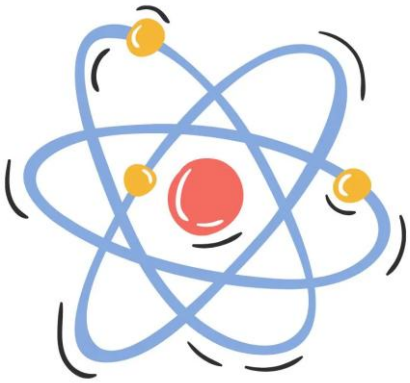

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REVIEW OF DYNAMIC ECONOMIC DISPATCH IN MICROGRID

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Abstract: *Microgrid provide a comprehensive strategic partnership with conventional methods to fulfil energy need globally. Microgrid provide energy need individually or with association with distributed energy resource such as solar, wind etc. energy supply mechanism should be economically beneficially for distributor and efficient. A Varity of cost optimization method available for reducing the generation cost for conventional as well as microgrid operation. Cost optimization techniques mainly classified with three sub categories such as conventional or traditional, artificial or computerized and hybrid or mixed based (conventional and AI) techniques. This review paper provides a comprehensive view to analysis these techniques.*

Keywords: *economic dispatch, optimization techniques, microgrids, artificial intelligence, hybrid*

1. Introduction

Microgrid effective optimization with DERs need optimization techniques for reducing its power generation cost. A list of optimization techniques available for efficiently reduced the generation cost [2][3]. Firstly, invented or described optimization techniques called conventional or traditional techniques. These techniques collectively take more time to find optimized solution classical coordinate, gradient, modified coordinate are subcategories of traditional method for optimization. Other techniques available which are more advance than previous are particle swarm optimization, ant lion, crow search, artificial algae technique. These are nature inspired population-based optimization techniques. More advanced techniques available which uses combination mechanism of conventional and ai techniques called hybrid method

2. Concept Of Economic Dispatch

economic dispatch is a very useful concept to optimize the generating cost of a given power system. Under economic dispatch we have to find the best useful way to allocate power distribution between associated generation units. Each generation unit have certain limitation called constraints under which they have to produce power to meet the demand. A following graph is shown the relation between fuel input and power output.

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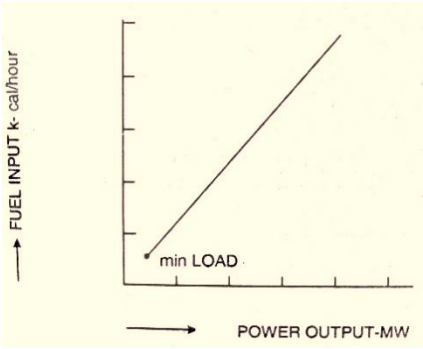

Fig1 . input output curv of a generating unit

The heat rate between input and output can easily be shown by the following figure

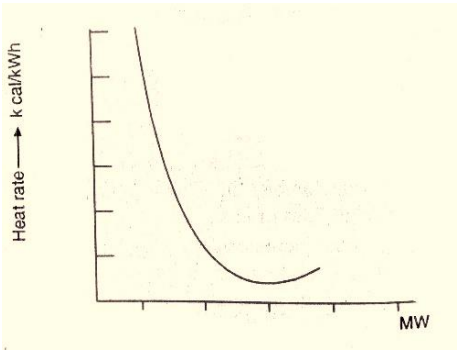

Fig2.- heat rate curv of generating unit

3. Problem Formulation

We have a case study in which we have six distributed energy resources units such as dg1 dg2 dg3 pv1 pv2 and CHP. Here the purpose of economic dispatch is to find optimal power generation with consideration of minimum operating cost. A mathematical standard equation been presented which as

$$C_i(P_i) = a_i P_i^2 + \beta_i P_i + \gamma_i$$

Where C is the generation cost ($), Power generation of i unit(kw), α,β,γ are cost coefficients ($/kw).

3.1 Constraints of System

Mathematical equation subjected to qualifying two given constraints which as

3.1.1 Power Balance:

All generated power among all the units should be in a manner that it must be satisfied the energy demand

Here total generated power is equal to the demand when there is no consideration of transmission losses

$$\sum_{i=}^{n} P_i = P_L$$

3.1.2 Generation limit

the power generation amount of each unit must be in the range of their upper bound and lower bound of the generation capacity. Power generation from DERs should be such that it

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satisfies the load requirement Power generation capacity remains in the range of minimal and maximum of DERs

Such that,

$$P_{imin} < P_i > P_{imax}$$

we have an updated mathematical formulation for minimal economic dispatch among other DERs units.

$$minOF = \sum_{i=1}^{n} (a_i P_i^2 + \beta_i P_i + \gamma_i) - P_i \times \sum_{i=1}^{n} P_i - P_L$$

4. Overview Of Computing Techniques

There are kind of optimization techniques used in microgrids for solving the complicated problems. The study finds three types of optimization techniques which we use in power system “conventional
based, artificial intelligence based and hybrid techniques. These techniques further classified into various sub techniques.

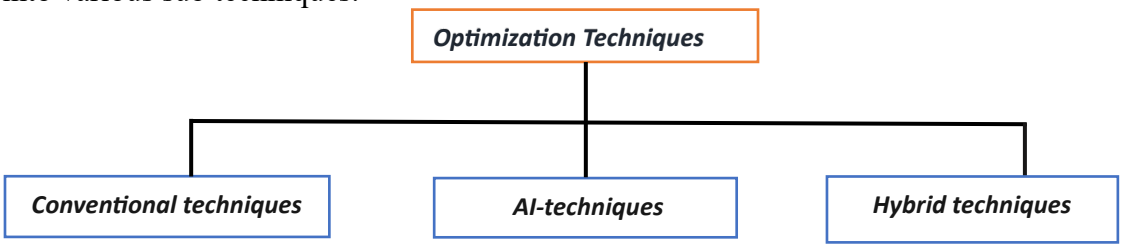

Fig 3 – Optimization techniques

4.1 *Conventional Techniques*: -

Conventionally techniques are those techniques which are traditional use to find optimal economic dispatch solutions. These techniques are easy to use and having simple operational mechanism. These techniques have some traditional drawbacks for not capable to deliver optimal solution for complex system [6]. Some conventional techniques are shown in the fig.-

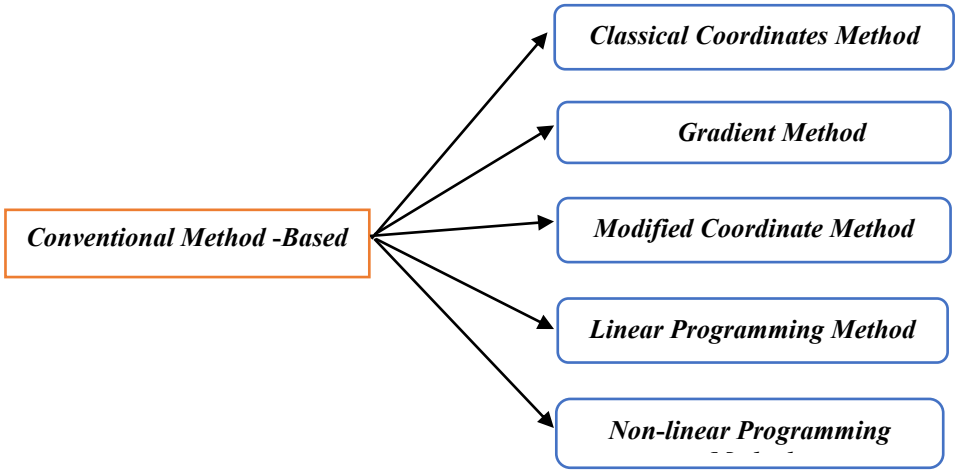

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Fig 4 - Conventional Method-based Optimization Techniques

4.2 AI Based Methods – artificial based intelligence techniques completely transformed the entire economic dispatch field of power system. These techniques are highly motivated to perform complex tasks where conventional based techniques show incapability. These techniques utilize the artificial intelligence-based programming working models to find optimal solutions. These algorithms have high accuracy, fast processing speed to perform even extremely complex task. Here are some ai based techniques [39].

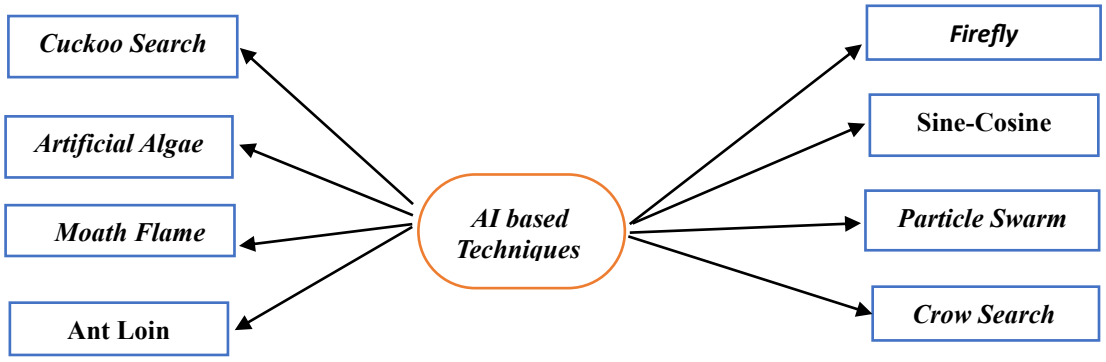

Fig5 - AI based techniques

4.2.1 Partial swarm optimization

The approach of particle swarm optimization is developed by Kennedy and Russell. Algorithm is based on the searching behavior of particles or agents of swarms. Swarms works with the helping natures of each other to find the food objects. Each swarm search the food in a way that they utilize their best position with each individual and also nearby swarm experiences. They find their food object by applying this approach with minimum time. PSO provide a high-quality best solution with a short duration of time. An objective function is provided to find best optimal output and for this case particle with lower value has high performance compare to another particle. Each particle has its best personal performance called Pbest and best performance among the pbest is called gbest. The updated velocities and positions of the particle is determined through

$$V_i^{t+1} = \omega V_i^t + C_1 r_1 (X_{ipbest} - X_i^t) + C_2 r_2 (X_{igbest} - X_i^t)$$

Where

V_i^{t+1} = velocity of particle i at iteration t+1
V_i^t = velocity of particle i at iteration t
r_1 , r_2 = random number between [0, 1]
C_1, C_2 = acceleration constant
ω = Inertia weight factor and position updating is determined through

$$X_i^{t+1} = X_i^t + V_i^{t+1}$$

where

X_i^{t+1} = position of particle i at k+1
X_i^t = position of particle i at iteration k
V_i^{t+1} = velocity of particle i at iteration k+1

inertia weight is determined through

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$$\Omega = \omega_{max} - \frac{\omega_{\max} - \omega_{min}}{iter_{max}} \times iter$$

Where

$iter_{max}$ = maximum number of iterations
iter = current iteration

We can analysis these steps with a flow chart

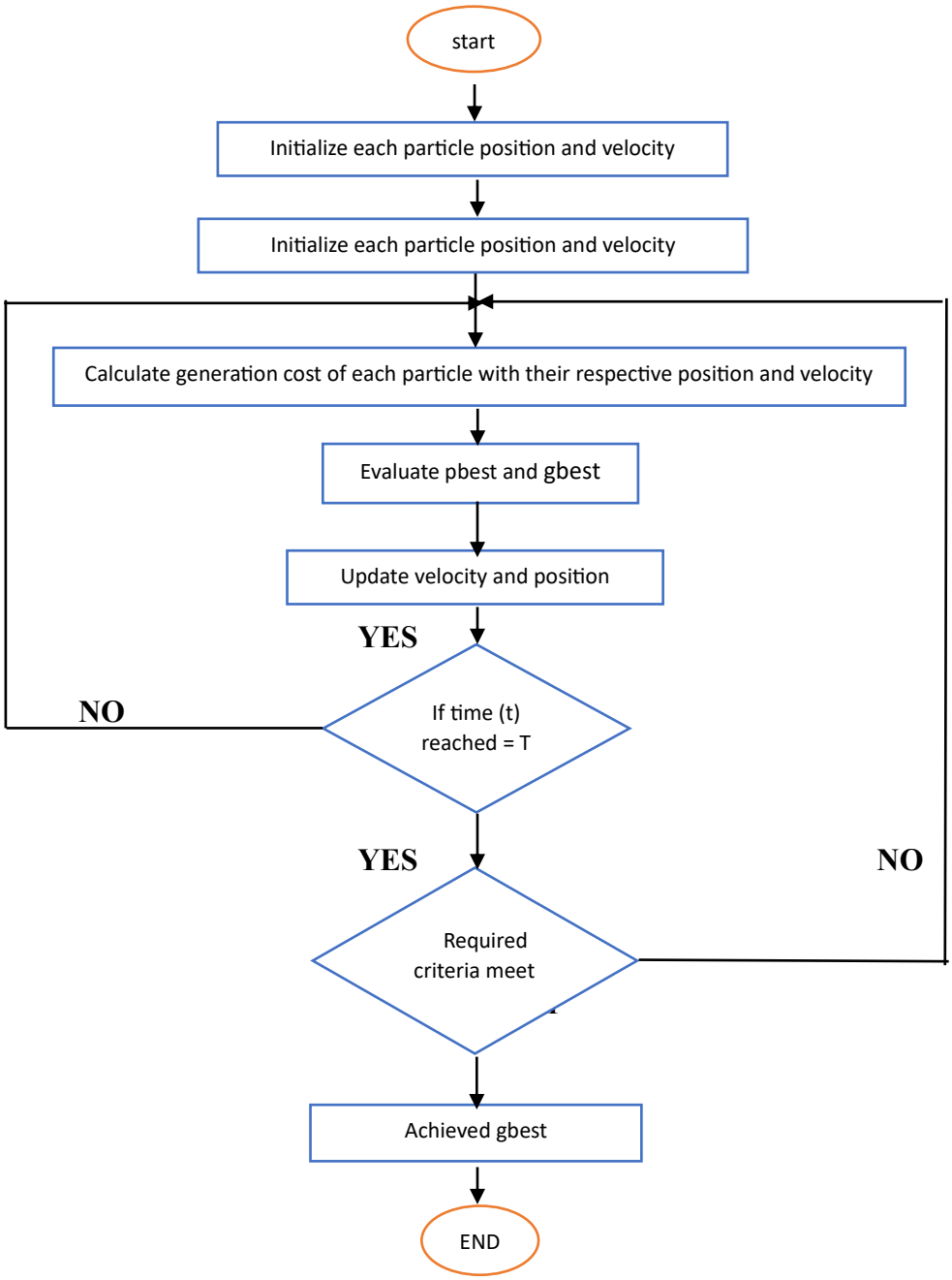

Fig: 6. - Flow chart of PSO with DED.

4.2.2 Genetic Algorithm –

The word of genetic is referred to a word of genetics in biological science. It specified with gens of parents which transferred from generation o generation. Genetic algorithm is an

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optimization technique based on genetic evolution. Through genetic algorithm we can capable to find best solution from a given pool of available solution. This group or pool is made by individuals or chromosomes. Assume we have a given pool or series of available solutions. Now a selection process initiated based on their fitness function that how this chooses solution could be fit to our requirement criteria. Now the crossover process is started with a group of chromosomes. Next mutation is done under which some minor changing is done in the chromosomes for maintaining the diversity of genes. The whole process is run continue until we get best part of the function. Two fitness function is provided for maximization and minimization. For maximization the fitness function is

$$f(x) = F(x)$$

and for minimization problem the fitness function is

$$f(x) = \frac{1}{1+F(X)}$$

where F(x) is an objective function and f(x) is a fitness function

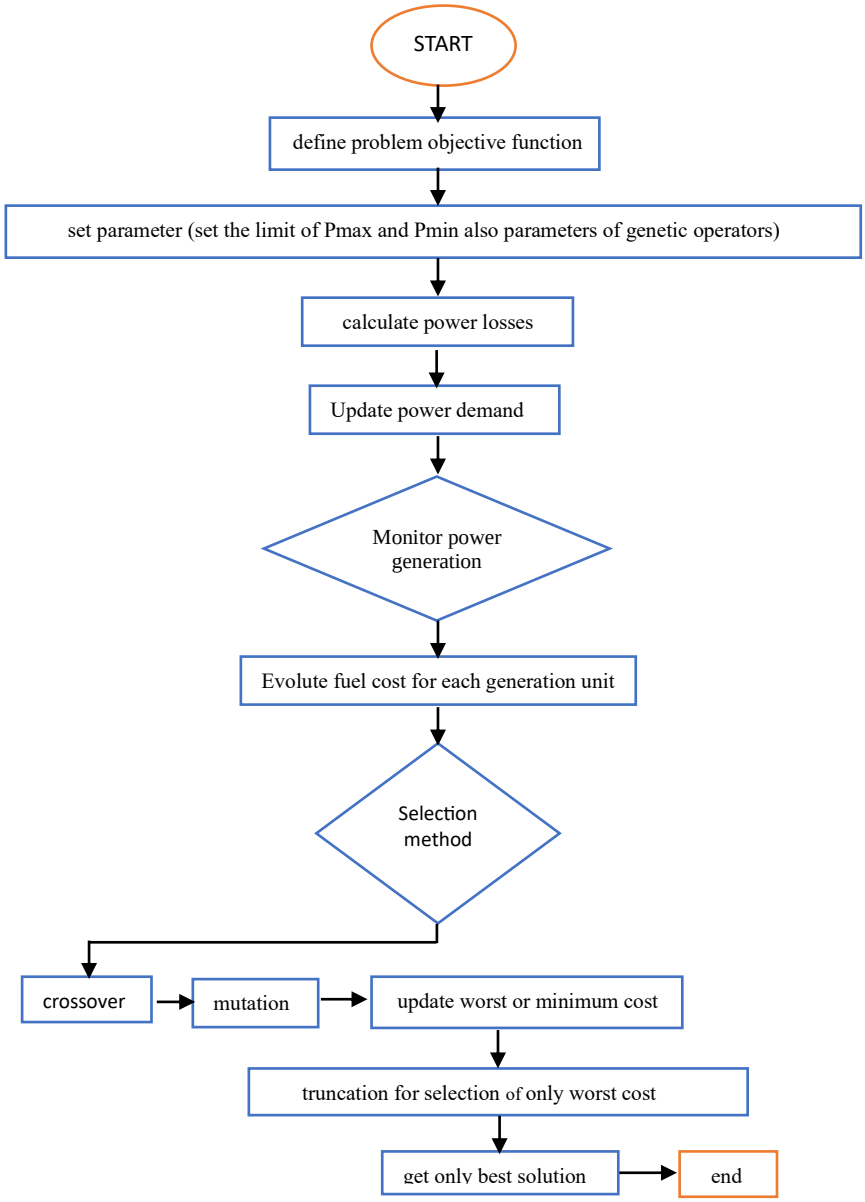

Fig7-. flow chart of economic dispatch with GA.

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4.3 Hybrid based techniques – hybrid techniques apply power system with a combination of two or more algorithm. The hybrid mechanism utilizes both algorithm advantages in common platform also by adjusting their limitations. Hybrid model is more efficient and capable to deliver complex tasks and long calculations. [60].

5 Recent advances in economic dispatch in Microgrid

In the paper [15] author presented an optimistic analysis using novel hybrid CSA-JAYA algorithm to address economic and emission dispatches with price penalty factor and fractional programming method. Author considered 4 test system with the focusing of environment toxic gases. Proposed algorithm gave a very comparative view between both these methods. Results suggested price penalty provide more optimistic economically beneficial and environmentally friendly compare to fractional programming.

In this paper [16] author proposed a solution technique called Harris hawks algorithm with consideration of a microgrid focusing economic and environment criteria. The suggested technique is discussed with the single demand and multiple demand with 24-hour cycle duration. Authors compared the outcomes with differential evolution and particle swarm optimization and data indicate that proposed technique has more efficiency for addressing the issues compare to other techniques.

In this paper [17] author emphasize an economic dispatch model called hybrid static economic dispatch model using improved pathfinder optimization model for addressing the system constraints. Algorithm utilize with three optimization strategies called Kent mapping initialization, nonlinear adaption factor and correction strategy. Outcome data suggest proposed algorithm having minimization cost with proposed model.

The purpose of completed research in the paper [18] by the authors to introduce a solution mechanism of dynamic behaviour to a microgrid with combination of multiple energy resources. authors considered a technique called grey wolf optimization Authors took two cases for optimization to the solution and results compared with the CSA, DE, and PSO and results showed better effectiveness of the proposed algorithm for considering these issues.

In this paper [19] authors discussed the dispatching economic behaviour of microgrid with different energy scenarios. Author present a microgrid dispatch model by proposing an algorithm called predictive control algorithm. Four microgrid model were considered to optimize the dispatching process and results showed the model proposed with the algorithm have better effective mechanism of economic dispatching.

This research paper [22] highlighted the importance of effective control mechanism called mixed integer linear programming-based method. A piecewise linearisation technique is utilize for effective cost optimization and to minimize the system constraints. The proposed algorithm effectively improvised the efficiency of distribution control mechanism of the system and results validated by simulation analysis.

In this research article [24] authors proposed a technique called Jaya algorithm to efficiently optimized the generation process of power system with consideration of efficiently distribution of power generation. Authors done a comparative analysis of proposed algorithm with genetic algorithm and Lagrange method to validate the output

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results. Output results suggest that Jaya algorithm is effective to provide in real time optimization solution.

in the paper [27] authors devolved a hybrid model to address the cost optimization mechanism of a hybrid microgrid model by introducing a technique called finite step consensus algorithm. The primary objective of the proposed model to address the daily operation cost by changing some parameter of the system. Proposed algorithm showed some additional advantages by minimizing the system variability, and ramp rate limits and. Efficiency and effectiveness is validated by output results.

In this paper [29] authors discussed of a very problematic scenarios of renewable energy resources. Authors discussed an algorithm called deep deterministic policy gradient which effectively provide a solution to the system parameters fluctuations and environment uncertainties. Results provide an optimistic view of the cost function optimization with validation of economic dispatch.

In this research article [30] authors mentioned the difficulties or incompetency of other metaheuristic algorithms. Author introduced a new algorithm for delivering the objective criteria of minimization the generation cost of the system. authors proposed a technique called artificial ALAGE algorithm. in this paper Authors discussed different conditions and results showed the robustness and competency of the proposed algorithm to counter the uncertainties of the system.

in this research paper [31] Optimal economic dispatch optimization of cooperative microgrid cluster system is discussed. Authors introduced a new technique called chaos sparrow search algorithm in the paper to overcome the challenging uncertainty of microgrid cluster system. Proposed technique was compared with other techniques and output results shows the algorithm has a high convergence rate, impressive accuracy and highly efficient and more effective.

Table 1. - comparative analysis of optimization techniques-

Ref. no.	Year	System type	Technique name	Specification	Limitation
59	2011	6 Power Generators Unit	Firefly Algorithm	Cost, Emission	Reliability
46	2015	3 Gen, and 6 Gen Units Set	Grey Wolf Optimization	Cost	Not Suitable for Large Sizes
58	2016	3unit, 6 unit and 15unit system	Water wave optimization	Reliable, useful for complex hydrothermal scheduling	Less effective with emission technology
47	2018	6-unit and 15-unit system	Moath-flame optimization	Cost effective	Environmental caution
53	2019	4 demand case in MW	Improved grasshopper algorithm	Improved convergence rate, also use in discrete domain	less reliable
35	2019	3-, 6-, and 30-unit systems	Ant lion optimization	Cost effective	Stability

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30	2020	IEEE (3-, 6,13-, and 40-unit system)	Artificial algae algorithm	Highly efficient, useful to solve multi area ED problem	Reliability
34,	2021	3-unit, 13-unit system	Improved harmony search algorithm	Lowest computation time, ability to handle large load	Renewable sources integration
49,	2021	5-unit, 10unit, and 15-unit system	Whale optimization	Efficient, fast processing	Not overloaded
29	2022	IEEE 30 node system	DDPG algorithm	Lowest dispatch cost	Less stable due to environmental
28	2023	11, 40,110 units system	Beluga Whale Optimizer (BWO)	Cost	Complicated with renewable technology
22	2023	Dg set and DERs with microgrid	Mixed Integer Linear Programming	cost	Smoothness and reliability

REFERENCES

[1] A Singh, B. S. Surjan, "Microgrid Review", International Journal of Research in Engineering and Technology (IJRET), vo.3, no. 2, pp. 185-198, 2014

[2] A Kumar, M. Zafar, U. Khan, D. M. Akbar Hussian, "Microgrids Technology Review: A Review Paper" in Gyan City Journal of Electronics and Computer Science, vol.3(1), pp. 11- 20, 2018

[3] L. li, J. Pei, and Q. Shen, "A Review of Research on Dynamic and Static Economic Dispatching of Hybrid Wind-Thermal Power Microgrids", Energies, vol. 16, pp. 1-23, 2023

[4] M.H. Saeed, W. Fang, Zong, B. A. Kalwar and S. Iqbal, "A Review on Microgrids Challenges and Perspectives", in IEEE Access, vol. 9, 2021, pp. 166502-166517, 2021

[5] M. Uddin, H. Mo., D. Dong, S. Elsa Wah, J. Zhu, "Microgrid: a review Outstanding Issue and Future Trends", Energy strategy Review, vol. 49, pp. 1-16 2023

[6] F. M. Bani, and A. Abdelfatah, "Economic Dispatch Optimization Strategies and Problem Formulations: A Comprehensive Review, Energies, vol. 17(550), 2024

[7] J, Lanos, J. Gomez, D. Saez, D. Olivares, J. S. Porco, "Economic Dispatch by Secondary Distributed Control in Microgrids", 21st European conference on power electronics and applications, pp.1-10 2019

[8] H. Shuai, J. Fang X. Ai, Y Tang, J. Wen and H. He "Stochastic Optimization of Economic Dispatch for Microgrid Based on Approximate Dynamic programming", In IEEE Transactions on Smart Grid, vol. 10, no. 3, pp 2440-2452, 2019

[9] F. Zhao, J. Yuan and N. Wang, "Dynamic Economic Dispatch Model of Microgrid Containing Energy Storage Components, Based on Variant on NSGA II, Algorithm", Energies, vol. 12, pp. 1-14, 2019

[10] Y S Jang, M. K. Kim, A Dynamic Economic Dispatch Model for Uncertain Power Demands in An Interconnected Microgrid, In Energies, vol. 10(3), pp. 1-16, 2017,

[11] D. McLarty, N. Panossian, F. Jabbari, A. Traverso, "Dynamic Economic Dispatch Using Complementary Quadratic Programming", Energy vol. 166. Pp. 755- 764, 2019

[12] A. r. Jordehi, "A Mixed Binary Continuous Particle Swarm Optimization Algorithm for Unit Commitment in Microgrid Considering Uncertainties and Emission", International Transaction on Electrical Energy Systems, vol. 30, issue, 11, pp. 1-20, 2020

https://doi.org/10.71058/jodac.v9i4001

[13] L. Benyekhlef, S. Abdelkader, B. Houari, A. A Nour, El Islam, "Cuckoo Search Algorithm, To Solve Problem of Economic Emission Dispatch with The Incorporation of Facts Devices Under the Valve Point loading Effect", FACATS, UNIVERSITIES Series Electronics and Energies vol. 34, pp. 569- 588, 2021

[14] T. Tran, The, B. H. Truong, K, D, Tuan, D. V. Ngoc, "A Nondominated Sorting Stochastic Fractal Search Algorithm, For Multi Objective Distribution Network Reconfiguration with Distributed Generations", Mathematical Problems in Engineering, Vol. 2021(1), 2021

[15] B. Dey, S. Basak, B. Bhattacharya, "A Comparative Analysis Between Price Penalty Factor and Fractional Programming Methode for Combined Economic Emission Dispatch Problem Using novel hybrid CSA-JAYA Algorithm, IET Smart Grid Vol. 4, pp. 367-380, 2021

[16] V, Tiwari, H. M Dubey, M. Pandit, S. R. Salkuti, "CHP Based Economic Emission Dispatch of Microgrid Using Harris Hawks Optimization" Fluids, vol. 7 (248), pp. 1-9, 2022

[17] L. N. Qu, B. X. Ji, M. K. Lim, Q. Shen, L. L. Li, M. L. Tseng, "A Hybrid Static Economic Dispatch Optimization Model with Wind Energy, Improved Pathfinder, Optimization Model", Energy Reports, vol. 10, pp. 371 -3723, 2023

[18] S. M. Dubey, H. M. Dubey, M Pandit, "Scheduling of Multi Energy Resources in microgrid Using Grey Wolf Optimization Model", International Journal of Smart Grid and Gren Communications, vol.2(2), pp. 87-102, 2022

[19] Y. Peng, W. Jiang, X. Wei, J. Pan, X. Kong, Z. Yang, "Microgrid Optimal Dispatch Based on Distributed Economic Model Predictive Control Algorithm", Energies, vol. 16(12), pp. 1-17, 2023

[20] M. A. Ebrahim, R. M. A. Fattah, E. M. M. Saied, S. M. A. Maksoud and H. El Khashab, Real Time Implementation of self-Adaptive SALP Swarm Optimization Based Microgrid Drop Control, IEEE Power And Energy Society Section, vol. 8, pp. 185738-185739, 2020

[21] A. Wang, W. Liu, "Distributed Incremental Consensus Based Optimization Algorithms for Economic Dispatch in A Microgrid, In IEEE Access vol. 8, pp. 12933-12941, 2020

[22] G Liu, M. F. Ferrari, Y. Chen, "A Mixed Integer Linear Programming Based Distributed Energy Management for Networks Microgrids Considering Network Operational Objectives and Constraints IET Energy System Integration, vol. 5, pp. 320- 337, 2023

[23] K. Ullah, Q. Jiang, G. Geng, S. Rahim and R. A. Khan, "Optimal Power Sharing in Microgrid Using the Artificial Bee Colony Algorithm", Energies, vol.15(1067), pp. 1-22, 2022

[24] K. E. Fahim, H. Yassin, L. C. De Silva, T. Roy, N. M. Rihan, M. A. Tanvir, "Jaya Algorithm a Practical Algorithm for Solving Economic Load Dispatch Problems", International Conference on Energy A Power Engineering (ICEPE), pp. 1-5, 2022

[25] A. A. Abou El -Ela, R. A. El-Sehiemy, N.A. A. Aziz, M. T. Mouwafi, "Economic Dispatch of Multi microgrid Systems with Renewable Energy Resources Using Marine Predictor Algorithm", Engineering Research Journal Faculty of Engineering, Menoufia University vol. 46(4), p 441 - 449, 2023

[26] T. G. Hlalele, R. M. Naidoo, J. Zhang, R. C. Bansal "Dynamic Economic Dispatch with Maximum Renewable Penetration Under Renewable Obligation", In IEEE Access vol. 8 pp 37794 -38808, 2020

[27] K. Jiang, F. Wu, X. Zong, Li Shi, K. Lin, "Distributed Dynamic Economic Dispatch of An Isolated AC/DC Hybrid Microgrid Based on A Finite Step Consensus Algorithm", Energies vol. 12 pp 1 -18, 2019

[28] M. H. Hassan, S. Kamel, F Jurado, M Ebeid, M F Elnaggar "Economic Load Dispatch Solution of Large-Scale Power System Using an Enhanced Beluga Hale Optimizer" Alexandria Engineering Journal vol. 72, pp. 573 -591, 2023

[29] Z. Liu, Y. Liu, H. Xu, S. Liao, K. Zhu, X. Jiang, "Dynamic Economic Dispatch of Power System Based on DDPG Algorithm", Energy Reports vol. 8 pp 1122- 1120, 2022

[30] H. M. Awais, T. N. Malik, A. Ahamd, "Artificial Algae Algorithm with Multi Light Source Movement for Economic Dispatch of Thermal Generation", Mehran University Research Journal of Engineering and Technology, vol 39(3), pp. 564 582, 2020

https://doi.org/10.71058/jodac.v9i4001

[31] P. Wan, Y. Zhang And H. Yang "Research on Economic Optimization of Microgrid Cluster Based on Chows Sparrows Search Algorithm", Computational Intelligence and Neuroscience, Vol. 2021(1), pp. 1-18, 2021

[32] M. Nitha, B. Pratheeksha, T. Aishwarya, D. Karthik Kannan, "Solution of Economic Load Dispatch Problem Using Conventional Methods and Particle Swarm Optimization", International Journal of Innovative Technology and Exploring Engineering (IJITEE), Vol, 9(10), pp. 2278- 3075, 2020

[33] M. Sulaiman Masih Ullah, Z. Hussian, S. Ahmad, W. K. Mashwani Muhammad A. Jan, R. Adeeb Khanum, "Implementation of Improved Grasshopper Optimisation Algorithm to Solve Economic Load Dispatch Problem", Hacettpe Journal of Mathematics and Statistics Vol. 48 (5), pp. 1570 – 1589, 2019

[34] B. Houari, L, Mohammed, B. Hamid, A. A. Nour Al Islam, "Solution of Economic Load Dispatch Problems Using Novel Improved Harmony Search Algorithm", International Journal on Electrical Engineering and Informatics, vol. 13 (1). pp 218 -241, 2021

[35] L. Daniel Dr. K. T. Chaturvedi, "Economic Load Dispatch Using Ant Lion Optimization", International Journal of Engineering Trends and Technology, (IJETT), vol. 67(4), pp. 81 -84, 2019

[36] V. Chaudhary, H. M. Dubey, M. Pandit, J. C. Bancal, "Multi Area Economic Dispatch with Stochastic Wind Power Using SALP swarm Algorithm" Array vol. 8, 2020

[37] M. A. Al Betar, M. A. Awadallah, R. A. Zitar, K. Assaleh, "Economic Load Dispatch Using Memetic Sine Cosine Algorithm", Journal of Ambient Intelligence and Humanized Computing, Vol. 14, pp, 11685 -11713, 2023

[38] Z. Nisar Jan "Economic Load Dispatch Using Lamda Iteration, Particle Swarm Optimization and Genetic Algorithm", International Journal for Research in Applied Science and Engineering Technology (IJRASET), vol. 9 (8), pp. 1 -6, 2021

[39] Dr. C. Kumar, Dr. A. Anbarasan, Dr. M. Karpagam And Dr. T. Alwar Samy "Artificial Intelligence Techniques in Economic Power Dispatch Problems" International Journal of Applied Engineering Research Vol. 10 pp. 23243 - 23254, 2019

[40] Z. Younes, I. Alhamrouni, S. Mekhilef, M. Reya Sudin "A Memory Based Gravitational Search Algorithm for Solving Economic Dispatch Problem in Microgrid", Ain shaims Engineering Journal, vol. 12(2), pp. 1985 -1999, 2021

[41] B. Dey B. Bhattacharya, S. Raj, R. Babu, "Economic Emission Dispatch on Unit Commitment Based Microgrid System Considering Wing and Load Uncertainties Using Mgwoscacsa", Journal of Electrical Systems and Information Technology vol. 7 (15), pp. 1 -26, 2020

[42] S. Phommixay, M. L. Doumbia, Q. Cui, "Comparative Analysis of Binary Binary Continuous Particle Swarm Optimization for Optimal Economic Operation of a Microgrid", Process Integration and Optimization for Sustainability, vol 6, pp. 93 - 111, 2022

[43] Y. Long Y. Li, Y. Wang Y. Cao, L. Jiang Y Zhou Y. Deng, Y. Nakanishi, "Low Carbon Economic Dispatch Considering Integrated Demand Response and Multistep Carbon Trading for Multi Energy Microgrid", Scientific Reports vol. 12 (6218), 2022

[44] K. A. qaid, A. Khamis, C. K. Gan, "Optimal Economic Dispatch to Minimize Load Shedding and Operation Cost for Networked Microgrids", Arbian Journal for Science and Engineering, Vol. 48, pp. 15419- 15434, 2023

[45] S. Mishra, P. K. Panigrahi, B. Dey, "An Efficient Way to Schedule Dispersed Generators for A Microgrid Systems Economical Operation Under Various Powe Market Conditions and Grid Involvement", International Journal of System Assurance Engineering and Management, Vol. 14, pp. 1799 - 1809, 2023

[46] Dr. R. Sharma, S. Mahta, N. Chopra, "Economic Load Dispatch Using Grey Wolf Optimization", International Jornal of Engineering Research and Applications (IJERA), vol. 5(4) part 6, pp. 1 -5, 2015

[47] M. H. Sulaiman, Z. Mustafa, M. I. M. Rashid and H. Daniyal "Economic Dispatch Solution Using Moth Flame Optimization Algorithm", 2nd International Conference on Information Processing and Control Engineering (ICIPCE), vol 214, pp .1 -6, 2018

https://doi.org/10.71058/jodac.v9i4001

[48] M. A. AL Betar, M.A. Awadallah, R A Zitar, K Asahel "Economic Load Dispatch Using Memetic Sine Cosine Algorithm", Journal of Ambient Intelligence and Humanized Computing vol. 14 pp. 11685 -11713, 2023

[49] W. Yang, Z. Peng, Z. Yang, Y. Guo, Xu Chen "An Enhanced Exploratory Whale Optimization Algorithm (EEWOA) For Dynamic Economic Dispatch" Energy Reports Vol .7 pp .7015 -7029, 2021

[50] V. Chaudhary, H. M. Dubey, M. Pandit, J. C. Bancal "Multi Area Economic Dispatch with Stochastic Wind Power Using SALP swarm Algorithm" Array, vol. 8 pp. 1 -13, 2020

[51] L. Daniel, Dr. K. T. Chaturvedi, "Economic Load Dispatch Using Ant Lion Optimization", International Journal of Engineering Trends and Technology (IJETT), Vol. 67(4), pp. 81 -84, 2019

[52] B. Houari, L. Mohammed, B. Hamid, A. A. Nour El Islam, "Solution of Economic Load Dispatch Problems Using Novel Improved Harmony Search Algorithm", International Journal on Electrical Engineering and Informatics vol. 13. pp. 21 -241, 2021

[53] M. Sulaiman, Masih Ullah, Z. Hussian, A. Ahamad, W. K. Mashwani, M. A. Jan, R. A. Khanum, "Implementation of Improved Grasshopper Optimization Algorithm (IGOA) to Solve Economic Load Despatch Problems", Hacettepe Journal of Mathematics and Statistics, vol. 48 (5), pp. 1570 -1589, 2019

[54] F. Mohammadi, H. Abdi, "A Modified Crow Search Algorithm for Solving Economic Load Dispatch Problem" Applied Soft Computing vol. 71, pp. 51-65, 2018

[55] M. H. Hasssan, S. Kamel, F. Jurado, M. Ebeed, M. F. Elnaggar "Economic Load Dispatch Solution of Large-Scale Power Systems Using an Enhanced Beluga Whale Optimizer (BWO)", Alexandria Engineering Journal vol. 72 pp. 573- 591, 2023

[56] Y. V. K. Reddy, M. D. Reddy, "Flower Pollination Algorithm (FPA) To Solve Dynamic Economic Loading of Units with Piecewise Fuel Options" Indonesian Jornal of Electrical Engineering and Computer Science, vol. 16 pp. 9 -16, 2019

[57] A. B. S. Sera Piao, "Cuckoo Search for Solving Economic Dispatch Load Problem" Intelligent Control and Automation vol. 04(4), pp. 385 -390, 2013

[58] M. Siva, R. Balamurugan, L. Lakshmi Narasimhan, "Water Wave Optimization Algorithm (WWOA) For Solving Economic Dispatch Problems with Generator Constraints", International Journal of Intelligent Engineering and Systems, vol. 9 (4), pp. 31- 40, 2016

[59] T. Apostolopoulos And A. Vlachos, "Application of The Firefly Algorithm, For Solving the Economic Emission Load Dispatch Problem", International Journal of Combinatorics Vol. 2011 pp 1- 23, 2011

[60] B. F. Azevedo, A. M. A. C. Rocha, A. I Pereira "Hybrid Approaches to Optimization and Machine Learning Methods", A Systematic Literature Review Machine Learning, vol. 113, pp. 4055 -4097, 2024