function defined as

$$f1 = \min \sum_{i=1}^n S_{i \text{ total losses}} \dots \dots \dots (11)$$

Where: f1 denoted to the single objective function for power loss minimization. n Indicates the bus branch number, and S_i Total loss denotes total loss of complex power.

Subjected to

$$|I_{m,m+1}| \leq |I_{m,m+1, \max}| \dots \dots \dots (12)$$

$$\frac{\partial P_{Loss}(m, m+1)}{\partial P_{m,m+1}} = \frac{2P_{m,m+1} R_{m,m+1}}{|V_m|^2}$$

$$\dots\dots\dots (13)$$

Voltage Stability Index. There are many indices used to check the power system security level. In this section, a new steady state voltage stability index is used in order to identify the node, which has more chance of voltage collapse and it is expressed in (12) In order to attain the stable operation of the radial distribution system, the VSI should be $m \geq 0$. The voltage stability at each node is calculated from the power flow using (14).

$$VSI(n)|V_m|^4 - 4 [P_{m,m+1} * X_{m,m+1} - Q_{m,m+1} * R_{m,m+1}]^2 - 4[P_{m,m+1} * R_{m,m+1} Q_{m,m+1} * X_{m,m+1}] \cdot |V_{m,m+1}|^2 \dots (14)$$

3.2 Integration of algorithms

3.2.1 Butterfly migration patterns in North America served as inspiration for and a source of inspiration for the BO approach. The butterfly in this monarch swarm migrates from territories 1-2 in April and 2-1 in September. They create offspring that replace their parents in swarms at the time of emigration. Additionally, this BO model includes two updated operators named the migration operator and the butterfly adjustment. This model continues to run until the required operational conditions are met. Various common functions have been projected using this paradigm. Further, for complicated standard functions like average fitness and standard deviation, the standard BO version shows considerable technological limits. Z_d is the step size of the butterfly walk y , which can be generated by $dZ = \text{levy}(Z, t)$ Levy flight, and BAR represents the butterfly adjustment rate. In addition, the performance metric denoted as α has been used as a balancing factor.

$$\alpha = W_{\max} / t^2 \dots\dots\dots (15)$$

3.2.2 Advanced Grey wolf optimizer (GWO)

It is a population-based meta-heuristics algorithm that was proposed in 2014 by Seyedali Mirjalili et al. and mimics the natural hunting mechanism and leadership hierarchy of grey wolves. The grey wolf is at the very pinnacle of the food web as an apex predator

Step 1: Collect a flexible and randomly created monarch swarm population of butterflies (NP), divide it into two parts (NP2 and NP1), and then configure the algorithm using parameters like BAR and Wmax, the maximum number of iterations.

Step 2: Find the fitness value of every monarch butterfly population.

Step 3: Organize the butterflies into two populations, NP1 and NP2, for territories 1 and 2, respectively, based on their fitness scores.

Step 4: The process of fertilization in Population NP1 in Territory 1 occurs as a result of operators' insatiable need for population growth. Similarly, NP2, the population of territory 2, modifies the operator of the butterfly algorithm with operators of the adaptive crossover scheme and the greedy algorithm to produce new generation.

Step 5: Design a correction method to fix any butterflies caused by impossible individuals.

Step 6: When a superior person is found, upgrade the effective individual butterfly.

Step 7: Repeat steps 2 through 6 as many times as necessary to reach the maximum number of stopping criteria or iterations.

Grey wolves typically inhabit in social groups called packs, with an average of 5 to 12 members per pack.

Main phases of Grey wolf hunting:

1. Locating, chasing, and approaching prey.
2. Encircling the prey and harassing it until it stops moving.
3. Predation on the prey

The ability of the current solution to reduce the system's Total Harmonic Distortion, as indicated in equation 16, is the first parameter in the fitness function description.

$$\min (f_3) = \min \left\{ \sum_{j=1}^n \frac{\sqrt{\sum_{n=2}^{\infty} x^2 j n}}{x j n} \right\} \quad (16)$$

The amplitude of each phase's sag is the second parameter under the fitness function description throughout the fault period. Since the load terminal housing the voltage sensitive load must operate precisely at 1.0 pu, the aim function is designed to minimize the variation from the operational voltage. The goal can be expressed mathematically as equation 16 if the fault timing falls between t_0 and t_f

$$\min(f_4) = \min \left\{ \sum_{j=1}^n \left(1 - \max(x_j(t_i)) \right) \right\} \quad t_0 \leq t \leq t_f \dots \dots \dots (17)$$

Implementation of hybrid algorithm for DG Interconnection with DSTATCOM

The following are the steps used to integrate the algorithms and implementation for DSTATCOM and DVR for 57 bus systems.

Step1: Initialize GWO optimizer in the bus system search space in bus systems.

Step 2: Update the search agent to find prey(Bus) Step 3: Update the search with-BO search earlier run Step 4: Update key search group

Step5: Update the value of weak bus

Step 6: Update controller for multi objective fitness

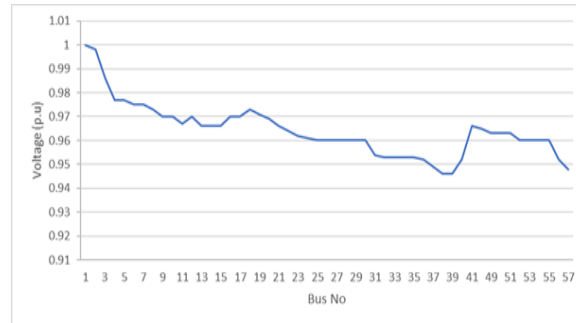


Figure 2: Optimal tracking for DG allocation for 57- bus system using BO

Total Real power Loss is 210.97kW and total Reactive power Loss is 143.12kVAr. Line sees the highest losses Similarly load flow analysis is conducted on 57 bus radial distribution networks system has 57 buses, 56 lines. The total real power demand is 3802 kW and reactive power demand is 2694.6kVAr. Base case study is initiated with all buses voltage at 1pu and source (Bus1) is reference bus. The least voltage occurs at 39th Bus and value 0.9465679p.u and the voltage profile is shown in fig Real and reactive power loss also computed maximum loss is seen in lines 2 and 3. Total real and reactive power loss are 158.45kW & 99.9kVAr

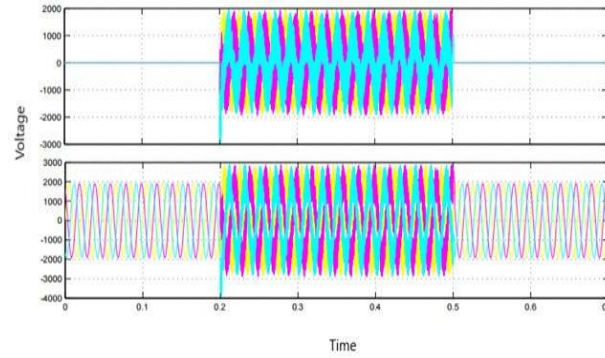
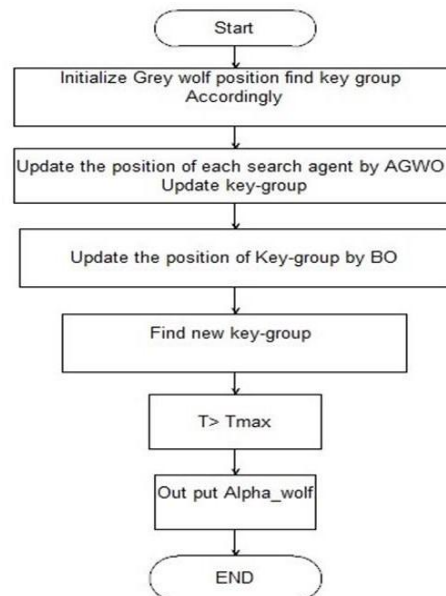
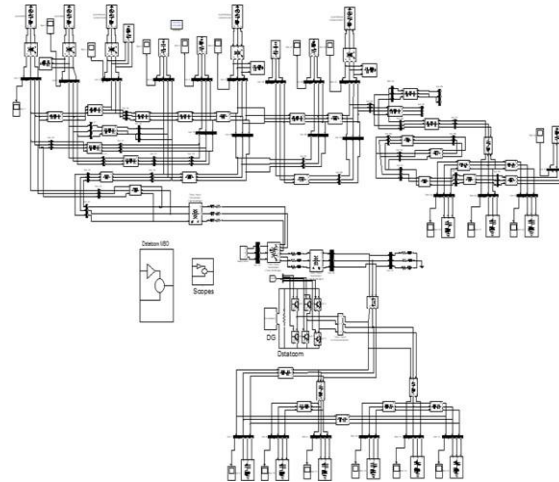


Figure :3 Sag 57- bus system

Figure shows that the minimum voltage value before DG is installed is 0.91 p.u, while the minimum voltage value after DG installation becomes 0.98 p.u. Figure shows that the more wind-based DGs installed on selected buses, it will have a positive impact on the improvement of the voltage profile on all buses. This is due to a decrease in the supply of current from the source to the load which in turn has a positive impact on the loss of power losses in each branch. for 57 bus test system bus 39 is the least voltage bus 0.9465p.u and five buses namely 37,38,39,44 and 57 buses have undergone low voltages below 0.95p.u.

3.3 Implementation of BO and AGWO algorithm for optimal DG with DSTATCOM and DVR allocation





4. Results and discussions

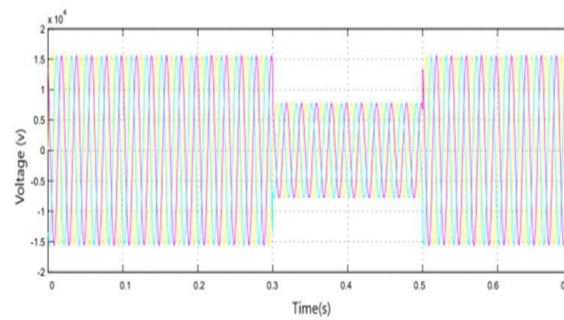


Figure 5: Voltage Sag in IEEE 57 bus system compensated with DG with DSTATCOM

Above figure 5 The voltage sag in the IEEE 57-bus system is analyzed through a Distributed Generation system. DSTATCOM senses voltage sag and injects some reactive power into the system within no time to overcome the sag in voltage due to its contribution toward rebuilding the level of voltage.

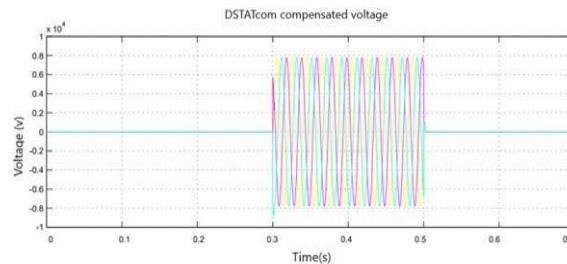


Figure 6: Voltage Sag in IEEE 57 bus system compensated voltage

Figure 6 In this section, Analyze how a DSTATCOM helps recover the voltage sag of a voltage level in an IEEE 57-bus system supplied by a DG power plant. After a drop in the voltage sag is initiated, the wave in the waveform recovers again, which is essentially compensated for by the injection of reactive power by the DSTATCOM.

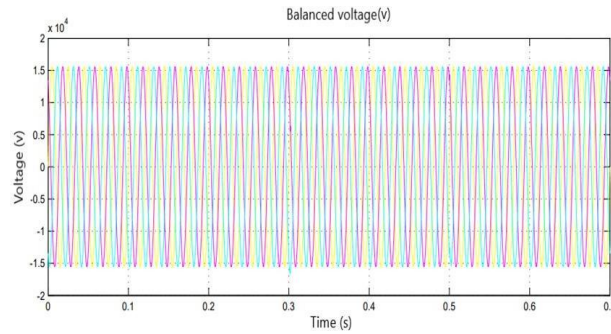


Figure 7: Voltage Sag in IEEE 57 bus system compensated voltage

To Analyze the compensated voltage in IEEE 57 bus system as shown in Figure 7. indicates that the sag event is successfully mitigated. The frequency of the compensated waveform of the voltage sag seems to be the same as the original waveform of the voltage sag. This means that the compensation system does not change the fundamental frequency of the power system considerably.

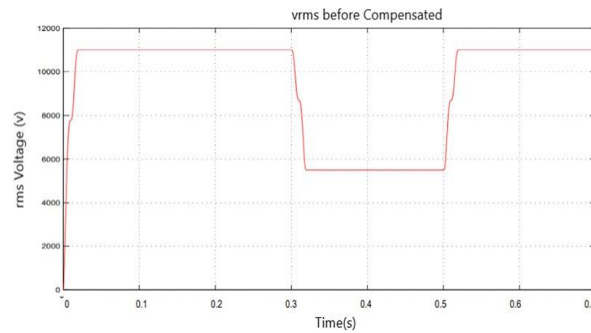


Figure 8: Voltage Sag in IEEE 57 bus system Vrms before compensation

To analyze the sag voltage event in the IEEE 57 bus system as illustrated above figure 4.15. The RMS voltages decrease to about 5000V. It should be noted that such RMS values are significantly below a nominal voltage level.

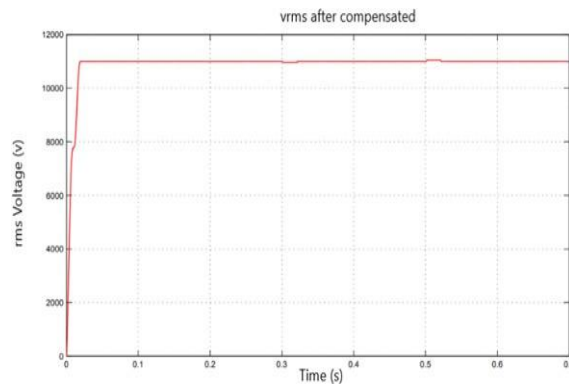


Figure 9: Voltage Sag in IEEE 57 bus system Vrms after compensation

To Study the rectified voltage waveform once the IEEE 57 bus system has been adjusted. All things considered, the figure demonstrates that the sagging event is effectively reduced by the compensation voltage sag in the waveform; it returns to its previous value and produces a smooth sinusoidal waveform.

Table 1: Comparative voltage balances with and with out DSTATCOM (added in Annexure)

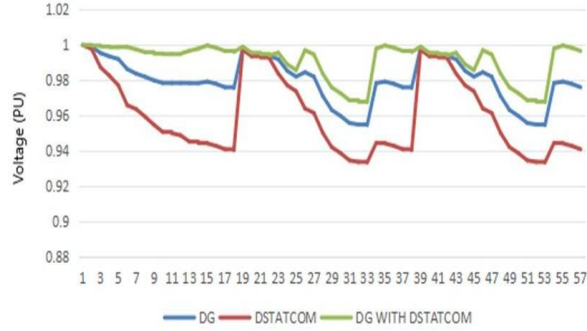


Figure 10: Comparison of DG, DSTATCOM and DG with DSTATCOM in IEEE 57 bus system

5. Conclusion and future work

Heuristic with nature inspired algorithms considered in the present work taken from the previous literature. The design of 57-bus systems with optimal tracking and compensation with fact devices. The following conclusions drawn from above simulation

BO integrated with AGWO algorithms are used for optimal tracking comparison in 57 bus system to ensure the design responding in same for any algorithm.

Integrated algorithm controller named as Grey wolf butterfly optimizer given better results compare with other by checking the PU values as given in table1.

Table 1: Comparative voltage balances with and without DSTATCOM

Bu s No	Base Case	DG	DSTATCO M	DG WITH DSTATCO M
1	1	1	1	1
2	0.9988	0.999	0.9999	0.9996
3	0.9862	0.9954	0.99873	0.9991
4	0.9772	0.9935	0.99825	0.9987
5	0.9772	0.992	0.99771	0.9988
6	0.9758	0.9863	0.99658	0.9988
7	0.9756	0.9837	0.99636	0.9975
8	0.9731	0.9819	0.98593	0.9959
9	0.9705	0.9799	0.98547	0.9951
10	0.9704	0.9784	0.98506	0.9948
11	0.9672	0.9784	0.98499	0.9948
12	0.9703	0.9784	0.98487	0.995
13	0.9667	0.9783	0.98451	0.9967
14	0.9663	0.9783	0.98443	0.9979
15	0.9665	0.9792	0.98441	0.9997
16	0.9703	0.9779	0.98427	0.9984

17	0.970 2	0.976	0.98408	0.9966
18	0.973 4	0.975 5	0.98402	0.996
19	0.971 3	0.998 5	0.9972	0.999
20	0.969 2	0.994 9	0.9936	0.9955
21	0.966 8	0.994 2	0.9929	0.9948
22	0.964 5	0.993 6	0.9923	0.9941
23	0.962 5	0.991 9	0.9837	0.9955
24	0.961 2	0.985 3	0.9771	0.989
25	0.960 8	0.982	0.9737	0.9857
26	0.960 7	0.984 5	0.9839	0.997
27	0.960 6	0.982	0.98614	0.9946
28	0.960 6	0.971	0.9801	0.9837
29	0.960 5	0.963 1	0.9652	0.9759
30	0.960 1	0.959 7	0.96386	0.9726
31	0.954 5	0.955 7	0.96345	0.9686
32	0.953 8	0.954 8	0.9636	0.9678
33	0.953 8	0.953 8	0.9538	0.9538
34	0.953 4	0.978 3	0.98443	0.9979
35	0.953 1	0.979 2	0.98441	0.9997
36	0.952 3	0.977 9	0.98427	0.9984
37	0.949 6	0.976	0.98408	0.9966
38	0.946 8	0.975 5	0.98402	0.996
39	0.946 6	0.998 5	0.9972	0.999
40	0.952 3	0.994 9	0.9936	0.9955
41	0.966 1	0.994 2	0.9929	0.9948
42	0.965 9	0.993 6	0.9923	0.9941
43	0.965 9	0.991 9	0.9937	0.9955
44	0.946 5	0.985 3	0.9871	0.989
45	0.966 2	0.982	0.9837	0.9857
46	0.965 0	0.984 5	0.98639	0.997
47	0.963 8	0.982	0.98714	0.9946
48	0.963 5	0.971	0.97501	0.9837
49	0.963 8	0.963 1	0.969	0.9759
50	0.963 7	0.959 7	0.9686	0.9726
51	0.963 7	0.955 7	0.96545	0.9686
52	0.960 1	0.954 8	0.96336	0.9678
53	0.960	0.954	0.96333	0.9675

	1	5		
54	0.960 1	0.978 3	0.98443	0.9979
55	0.960 1	0.979 2	0.98441	0.9997
56	0.952 1	0.977 9	0.98427	0.9984
57	0.948 7	0.976	0.98408	0.9966



LAVANYA SANAGARI received B.Tech. from JNTU Hyderabad, Telangana, India, in 2009 and an M-tech from SKD college 2014 respectively, and pursuing Ph. D in Annamalai University, Tamilnadu, India. She is working presently as an Assistant Professor at Teegala Krishna Reddy Engineering College, Hyderabad, India. She has presented technical papers in various national and international journals and conferences. Her areas of interest include Power systems, Hybrid energy systems and power quality.

She can be contacted at email: hymalavi7@gmail.com



Bandari Haritha received the Diploma (Electrical and Electronics Engineering) from Jaya Prakash Narayan College of Engineering, Dharmapur, Mahabubnagar, India in 2022. She is presently a UG student in Electrical and Electronics Engineering at Teegala Krishna Reddy Engineering College, Hyderabad, India.

She can be contacted at email: harithabandari2705@gmail.com



Busaramoni Shiva Sai Prasad received the Diploma (Electrical and Electronics Engineering) from T.R.R. College of Technology, Meerpet, Hyderabad, India in 2022. He is presently a UG student in Electrical and Electronics Engineering at Teegala Krishna Reddy Engineering College, Hyderabad, India. He can be contacted at email: shivasaiprasad05@gmail.com



Banoth Anil Kumar received Intermediate Education from Excellent junior college Burahanpuram, Khammam, India in 2021. He is presently a UG student in Electrical and Electronics Engineering at Teegala Krishna Reddy Engineering College, Hyderabad, India.

He can be contacted at email: anilbanoth937@gmail.com



Shaik Rahamathulla received Intermediate Education from Narayana junior college, Champapet, Hyderabad, India in 2021. He is presently a UG student in Electrical and Electronics Engineering at Teegala Krishna Reddy Engineering College, Hyderabad, India.

He can be contacted at email rahamathullashaik062@gmail.com

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