RESEARCH ARTICLE OPEN ACCESS

Renewable Energy Source with Power Quality Analysis with Power Flow Controller (RES- PQA -PFC) using Crow Search Optimization Algorithm

Moloy Dhar
Assistant Professor CSE Department Guru Nanak Institute of Technology - India

ABSTRACT
To improvise IPFC performance, Crow Search Algorithm (CSA) has developed. At first, the Renewable energy resources (RES) like Photovoltaic (PV) and Wind are taken in to account for the power supply. From that, either non-linear load or grid is connected through the VSI to determine the power flow of the system. Now this proposed method is undergone for investigation with PQ issues like voltage sag, swell and distortion problems. At last, the Fast Fourier Transform (FFT) is also applied to analyze the THD performance of the proposed system and it is compared with some existing algorithm like Artificial Bee Colony (ABC) and Particle Swarm Optimization (PSO) under the platform of MATLAB/Simulink.
Keywords: Crow Search Algorithm (CSA), Renewable energy resources (RES), Particle Swarm Optimization (PSO), Renewable Energy, RES- PQA -PFC.

I. INTRODUCTION

Now-a-days, PQ is the prevalent problems in the power system. The intensity of PQ issues leads to raise of power electronics usage in distribution area and industries. The PQ issues were divided on the basis of current and voltage. The flicker, unbalanced source, voltage sag/swell, interruption and notches are the class of voltage based issues in PQ. The current related from PQ problems in become unbalanced load, reactive power demand, lagging, power factor and total harmonic distortion (THD) [1-3]. The lightning strikes in transmission lines, harmonics, switching of capacitor and different faults in a network can also find PQ issues like interruption and transients [4]. In these view, PQ problems like voltage sag acts directly on diminish the efficiency of power system network. Therefore, it leads to reduce the life span of the power electronics equipment that connected in the network. It can be overcome by conditioning them with suitable devices such as active filter. The compensation of PQ disturbances is done only when the Flexible AC transmission system (FACTS) are connected to the power system network. [5-8].

Ordinarily, the FACTS create the real power and reduce the PQ issues on the power system. The fundamental kinds of the FACTS controllers can be categorized into shunt controller, series controller, combined series-series controllers and combined shunt-series controller [18]. However, the controllers of FACTS can be clustered into two main categories: Voltage Source Converter (VSC) based FACTS controllers and thruster controlled FACTS controllers [18]. Thus, the unified power quality conditioner (UPQC) turns into the mainstream control gadgets for PQ compensation. Essentially, the Dynamic Voltage Restorer (DVR) and Static Synchronous Series Compensator (SSSC) are used to breakdown the PQ issues. In this manner the Distribution STATCOM (DSTATCOM) executes fast control of the reactive power and it allows the flicker suppression, stabilization of voltage and other types of PQ disturbance compensation. IPFC is mostly focus on PQ issues, which is usage for the control of both the reactive power and active power in multi-line network. The arrangement of IPFC FACTS controller is packed by on' number of SSSC. In this manner the terminals of dc converters are connected mutually by means of a common dc link. The voltage sourced converter of SSSC injects the series voltage with the line transmission. The total estimation of SSSC voltage is not associated with the line current and it might control independently [19]. The procedure of IPFC is capable to transport active power between the line compensation [17].

II. LITERATURE REVIEW: A RECENT ANALYSIS

Numerous works are presented to solve the PQ issues in Distribution System with various kinds of FACTS devices. Some of them are reviewed here,

Asit Mohanty *et al.* [21] advocated the robust fuzzy-sliding mode based autonomous wind–diesel-photovoltaic in unified power flow controller (UPFC) which are depends on the hybrid system (HS). The small signal model linearization with the different components of the HS was noted

for the stability investigation of transient in the HS under various loads. Their proposed controller was planned to improve the exhibition of transient. The simulation analysis of reflects that proposed fuzzy sliding mode controller are utilized in well appropriate administration of the reactive power and it upgrade the voltage stability in contrast with the fuzzy - PI controllers and ordinary PI.

P. Kannan et al. [22] suggested an artificial neural system (ANN) with gravitational search algorithm (GSA) controller to improving a performance of UPQC and remunerating the PQ issues. They have produced the control signals of the Active Power filter (APF) and decrease the issues in PQ. The shunt APF was also used for the decrease in harmonic disturbances. The dc link voltage was synchronized by their recommended controller technique. Subsequently, the recommended system was implemented in the platform of MATLAB/Simulink and the THD value of system was estimated.

Behnam Tamimi et al. [23] showed that the Hybrid Power Flow Controller (HPFC) can be investigating the PQ issues in the distribution system. Their proposed control strategies were used for the correct the activity of distribution controller and suggest applications like simple and effective procedure to starting-up the machine. Their suggested mechanism was utilized to uncover the controller effectiveness for solving issues in distribution systems like voltage sags associated with the power flow fluctuations and feeder faults due to inexhaustible case.

Mehdi Bagheri et al. [24] concluded an online reference control procedure for PQ issues in microgrid. Their proposed control technique is utilized the reinforcement learning algorithm for distribution static compensator. Their controller was hypothetical to repay the harmonics, reactive power and unbalanced load current in a micro grid utilization of current and voltage parameters. Their proposed control idea was practical with self-governing microgrid with a weak AC supply (non-firm source) distribution system with different loads in three-phase fault conditions are obtained.

S. Mani Kuchibhatla et al. [25] carried out a recurrent neural network (RNN) algorithm with Cuttle fish algorithm (CFA) for decreasing the PQ issues in distribution system. Their proposed technique was dealing with the irregular switching procedure in shunt capacitor banks that were tuned on the SSFC devices of arm filter. Their recommended technique was improved the energy efficiency and grid utilization process with the manageable demands. Subsequently, the switching way was banned by producing unbalancing control signal by pulse width modulation (PWM) technique. The modulation of PWM was used by the both regulators and it was bottom on a tri-loop real error controlled by the amalgamation of adjusted weighted proportional to the integral derivative controller. Their upgraded SSFC device was proposed and simulated in the stage of MATLAB/Simulink. Consequently, the performance is confirmed by utilizing few existing devices like SSFC and the unified power flow controller.

Most of the progressing investigates are looking into PQ issues in distribution system. Here, two sorts of ways used to direct the PQ issues. At first, it acquired from customer side and from opposite side utility. The essential strategies are given as the state of load and it is ensures that the apparatus is less sensitive to power disturbances. The elective course of action is to include a line molding network that neutralizes or smother the power system network. Devices like super-capacitors, flywheels, constant voltage transformers, other energy storage systems; isolation transformer, transient voltage surge suppressor, harmonic filters and noise filter are utilized for the alleviation of explicit PQ issues. The Different FACTS devices like DSTATCOM, UPQC, UPFC, and DVR are prepared for directing the characteristic of PQ related with utility conveyance and the end user appliances. Here, the participation of harmonics is strikingly risky in both connected loads and addition with the connected power system network owing to current harmonic flow. Subsequently, the complexities expanding enormously in large unified networks with fluctuations in power supply reliability; it is resulted in instability system and it is tricky in power flow stream and security issues with huge number of power outages in different region around the world. The reasons for the above deficiency groupings might be expected to the automatically blunders in arranging and task, feeble connection of the power framework, absence of support or because of over-burden of the system. The procedure to defeat the issues and it to give a preferred power flow the system length reliability, stability and installations of advanced controllers become needed. Likewise, PQ issues associated with renewable distributed systems generation and it customize power gadgets (CPD) such as DVR, UPQC and STATCOM provides a huge job in PQ improvement. By this way, the establishments of advanced FACTS devices with the power system are controlled to some factor like control parameters and error functions related with PQ issues. The Reactive power control of RES integrating a wind and source of photovoltaic has many technological difficulties. This development needs control electronic devices with a propelled

technique. These issues are inspired to do the assessment in the field of PQ examination with Renewable Energy Sources (RES). Here, the recommended strategy used to improve the performance of IPFC so as to moderate the PQ issues in distribution system. The detailed analysis of the proposed method is mentioned as below,

III. ANALYSIS OF IPFC

In the FACTS devices, the IPFC is one of the most recent controllers which were utilized to regulate the power flow of various transmission lines. The IPFC comprises with a minimum of two SSSCs. The generalized Unified Power Flow Controller (GUPFC) utilizes a STATCOM and at least two SSSCs. The basic element of the device referenced the probability to exchange dynamic power between their shunt and series or between arrangements in the IPFC. The rating of the IPFC can be indicated by methods for two amounts, most extreme voltage that can be injected and the volt-ampere rating. The IPFC achieves its appraised power just when the injected voltage magnitude and the line current are equivalent to the evaluated qualities. The line current depends upon the power flow through the line. Along these lines, regardless of whether the IPFC can infuse the evaluated capacity to the line depends upon the first power flow in the line (with no infusion). The IPFC can be completed the general real and the reactive power compensation of the entire transmission system. This ability makes it is possible to adjust both real and reactive power flow between the lines, move control from over-load and increase the reasonability of the compensating structure against dynamic disturbances.

The IPFC can achieve the level of real transmission lines. It's engages reactive power flow between the power transmission lines and transform to under load one and to the over-disturbances. This controller can also control the power flow of various lines. In this paper IPFC converters are considered and after that they are directed with the PQ issues.

Crow Search Optimization Algorithm

Alireza Askarzadeh [32] created a meta-heuristic algorithm, of crow search optimization algorithm (CSOA) and resolving the constrained optimization issues which are based on the intelligent behaviors of crows. However, the working and operational attitude of CSOA is supported by the idea of crows that it can hide the excess foods as well as retrieve at the time of they required. The crows are also behaves in the commit stealing, thievery and bird's food. The crows are committed by this, which act extra precautions to avoid being a future victim and can in fact; determine the safest hide that carried out to protect their food items and being stolen by others. The CSOA concept with basic structures is given as below:

- The crows live in the appearance of flock.
- The positions are memorized by crows and their hiding places.
- The crows follow with each other to do thievery.
- The crows are protects with their caches are pilfered by using the probability function.

IV. RESULTS AND DISCUSSIONS

In the section, CSA based IPFC device is utilized to analyze the PQ issues in distribution system. The proposed method is implemented in MATLAB/Simulink platform. The proposed CSA method is work as the optimal control algorithm of IPFC device. Then evaluate the optimal gain and pulse capability of the IPFC device. Finally, the results were compared with traditional methods PSO and ABC methods. It works as a quick and fast reimbursing source for reactive power and the functionality on the distribution power system to moderate the voltage deviations like voltage sags, swells, and voltage flicker. This is carried out with unsteadiness produced by quickly changing reactive power demand. The PQ enhancement reliability predictions are continued throughout the development procedures are beneficial to promote the capability establishment of IPFC device and guaranteed as more dependable controller.

Analysis of Case 1:

In the subsection, the voltage sag and swell are analyzed and depicted in the Fig.8. In the figure, the voltage sag is occurred in the time instant t=1-2.5sec and the swell is occurred in the time instant t=2.5-3sec.It is clearly mentioned about the sag and swells appearances. To exactly view the voltage sag, this is created at the particular time instant t=0-0.1sec. The corresponding grid voltage, source voltage is also analyzed.

V. CONCLUSION

This paper deals with CSA based IPFC controller designed to diminish the PQ issues in distribution system. They some PQ issues, such as voltage sag, swell and flicker conditions are tested under this proposed method in MATLAB/Simulink platform. Normal supply source and RES are considered to given in the inputs to the IPFC. In addition, compensating reactive currents and the dynamic response of the system will help the mitigation of voltage sag, swell and flicker. The corresponding analysis of the real and reactive power, dc link voltage is also

analyzed. Finally, the FFT transform was utilized to analyze the THD performances of the system. The proposed method achieved the THD by 0.81% and the other methods are 6.20% and 8.76% respectively. It shows that the proposed method is given the less THD computation and optimal results when compared with the traditional PSO and ABC methods.

REFERENCES

[1] Vaiyapuri, T., Parvathy, V. S., Manikandan, V., Krishnaraj, N., Gupta, D., & Shankar, K. (2021). A Novel Hybrid Optimization for Cluster-Based Routing Protocol in Information-Centric Wireless Sensor Networks for IoT Based Mobile Edge Computing. Wireless Personal Communications, 1-24.

[2] Raveendran, A. P., Alzubi, J. A., Sekaran, R., & Ramachandran, M. A high performance scalable fuzzy based modified Asymmetric Heterogene Multiprocessor System on Chip (AHt-MPSOC) reconfigurable architecture. Journal of Intelligent & Fuzzy Systems, (Preprint), 1-12.

[3] Mansour, Romany F., and A. A. Marghilani. "A new technique to fingerprint recognition based on partial window." Computer Engineering and Intelligent Systems 3.10 (2012): 63-76.

[4] Namasudra, S. (2020). Fast and Secure Data Accessing by using DNA Computing for the Cloud Environment. IEEE Transactions on Services Computing.

[5] Goli, A., Zare, H. K., Moghaddam, R. T., & Sadeghieh, A. (2019). An improved artificial intelligence based on gray wolf optimization and cultural algorithm to predict demand for dairy products: a case study. IJIMAI, 5(6), 15-22.

[6] Elhoseny, M., Shankar, K., & Uthayakumar, J. (2019). Intelligent diagnostic prediction and classification system for chronic kidney disease. Scientific reports, 9(1), 1-14.

[7] Alzubi, J. A. (2020). Bipolar fully recurrent deep structured neural learning based attack detection for securing industrial sensor networks. Transactions on Emerging Telecommunications Technologies, e4069.

[8] Mansour, R. F. (2015). Using adaptive mutation to accelerate the convergence of immune algorithms for prediction of 3D molecular structure. International Journal of Computers and Applications, 37(3-4), 127-133.

[9] Namasudra, S., Sharma, S., Deka, G. C., & Lorenz, P. (2020). DNA computing and table based data accessing in the cloud environment. Journal of Network and Computer Applications, 172, 102835.

[10] Namasudra, S., & Deka, G. C. (2020). Applications of Blockchain in Healthcare. Springer Singapore Pte. Limited.

[11] Joshi, R. C., Singh, A. G., Joshi, M., & Mathur, S. (2019). A Low Cost and Computationally Efficient Approach for Occlusion Handling in Video Surveillance Systems. International Journal of Interactive Multimedia & Artificial Intelligence, 5(7).

[12] Le, D. N., Parvathy, V. S., Gupta, D., Khanna, A., Rodrigues, J. J., & Shankar, K. (2021). IoT enabled depthwise separable convolution neural network with deep support vector machine for COVID-19 diagnosis and classification. International Journal of Machine Learning and Cybernetics, 1-14.

[13] Babu, M. V., Alzubi, J. A., Sekaran, R., Patan, R., Ramachandran, M., & Gupta, D. (2020). An Improved IDAF-FIT Clustering Based ASLPP-RR Routing with Secure Data Aggregation in Wireless Sensor Network. Mobile Networks and Applications, 1-9.

[14] Mansour, R. F. (2017). Evolutionary computing enriched ridge regression model for craniofacial reconstruction. Multimedia Tools and Applications, 1-18.

[15] Namasudra, S., Chakraborty, R., Majumder, A., & Moparthi, N. R. (2020). Securing Multimedia by Using DNA-Based Encryption in the Cloud Computing Environment. ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM), 16(3s), 1-19.

[16] Rodríguez, J., Corredor, B., & Suárez, C. (2019). Genetic Operators Applied to Symmetric Cryptography. International Journal of Interactive Multimedia & Artificial Intelligence, 5(7).

[17] Raj, R. J. S., Prakash, M. V., Prince, T., Shankar, K., Varadarajan, V., & Nonyelu, F. (2020). WEB BASED DATABASE SECURITY IN INTERNET OF THINGS USING FULLY HOMOMORPHIC ENCRYPTION AND DISCRETE BEE COLONY OPTIMIZATION. Malaysian Journal of Computer Science, 1-14.

[18] Hamdoun, H., Nazir, S., Alzubi, J. A., Laskot, P., & Alzubi, O. A. (2021). Performance benefits of network coding for HEVC video communications in satellite networks. Iranian Journal of Electrical and Electronic Engineering, 1956-1956.

[19] Marghilnai, A. L. (2017). Abdulsamad, and RF Mansour," Wavelet filter techniques for segmenting retinal blood

vessels,". International Journal of Advanced and Applied Sciences, 4(9), 156-160.

[20] Namasudra, S., Chakraborty, R., Kadry, S., Manogaran, G., & Rawal, B. S. (2020). FAST: Fast accessing scheme for data transmission in cloud computing. Peer-to-Peer Networking and Applications, 1-13.

[21] Arora, S., & Singh, S. (2017). An Effective Hybrid Butterfly Optimization Algorithm with Artificial Bee Colony for Numerical Optimization. International Journal of Interactive Multimedia & Artificial Intelligence, 4(4).

[22] Shankar, K., Perumal, E., Elhoseny, M., & Nguyen, P. T. (2021). An IoT-Cloud Based Intelligent Computer-Aided Diagnosis of Diabetic Retinopathy Stage Classification Using Deep Learning Approach. CMC-COMPUTERS MATERIALS & CONTINUA, 66(2), 1665-1680.

[23] Amiri, I. S., Palai, G., Alzubi, J. A., & Nayak, S. R. (2020). Chip to chip communication through the photonic integrated circuit: A new paradigm to optical VLSI. Optik, 202, 163588.

[24] Mansour, R. F. (2011). Applying an evolutionary algorithm for protein structure prediction. American Journal of Bioinformatics Research, 1(1), 18-23.

[25] Namasudra, S., & Roy, P. (2017). Time saving protocol for data accessing in cloud computing. IET Communications, 11(10), 1558-1565.

[26] Dur-e-Ahmad, M., & Imran, M. (2020). Transmission Dynamics Model of Coronavirus COVID-19 for the Outbreak in Most Affected Countries of the World. International Journal of Interactive Multimedia & Artificial Intelligence, 6(2).

[27] Pustokhin, D. A., Pustokhina, I. V., Dinh, P. N., Phan, S. V., Nguyen, G. N., & Joshi, G. P. (2020). An effective deep residual network based class attention layer with bidirectional LSTM for diagnosis and classification of COVID-19. Journal of Applied Statistics, 1-18.

[28] Alrabea, A., Alzubi, O. A., & Alzubi, J. A. (2019). A task-based model for minimizing energy consumption in WSNs. Energy Systems, 1-18.

[29] Mansour, R. F. (2020). A robust deep neural network based breast cancer detection and classification. International Journal of Computational Intelligence and Applications, 19(01), 2050007.

[30] Namasudra, S., Roy, P., Vijayakumar, P., Audithan, S., & Balusamy, B. (2017). Time efficient secure DNA based access control model for cloud computing environment. Future Generation Computer Systems, 73, 90-105.

[31] García, C. G., Zhao, L., & García-Díaz, V. (2019). A User-Oriented Language for Specifying Interconnections between Heterogeneous Objects in the Internet of Things. IEEE Internet of Things Journal, 6(2), 3806-3819.

[32] Anupama, C. S. S., Sivaram, M., Lydia, E. L., Gupta, D., & Shankar, K. (2020). Synergic deep learning model–based automated detection and classification of brain intracranial hemorrhage images in wearable networks. Personal and Ubiquitous Computing, 1-10.

[33] Alzubi, O. A., Alzubi, J. A., Dorgham, O., & Alsayyed, M. (2020). Cryptosystem design based on Hermitian curves for IoT security. The Journal of Supercomputing, 76(11), 8566-8589.

[34] Mansour, R. F. (2012). A robust method for arabic car plates recognition and matching using chain code. American Journal of Computational and Applied Mathematics, 2(3), 105-111.

[35] Namasudra, S. (2021). Data access control in the cloud computing environment for bioinformatics. International Journal of Applied Research in Bioinformatics (IJARB), 11(1), 40-50.

[36] Cueva-Fernandez, G., Espada, J. P., García-Díaz, V., & Gonzalez-Crespo, R. (2015). Fuzzy decision method to improve the information exchange in a vehicle sensor tracking system. Applied Soft Computing, 35, 708-716.

[37] Alqaralleh, B. A., Mohanty, S. N., Gupta, D., Khanna, A., Shankar, K., & Vaiyapuri, T. (2020). Reliable Multi-Object Tracking Model Using Deep Learning and Energy Efficient Wireless Multimedia Sensor Networks. IEEE Access, 8, 213426-213436.

[38] Alzubi, J. A., Manikandan, R., Alzubi, O. A., Qiqieh, I., Rahim, R., Gupta, D., & Khanna, A. (2020). Hashed Needham Schroeder industrial IoT based cost optimized deep secured data transmission in cloud. Measurement, 150, 107077.

[39] Mansour, R. F., & Abdelrahim, E. M. (2019). An evolutionary computing enriched RS attack resilient medical image steganography model for telemedicine applications. Multidimensional Systems and Signal Processing, 30(2), 791-814.

[40] Chakraborty, R., Verma, G., & Namasudra, S. (2020). IFODPSO-based multi-level image segmentation scheme aided with Masi entropy. Journal of Ambient Intelligence and Humanized Computing, 1-19.

[41] García-Díaz, V., Fernández-Fernández, H., Palacios-González, E., G-Bustelo, B. C. P., Sanjuán-Martínez, O., & Lovelle, J. M. C. (2010). Talisman mde: Mixing MDE principles. Journal of Systems and Software, 83(7), 1179-1191.

[42] Shankar, K., & Perumal, E. (2020). A novel hand-crafted with deep learning features based fusion model for COVID-19 diagnosis and classification using chest X-ray images. Complex & Intelligent Systems, 1-17.

[43] Alzubi, O. A., Alzubi, J. A., Alweshah, M., Qiqieh, I., Al-Shami, S., & Ramachandran, M. (2020). An optimal pruning algorithm of classifier ensembles: dynamic programming approach. Neural Computing and Applications, 32(20), 16091-16107.

[44] Cueva-Fernandez, G., Espada, J. P., García-Díaz, V., Crespo, R. G., & Garcia-Fernandez, N. (2016). Fuzzy system to adapt web voice interfaces dynamically in a vehicle sensor tracking application definition. Soft Computing, 20(8), 3321-3334.

[45] Mansour, R. F. (2012). Multiple Views Effective for Gait Recognition Based on Contours. Computer Engineering and Intelligent Systems, 3(10), 50-62.

[46] Alzubi, J. A., Jain, R., Kathuria, A., Khandelwal, A., Saxena, A., & Singh, A. (2020). Paraphrase identification using collaborative adversarial networks. Journal of Intelligent & Fuzzy Systems, (Preprint), 1-12.

[47] Pavithran, P., Mathew, S., Namasudra, S., & Lorenz, P. (2020). A Novel Cryptosystem based on DNA Cryptography and Randomly Generated Mealy Machine. Computers & Security, 102160.

[48] Elhoseny, M., & Shankar, K. (2019). Reliable data transmission model for mobile ad hoc network using signcryption technique. IEEE Transactions on Reliability, 69(3), 1077-1086.

[49] Nieto, Y., García-Díaz, V., Montenegro, C., & Crespo, R. G. (2019). Supporting academic decision making at higher educational institutions using machine learning-based algorithms. Soft Computing, 23(12), 4145-4153.

[50] Miled, A. B., Dhaouadi, R., & Mansour, R. F. (2020). Knowledge Deduction and Reuse Application to the Products' Design Process. International Journal of Software Engineering and Knowledge Engineering, 30(02), 217-237.