Research Journal of Engineering Sciences ISSN 2278 – 9472
Vol. **11(2),** 22-25, May **(2022)** *Res. J. Engineering Sci.*

Short Review Paper

Economic Load Dispatch using Particle Swarm Optimization

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Available online at: www.isca.in, www.isca.me
Received 3rd September 2021, revised 17th May 2022, accepted 26th May 2022

Abstract

There is a constant and dynamic growth in intricacy of interconnection and demand of power in current power system all around the globe. In the current outlook, rocketing power generation expense, scantiness of energy resources, environmental consideration optimal economic dispatch. Practically power stations are non-uniform both in the load distance and fuel cost. For providing economic power generation, distribution of load needs to be done based upon the rating of the various plant. There is highly erratic objective function along with invariable inequality and equality limitations in practical ED problems. PSO is employed to allocate the active or real power between the generating stations fulfilling the system limitations and diminishing the power generation cost.

Keywords: Economic Load Dispatch, Particle Swarm Optimization, Energy, Power.

Introduction

With decarbonisation of electrical system, global energy crisis & rise in the cost decreases the fare of electrical energy. A reduction in the functioning of the grid brings about a notable deduction in the functioning expense and the amount of fuel utilized[1].

ELD becomes a demanding non-convex optimization problem, which is laborious to solve using the conventional soft computing techniques for optimization which provides accurate and optimal solutions[2].

Objectives: i. PSO is used to reduce the ED including losses for the IEEE standard power systems: IEEE 30-bus system, IEEE 9-bus system and 39-bus system[3]. ii. To minimize the computation time of optimize value to make the solution quickly. iii. To compare the outcome of PSO with other optimization techniques to find the best suitable technique.

Economic load dispatch: ELD is a critical issue with the goal of achieving the lowest possible economic costs by designing the output of generator units while satisfying load demands &constraints[9]. The traditional mathematical method becomes increasingly unsuitable for the ELD because of the increase in the proportions of the variables and constraints increases[4].

Particle swarm optimization

PSO is primarily assimilated from animal activity or habits. In PSO each member is referred to as a particle and called as a swarm[10]. During the searching process, all particles fly towards better places until the swarm approaches fitness function f(Rn) R. It's the ease of use and ability to quickly arrive at a solid answer, the PSO method is becoming increasingly popular[5].

The particle swarm optimization (PSO) algorithm

Each discrete feasible solution in real number space can be represented by a particle moving through the issue space. Each particle's position is specified by the vector, and its movement is determined by the particle's velocity, which is given by

$$P^{k+1} = P_i^k + v_i^{k+1}$$

The ability to assess the performance of others in its immediate environment[4]. The proportional importance of these two pieces of information varies from one conclusion to the next. Each piece of information is given a random weight, and the velocity is calculated as follows[6]:

$$v_i^{k+1} = c_1 \cdot r_1\left(P_{best}^k - P_i^k\right) + c_2 \cdot r_2(G_{best}^k - P_i^k)$$

Where, $P_i^k =$ position of particle for ith iteration. $c_1, c_2 =$ positive acceleration coefficients more than 1.0. Normally its value is taken. $c_1 + c_2 = 4$ or $c_1 = c_2 = 2$. $r_1, r_2 =$ random number between 0.0 & 1.0. $P_{best}^k =$ local best position for ith iteration. $G_{best}^k =$ global best position for ith iteration.

System Studies and Result: IEEE 9 Bus System comprises of 3 generator buses and 6 load buses. Slack node is bus number1[8].

Table-1: Generator data of IEEE 9 Bus System [10,11].

Bus	Pmin (MW)	Pmax (MW)
1	100	600
2	100	400

3	50	200

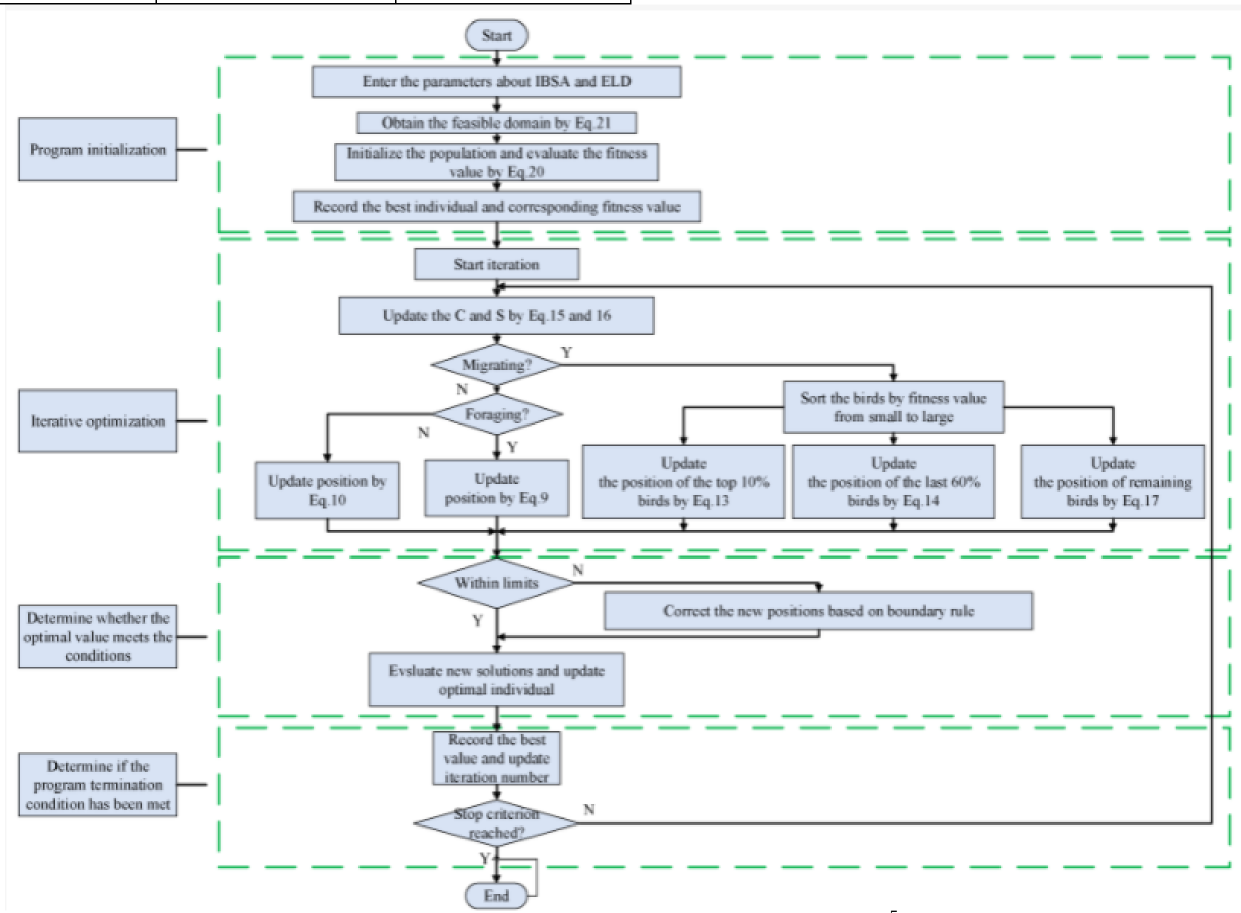

Figure-1: Flowchart for Economic Load Dispatch[5].

Flow Chart of Proposed Algorithm

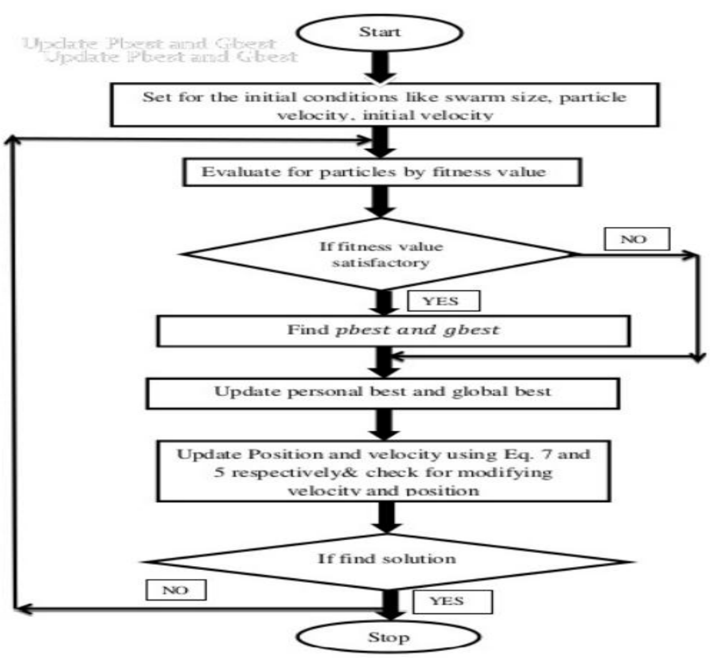

Figure-2: ELD Optimization using PSO[7]

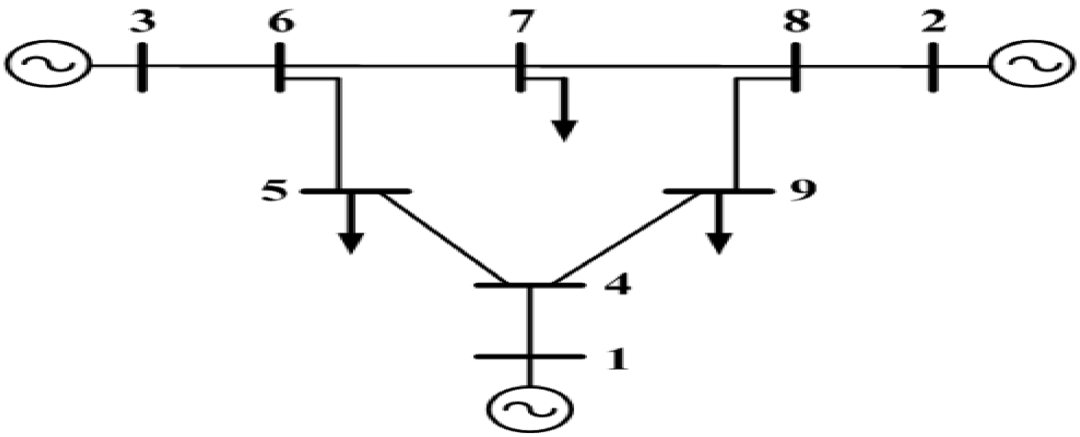

Figure-3: SLD of IEEE 9 Bus System[9]

Table-2: Generator cost coefficients IEEE 9 Bus System[12].

Bus	a	b	c
1	0.0015	7.92	561
2	0.00194	7.85	310
3	0.0048	7.97	78

Table-3: Fuel cost for different loads Without Loss IEEE 9 Bus System[13].

Load (MW)	P_1	P_2	P_3	Fuel Cost	Fuel Cost
500	286.72	142.33	70.93	5094	5183
600	311.5	226.11	62.38	5957	6026
700	321.81	227.13	73.3	6838	6972
800	370.12	315.35	114.51	7738	7812
900	414.79	353.17	132.03	8653	8698

Table-4: Fuel cost for different loads With Loss IEEE 9 Bus System[14].

Load (MW)	Losses (MW)	P_1	P_2	P_3	Fuel cost (R_S./H_r) (PSO)	Fuel cost (R_S./H_r) (GA)
500	6	283.12	172.87	50	5142	5239
600	7.5	307.05	227.13	73.30	6021	6156
700	10	314.8	289.79	105.39	6928	7019
800	13.2	376.14	320.50	116.55	7858	7944
900	15.7	431.79	351.96	131.94	8798	8891

Conclusion

High quality solution, unvarying convergence characteristics were among some of the exceptional features demonstrated by PSO. The results were not any different from traditional methods except for higher order systems where the results were much better than traditional methods. The result for higher order system problem can be acquired much quicker than the conventional method**.**

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