Power Flow Optimization Using MFO to Reduce Energy Losses

Pradeep Singh Chouhan, Akash Soni, Khushboo Sharma, Arindam Singha

{ Pradeepsingh2201@gmail.com, Akashsoni8955@gmail.com, Khushboochaturvedi5@gmail.com }

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Abstract. Loads in energy systems that reduce the complexity in energy systems that causethe electric voltage to produce RES to fluctuate a lot. In order to efficiently address theOPF issues, this article presents a moth flame optimization (MFO) method. The theory of maximizing moth flame (MFO) is influenced by the motion of the moon in the path of the moon. With the modification of the direction of moths in different spirals across the blaze, MFO is mostly focused on the MFO principle. Many well optimization methods equate the simulator accuracy of the suggested method with those received. The proposed model providesthe capacity and reliability of the MFO approach to address OPF issues. The findings indicate that contrasted to other methods, the MFO method is successful of identifying correct and good OPF approaches.

Keywords: Renewable energy, Electrical load, Power Flow Optimization, MFO, Energy Losses.

1 Introduction

The electric power industry has already seen a growing interest in distributed sources of generation[1]. The existence of Renewable Distributed Generations (RDGs), particularly in distribution networks, influences the attention of investigators in a number of key aspects and issues. On the another side, they could be efficient in preventing energy loss and enhancing thetotal quality of the power scheme, based on the area and length of RDGs, allowing the development against a sustainable and smart grid[2].In addition, RDGs are an ideal method to energy micro grids that improve the adaptability of the grid via local capacity to deal with a crisis. Off-grid by operating (islanded mode). On either side, new problems emerge referring, and other, to reliability, voltage regulation and power quality problems, which need to be tackled through novel scientific studies and creative answers[3].Even so, this study covers a wide range theme of the integration of RDGs into distribution systems, given the fact that production of high reliability, reliable power and a growing amount of loads can result to a heightened understanding of the amount of water by both users as well as utilities[4].Therefore, in accordance to their form, RDGs units are regarded as a viable strategy for these issues with optimum size and position. The deployment of RDG systems hasa lot of

THEETAS 2022, April 16-17, Jabalpur, India

DOI 10.4108/eai.16-4-2022.2318069

significant, scientific and cultural advantages[5].In addition to reducing greenhouse emissions, financial and ecological benefits could be expressed in reducing energy savings, storage and production rates, energy rates. The technological advantages and benefits of deferring electricity grid improvements, enhancing voltage level and transient control, reducing power loss, protecting quality, or ensuring power quality[6] are deducted. In latest days, several studies have centered on RDGs, PV systems and WTs, which offer reliable energy production[5].

Many investigators [4] have focused on reducing the power loss by enhancing the voltage profile without evaluating the expense of failures and RDGs units' infrastructure and servicingwith their procedure. Since some investigators [7] regarded these expenses in their transactions, they focused on developing voltage stability only, without decreasing device losses and costs suitably.

This paper examines various steps to address these drawbacks. First, the LSF are conducted to appoint its most it also buses for RDGs implementations. Then, in the second phase, an MFO is designed to classify from the identified candidate buses the efficiency level of RDGs and their position. The goal of this task is formed under numerous optimization problem for optimum convergence of RDGs units to minimize the average operational cost and structure power loss, in order to enhancing the power quality and its reliability.

The remaining section of the paper is organized as follows, Section II defines the literature review and section III explains the research methodologies. Section IV describes the Moth Flame Optimization and its mathematical modeling in section V. Section IV discusses the study of the related work of MFO in PFO. Section V and VI describes the proposed methodology and results Section VII concludes the paper.

2 Literature Review

Mao et al.,[10] This paper lays forth a hierarchical plan for multi-agent energy management. To better determine the approach, a two-step framework is designed that aims to optimize RES use. The plan is focused in the first phase to optimize local RES consumption, depend on the DRP and BESS within the separate MG. A new approach for enhancing local use of the MMG program by MAS for renewable energy has been suggested in this paper. In contrast to the CBESS, MMG, EMS also considers the BESSs of each MG as contrasted with conventional energy management techniques. In addition, simulation with a three-MG framework shows that the technique can efficiently raise RES consumption ratio and minimizepower grid transaction relative to conventional approach.

Dawn et al.,[11] In this paper, optimal supplier bidding method under congested method was developed to affect the financial participant profit evaluating double sided bidding. In this paper, engine rearranging predicated on the GSF was introduced for mitigating system congestion. MFO methodology was utilized to get bidding possible solutions. In the deregulated electricity market a updated IEEE 30 bus device is use to validate the bidding method. Obtained results through the MFObased algorithm are contrasted with the ABC-based algorithm, and are thought to be higher than the ABC method.

Parmar et al.,[12] The recently designed MFO approach is used in this article that uses unique moth shipments in the midst of moonlight (flame) to navigate large distances in a single direction. This moth conduct is used to maximize DG's position and scale. This paper's prime objective is to minimize the decline of actual energy. The suggested approach was evaluated on a radial distribution system for 33 buses. An element named IV is utilized to screen the main thoughtful DG placement buses. Then automated process these screened buses are draw as search space which decreases the computational transmission.

Das et al.,[13] By novel meta-heuristic optimization method MFO, the most major complaint of modern power system decided to name Optimal Power Flow (OPF) is configured in this work. Standard IEEE-30 bus device is used for solving the power quality concerns. For the solution of the presented solution MFO is introduced. The Fuel lower costs, Effective energy Loss reducing and RPL avoidance are the issues considered in the OPF crisis. MFO's benefits are contrasted with another method's like the FPA and the PSO for example. Findings demonstrate that MFO gives excellent value for optimization contrasted to FPA and PSO which affirms efficacy of the suggested method.

Mustaffa et al.,[14] MFO is perceived in this paper in ORPD issue to evaluate the perfect mixture of track parameters such as voltage engines, tap transformer configuration as effectively as reactive compensator sorting to maintain acceptable average energy loss and standard potential deviation. However, the efficacy of the MFO approach is contrasted on three case studies with other known optimization methods, including IEEE 30-bus device, IEEE 57-bus device and IEEE 118-bus device. The SA of this investigation showed that MFO is capable of producing successful performance by reducing the energy failure and low energy deviation as compared to chosen from literature approaches.

Reddy et al.,[15] The Moth Flame Optimization (MFO) is added successively in this document to a reconfiguration of the feeder for delivery. The maximum real power loss limitation in optimization phase is 45, 3090kW for 16-node and 125,1838 kW for 69-node networks, despite affecting the radial existence of the given network focused on switching vectors. After optimum reconfiguration the actual average power loss decrease is 8.86 percent for 16-node and 55.64 percent for 69-node respectively. On regular IEEE 16-node and 69-node networks, an effectiveness of the Moth Flame Optimization method is evaluated.

3 Proposed Methodology

3.1 Research Gaps

After reviewing the things various research gaps are noticed which are given below.

1. Most of the researches are done on power systems normalizations and due to large scale of the power systems management of the renewable energies don't get stability which produces problem to handle energy managements at large scales.

2. Different control procedures are functional in this domain but are not able to achieve good precision for the management of tolerances in the power systems.

3. There are lot of voltage instability which can degrade the system due to improper management of the loads in the power systems.

3.2 Problem Statement

1. Loads in power systems enhancing the risks in the power systems due to which there are lot of fluctuations in the alternating current to create renewable energy resources.

2. The main issue in maintaining varying loads and tolerances. Electrical load needs to connect to the system which is responsible in generating sinusoidal currents at the same frequency as the voltage which is not in the phase.

3. The renewable and energy management systems are really getting affected due to low fault tolerance which is responsible to make system less adaptable and accurate. So an efficient approach is needed to accomplish good management of this power system and performance evaluation to decrease the losses in the distributed power systems.

3.3 Proposed Objectives

The objectives of the proposed work are given below

1. To study the various techniques used for the renewable energy resource managementsystem and their consequences to achieve low losses.

2. To implement the power flow optimization using MFO to reduce the energy losses forhigh tolerances.

3. To verify the productivity of the device and comparison with the base paper for the enhanced system.

3.4 Methodology Steps

1. The first step is initializing the requirements of the distributed power systems connected tothe grid.

2. Create situation and voltage levels of the distribution network for the power flow system.

3. Implement the load and failures to test the effect of the power flow tolerance on distributed networks.

4. Assess the overall current and voltage levels for the renewable energy system protectionload varying.

5. Execute optimization of the power flow to reduce energy losses to boost the high energy distribution.

6. Assess the power distribution system performance for increased power and voltagestability.

7. Compare the results with the base approach to validate the enhancements in terms of lowlosses and low energy cost.

4 Moth Flame Optimization

The first introduction of the Moth Flam Optimizer (MFO) was in [8]. With several optimization algorithms influenced by physical processes in nature, the MFO has proven its efficiency. The navigation method of moths in nature, known as transverse orientation, is the good spot of the training methodology. Figure 1 illustrates a transverse orientation structural framework. Moths are stylish creatures that use moonlight to fly at dark, with a unique way of navigating at night. By keeping a set angle with respect to the moon, their rotation is accomplished, allowing them to travel in a clear light. This process is known as transverse orientation. The insects do not jump directly, because of artificial light But loop. For that, for moths that need to be co - integrated, this illumination is seen as a new target. The method for optimization of this step is named Moth-Flame Optimization (MFO). From what follows, the mathematical model of the suggested spiral flying path technique for moths is presented. To minimize the optimal solution, the app needs the evaluation of the maximum point for control variables.

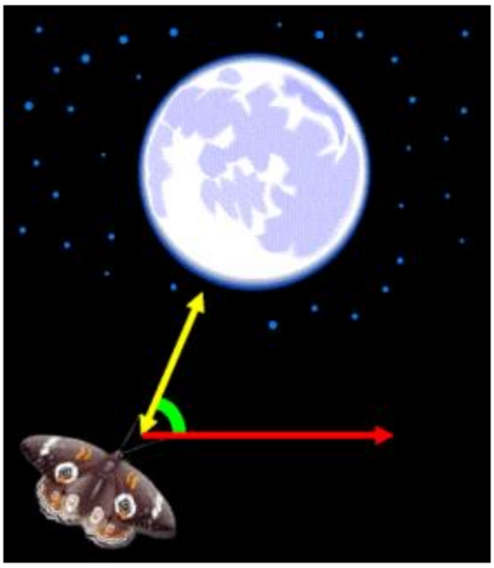

Fig. 1. Transverse Orientation[8]

5 Mathematical Modeling

The design parameters are believed to be the moths, and the issue's variables are the location of moths in space. With adjusting their location dimensions, the moths could fly hyper dimension space. The method for MFO is population-based. In a vector, all the moths aredescribed as follows[9]:

$$M = \begin{bmatrix} m_{1,1} & \cdots & m_{1,d} \\ \vdots & \ddots & \vdots \\ m_{n,1} & \cdots & m_{n,d} \end{bmatrix} \quad (1)$$

Where the number of moths is n and the variety of factors is d (dimension). Designers expecta table to hold the configuration properties of all moths as obeys:

$$\mathrm{OM} = \begin{bmatrix} \mathrm{OM}_1 \\ \mathrm{OM}_2 \\ \vdots \\ \mathrm{OM}_n \end{bmatrix} \quad (2)$$

Here n represents the number of moths. Flames are also a main factor in the suggested technique. As followed, a matrix close to the moth matrix is regarded:

$$\mathrm{F} = \begin{bmatrix} \mathrm{F}_{1,1} & \cdots & \mathrm{F}_{1,d} \\ \vdots & \ddots & \vdots \\ \mathrm{F}_{n,1} & \cdots & \mathrm{F}_{n,d} \end{bmatrix} \quad (3)$$

Where the number of moths is n and the number of variables is d (dimension). The set for holding the corresponding forming of variables is also believed to exist as obeys:

$$\mathrm{OF} = \begin{bmatrix} \mathrm{OF}_1 \\ \mathrm{OF}_2 \\ \vdots \\ \mathrm{OF}_n \end{bmatrix} \quad (4)$$

Where n represents the number of moths. The moths are meet challenges agents that travel around the searching room, while the fires are the best moths in the location. Using the equation 5, the location of each moth is changed with regard to a flame:

$$\mathrm{M}_i = \mathrm{S}(\mathrm{M_i}, \mathrm{F_j}) \quad (5)$$

Here Mi shows the i-th moth, the j-th flame is shown by Fj, and the spiral feature is S. Regarding these factors, for the MFO technique, a logarithmic spiral is formulated as having:

$$S\left(M_i, F_j\right) = D_i . e^{bt} . \cos 2\prod \mathrm{t} + F_j \quad (6)$$

Here Di denotes the j-th flame range of the i-th moth, b is a fixed to describe the logarithmic spiral form, and t is a special variable in [-1, 1]. Figure 2 shows the logarithmic spiral, the area across the flame, and the location on the curve regarding distinct t.D is measured as follows:

$$D_i = \left|F_j - M_i\right| \quad (7)$$

Here Di measures the difference of the j-th flame to the i-th moth. Expanding the number ofiterations decreases the number of flames. In this topic, the below equation is utilized:

$$flame\ no = round(N - l * \frac{N-1}{T}) \qquad (8)$$

here l is the present amount of iteration, N is the highest number of flames, and T represent the highest number of iterations.

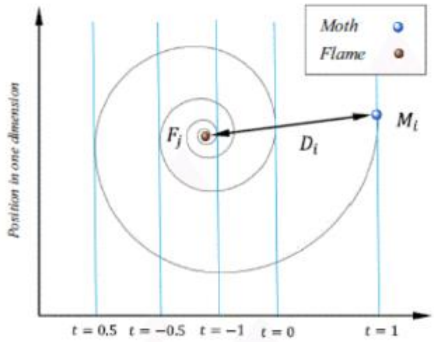

Fig. 2. Logarithmic spiral, space around a flame, and the position with respect to [8]

6 Results

To evaluate the MFO approach, the device is simulated in Simulink/MATLAB. The features of the converter and PV module in the standard conditions. The suggested Moth-Flame Optimization (MFO) approach has been evaluated in quality IEEE experiment devices and simulation outcomes demonstrated clear about the better productivity of the suggested approach in minimizing the actual energy failure with control variables within the restrictions. In three cases, the quality of the work of the MFO is contrasted with current, previous techniques in order to verify the effectiveness of the suggested technique. The number of moths in MFO is assumed to be equal to offer a consistent correlation between theseprotocols. In addition, the actual, conventional, planned MFO wants to keep until the sameextends phase is reached.

Wind power is one of the most renewable sources of energy and has been extensively employed around the globe. The key points for designing and implementation wind turbines are precise forecasts of wind resource evaluation and acceptable wind velocity distribution methods (for any area) due to higher natural fluctuation in the wind resource.

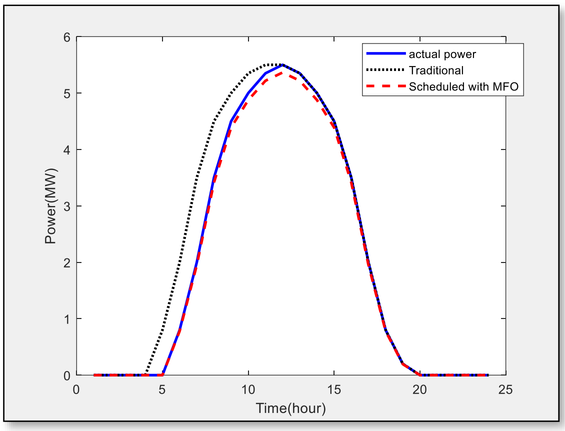

Fig. 3. Comparison show the actual, traditional and scheduled with MFO PC for solar PV

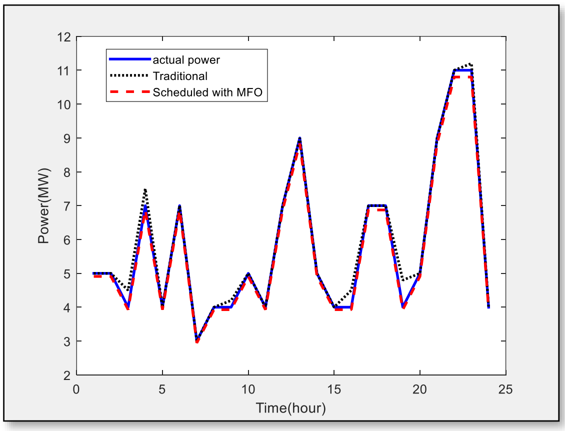

Fig. 4. Comparison indicate the actual, traditional and scheduled with MFO PC for wind

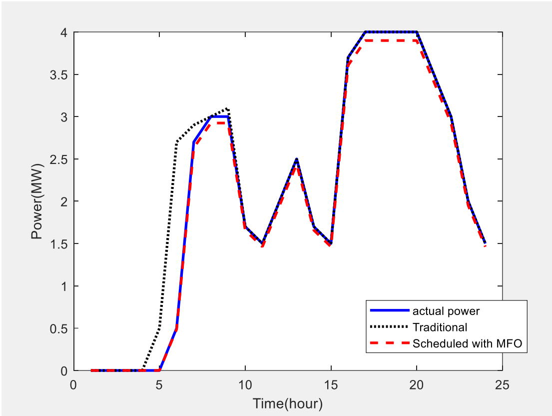

Fig. 5. Comparison show the actual, traditional and scheduled with MFO PC for wind

Table 1. Show Comparison Values for Actual, Traditional and Scheduled With MFO

Actual		Traditional		Scheduled with MFO	
Interval	Power (MW)	Interval	Power (MW)	Interval	Power (MW)
5 H	0	5 H	0	5 H	0
10 H	1.6	10 H	1.6	10 H	1.6
15 H	1.5	15 H	1.5	15 H	1.5
20 H	4	20 H	4	20 H	3.7
25 H	1.5	25 H	1.5	25 H	1.5

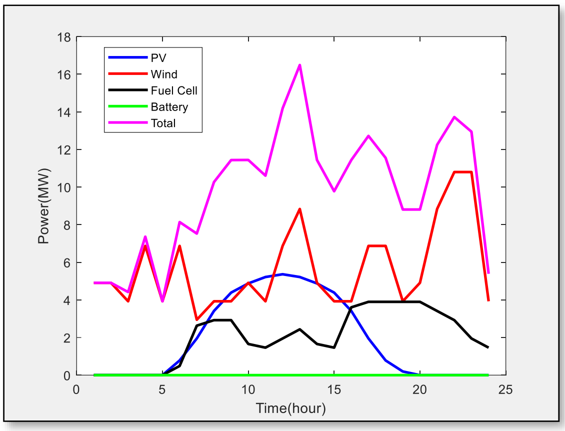

Fig. 6. Output power of different energy sources

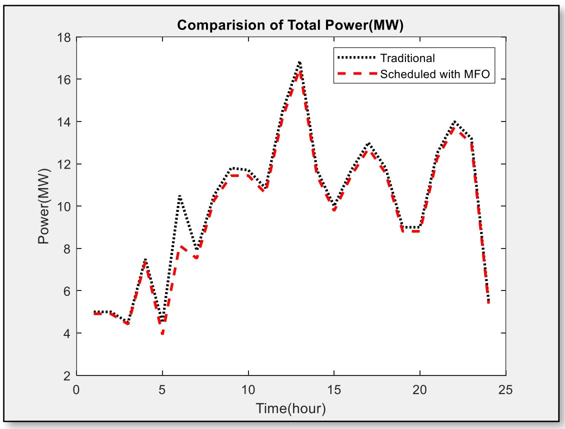

Fig. 7. Comparison of total generated power

Comparison effects for actual, conventional and scheduled with MFO are shown in Table 1, which simply demonstrates that the power voltage rises when the time increases, and could balance after more time proceeds. Its shows that MFO technique is better for power scheduling for wind energy.

The correlation of the maximum produced energy extracted from the suggested approaches with other optimizing strategies is shown in Figure 7. As Contrasted to conventional methods, such findings demonstrate the superiority of the suggested techniques to provide a stronger, ideal outcome.

7 Conclusion

Moth Flam Optimizer was introduced and proposed to fix the OPF issue in this report. In order to: minimize fuel cost, minimize the total output and minimize, boost the power factor, the maximum fuel cost including the valve point influence, the software should address various goals. Comparison with those published in recent literature, the results found from the MFO method were contrasted. The efficiency, reliability and quality of MFO accomplish the maximum of all goals, as per the data achieved. The Future scope of proposed work is that the suggested approach has a large RT as compared to another methods. It’s a drawback of the MFO approach that would be the point of subsequent research, Hybrid optimization approaches for resolving other more complex engineering issues and working fields.

References

[1] Ou, T.-C. and Hong, C.-M, “Dynamic operation and control of microgrid hybrid power systems”, Energy, vol. 66, pp. 314–323,2014.

[2] Chiradeja, P. and Ramkumar, R., “An Approach to Quantify the Technical Benefits of Distribute Generation”,IEEE Trans. Energy Convers”, vol. 19, pp. 764–773,2004.

[3] Ou, T. C., “A novel unsymmetrical faults analysis for microgrid distribution systems”,Electr. Power Energy Compon, vol. 43, pp. 1017–1024,2012.

[4] Tulsky, V., Vanin, A., Tolba, M. andSharova, “Study and analysis of power quality for an electric power distribution system—Case study: Moscow region”, In Proceedings of the 2016 IEEE NW Russia Young Researchers in Electrical and Electronic Engineering Conference (EIConRusNW),pp.710– 716, 2016.

[5] Sudabattula, S. andKowsalwa, M., “Optimal allocation of wind based distributed generators in distribution system using Cuckoo Search Algorithm” Procedia Comput. Sci., vol. 92,pp. 298–304 ,2016.

[6] Georgilakis, P. andHatziargyriou, N., “Optimal distributed generation placement in powerdistribution networks: Models, methods and future research”, IEEE Trans. Power Syst. , vol. 28, pp. 3420–3428,2013.

[7] Imran, M.andKowsalya, M., “Optimal size and siting of multiple distribution generators in distribution system using bacterial foraging optimization”, Swarm Evol. Comput., vol. 15, pp. 58–65,2014.

[8] S Mirjalili, “Knowledge-Based Systems Moth-flame optimization algorithm : A novel natureinspired heuristic paradigm”, Knowledge-Based Syst. 2015.

[9] BachirBentouati andLakhdarChaib, “Optimal Power Flow using the Moth Flam Optimizer: A Case Study of the Algerian Power System”, TELKOMNIKA Indonesian Journal Of Electrical Engineering, vol. 1, No.3,2016.

[10] Jiang, W., Yang, K., Yang, J. andZhuo, Z. , “A Multiagent-Based Hierarchical Energy Management Strategy for Maximization of Renewable Energy Consumption in Interconnected MultiMicrogrids”, IEEE Access, vol. 7, pp. 169931–169945,2019.

[11] Gope, S., Dawn, S., Goswami, A. K., and Tiwari, P. K. , “Moth Flame Optimization based optimal bidding strategy under transmission congestion in deregulated power market”, 2016 IEEE Region 10 Conference (TENCON),2016.

[12] Parmar, S. A., Pandya , Trivedi, I. N., and Ladumor, D. , “ Optimal active and Reactive Power dispatch problem solution using Moth-Flame Optimizer algorithm”, International Conference on Energy Efficient Technologies for Sustainability (ICEETS), vol.23, 2016.

[13] Das, A., and Srivastava, L., “Optimal placement and sizing of distributed generation units for power loss reduction using Moth-Flame optimization algorithm”, International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT), vol. 8, 2017.

[14] N. Shin Mei, R., Sulaiman, M. and H., Z., Daniyal, H., “Optimal reactive power dispatch solution by loss minimization using moth-flame optimization technique”, Applied Soft Computing, vol. 59, pp. 210–222,2017.

[15] M. Damodar andReddy,A., “Distribution Network Reconfiguration for Maximum Loss Reduction Using Moth Flame Optimization”, International Journal of Emerging Technologies in Engineering Research (IJETER) vol. 6, no.1, 2018.