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ARTICLE

ENHANCED ARTIFICIAL BEE COLONY OPTIMIZATION FOR SOLVING ECONOMIC LOAD DISPATCH

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ABSTRACT

The power system needs accurate solution for carrying Economic load dispatch (ELD) optimization problems. The constraints involved in ELD are complex and it requires a perfect algorithm to minimize the cost and reduce the transmission loss. There are certain methods for solving the issues but they fail to achieve the target by retained in local optima. In this paper we proposed an enhanced Artificial Bee Colony optimization algorithm with new search technique. It inherits the behaviour of honey bees, to solve ELD problem in an effective way. It increases the local exploitation capability and avoids the premature convergence. The effectiveness of EABC algorithm is verified by and its performance is validated using the four test cases units. The algorithm is compared with other methods and simulation results show that algorithm suppress the performance of other traditional approaches, by generating better results.

KEY WORDS
Economic load dispatch (ELD), Artificial Bee Colony Optimization (ABC), Transmission Loss, Economic Dispatch (ED)

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INTRODUCTION

The core attributes of Economic Dispatch (ED) for handling energy generation and distribution at present days is major task. The requirement of energy and the cost of the fuel get increased, it also reflects by maximizing the cost of the entire system. In Economic Dispatch load schedules are optimized for the generators to achieve the proper power system, and it also needs to provide complete power demand with minimum generating cost [1]. The result comprises of mathematical optimization techniques which explains about the cost function curves. The curves for power unit generator need to be formulated [6]. It is adapted to the system inorder to find the optimal allocation of the load. The main objective of the system in EDP is to attain minimal cost and to utilize the complete power demand.

Some of the evolutionary algorithms are noted such as Particle Swarm Optimization (PSO), Real-Coded Genetic Algorithm (RCGA), Differential Evolution (DE), and Covariance Matrix Adapted Evaluation strategy (CMAES). The above mentioned Traditional approaches consist of some issues, which don't have the ability to fulfil the requirements of the power output generating units. It faces many issues such as converging to the local optimum, consuming more cost etc. Hence we need to go for some complex algorithms which satisfy the requirements of the system [2]. The role of Swarm Intelligence is to provide optimal results for complex problem. In the paper, we discuss about the artificial bee colony optimization with enhanced exploration.

LITERATURE STUDY

Lu, Peng, et al. [1] discuss about the dynamic economic dispatch, the performance of the scheme in thermal system works efficient. Here valve point effect is considered for non-smooth and non-convex to handle the DED problem. In this paper chaotic differential bee colony optimization algorithm (CDBCO) is endorsed to resolve issues of premature convergence. It helps to improvise the local exploitation capacity by incorporating a chaotic local search (CLS) method. The proposed CDBO algorithm is showcased by using four test case units and the comparison of results. The simulated results for the proposed scheme outperform other results with less computational time. Gaing, Zwe-Lee [2] enunciates a particle swarm optimization (PSO) method for handling the economic dispatch(ED) problem. The ramp rate limits, Prohibited operating zone and non smooth cost function are non-linear attributes. The proposed method is demonstrated for three different systems and the comparison is carried with GA method. The experiments results displays that the proposed PSO method has the ability to provide better results. Zhou, Jianzhong, et al [3] discuss about environmental issues such as global warming increases everyday it has drawn more focused towards daily optimization of electric power systems. The aim of Economic emission dispatch (EED) is to deduct the pollution produced by power generation, and these are proposed as non- convex, multi-objective and non-linear optimization problem. In a functional power system, the problem of EED becomes more intrigue among the objectives of the economy and emission, valve point effect, prohibited operation zones of generating units, and security constraints of transmission networks. To resolve such intrigued problems, an algorithm of a multi-objective-population ant colony optimization for uninterrupted domain (MMACO_R)is proposed. MMACO_R redesigns the pheromone structure of the ant colony

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to expand the primary uni-objective method to multi-objective area. Moreover, to intensify the searching ability and overcomes early convergence. Multi-population ant colony is also propounded, which consists of ant populations with varied searching scope and speed. Along with that, a Gaussian function based niche search method is proposed to increase efficiency in distribution and accuracy of solutions on the Pareto optimal front. To confirm the working of MMACO_R in various multi-objective problems, conventional test are conducted. And ultimately, the algorithm that was proposed is applied to solve the EED based on a six-unit system, a tent-unit system and a standard IEEE 30-bus system. Simulation Results displays that MMACO_R is efficient in solving economic emission dispatch in a functional power system. Basu, M[4] discuss about the multi-area economic dispatch using the artificial bee colony optimization. In this paper some of constraints are considered such as prohibited operating zones, loss occurs during transmission, limitations for multiple fuels and valve-point loading. Three variety of system is used to evaluate the performance of the proposed system with variety in degree of complexity. The outcomes are compared with differential evolution, evolutionary programming and real coded genetic algorithm by knowing some of the important factors. The results show the proposed algorithm provides efficient results for handling MAED problems in practical power system.

Jadhav and Roy [5] propose Gbest guided artificial bee colony algorithm (GABC) inorder to solve the complex constraints in the power system. Here they took wind thermal power system problem modelled with weibull probability distribution function (PDF). Moreover, optimizing the cost of wind power is critical task, where it requires special methods to solve the issue. To calculate the performance of the proposed method, it is implemented to three standard test systems. The constraint used in the first scenario is considering different technical constraints such as prohibited zones, ramp rate limits valve loading effect, etc. In second scenario IEEE-30 bus test system is sued for evaluation. The proposed optimization techniques reveal that the proposed technique has better solution accuracy and convergence results.

Sen, Tanuj, and Hitesh Datt Mathur [6] present a newly developed hybrid optimization algorithm for handling the Economic Dispatch (ED) issues for a multi-generator system. The combination of Ant Colony Optimization (ACO), Artificial Bee Colony (ABC) and Harmonic Search (HS) algorithms is merged to form a hybrid algorithm. This strategy helps to identify optimized solution for the system, by improvising each solution given by the ACO module. The role HS module is used to remove the low value from the solution set and replace the better ones. The efficiency of this hybrid algorithm is estimated with other conventional ED solving methods like Gradient Search, evolutionary algorithms. The constraints like valve points, transmission loss are considered to be the key factors for comparison. The results show better performance with minimize the cost and loss.

Abdelaziz, A. Y., E. S. Ali, and SM Abd Elazim[7] propose a method for minimizing the operation cost by mapping needed load between the obtainable generation units. The non linear based constrained optimization is problem is formulated with both equality and inequality constraints. The emission of gaseous pollutants of fossil-fuelled power plants is used by the dual-objective Combined Economic Emission Dispatch (CEED) problem. In this paper, handling ELD and CEED issues in power system is carried by incorporating Flower Pollination Algorithm (FPA). The outcome is compared with other optimization algorithms for various power systems. The generated results from the proposed algorithm outperform other techniques even for massive power system with less computational time. Secui, Dinu Calin [8] discuss about the random sequences used for solution updating of GBABC (global best artificial bee colony algorithm). By using chaotic maps generated by the chaotic sequence replaces chaotic optimization method to provide solution to the multi-area economic/emission dispatch problem. To solve the problem some constraints are imposed such as multi-fuel sources, tie line capacity, valve-point effects and transmission loss. To study the behaviour of the algorithm, ten chaotic maps are implemented by both one dimensional and bi-dimensional. The efficiency of CGBABC algorithms is tested on five systems (6-unit, 10-unit, 16-unit, 40- unit and 120-unit) with variety characteristics, sizes. They solved by incorporating different chaotic maps. The obtained results are compared with other chaotic maps and they display better performance than the classical ABC algorithm, the GBABC algorithm and other optimization techniques.

PROBLEM FORMULATION

The main theme of Economic Dispatch is to identify optimum load allotment to the generators in a power system. The total fuel cost is reduced to the nominal value and to reduce the transmission [9-11]. The total fuel cost linked with the power system for understanding the requirements of the system.

Objective function

The key objective for solving the Economic dispatch is to reduce total generation cost for acquiring load demand of the power system by satisfying variety of constraints [12]. The fuel cost can be achieved nominal by

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using the quadratic function of output power generator. The quadratic cost function is enoted by using the below equation

$$F_i = a_i p_{gi}^2 + b_i p_{gi} + c_i \dots\dots (1)$$

$$\sum_{i=1}^{n} F_i(p_{gi}) = \sum_{i=1}^{n} [a_i (p_{gi})^2 + b_i (p_{gi}) + c_i] \text{ where i=1,2,...,n} \dots\dots (2)$$

where n denotes the sum of generators and a_i, b_i, c_i are the fuel coefficients cost of the ith unit

We must also consider the valve opens constraints, because it has the ability to fuel cost due to wire drawing effect. It can easily change the objective function to have non-differentiable points. Inorder to handle this issues a sinusoidal function is added and the equation is

$$F_t = \sum_{i=1}^{n} F_i(p_{gi}) = \sum_{i=1}^{n} \sum_{i=1}^{n} [a_i (p_{gi})^2 + b_i (p_{gi}) + c_i + e_i * |\sin(f_i * (p_{gi}^{\min} - p_{gi}))|] \dots\dots (3)$$

Generation capacity constraints

The above mentioned objective function is subjected to the below displayed constraints.

Operation limit unit

The main constraints of power generation of each power unit should not be exceed its higher and lower limits

$$p_{gi}^{LL} \leq p_{gi} \leq p_{gi}^{UL} \dots\dots (4)$$

where p_{gi} is the amount of output power unit for the ith generator

p_{gi}^{LL} *is the lower limit of power output of ith generator*

p_{gi}^{UL} *is the upper limit of power output of ith generator*

Power Balance constraints

The total produced powers consider be equal to the total losses and total demand load. The mathematical expression for power balance is

$$\sum_{i=1}^{n} p_{gi} = p_D + p_L \dots\dots (5)$$

p_L *refers to* total line loss and p_D refers to the system demand. The Kron's formula for finding the transmission loss is refers to the system demand. The Kron's formula for finding the transmission loss is

$$p_L = \sum_{i=1}^{n} \sum_{j=1}^{n} p_{gi} B_{ij} p_{gi} + \sum_{i=1}^{n} B_{0i} p_{gi} + B_{00} \dots\dots (6)$$

B_{ij} *denotes the* $(i-j)$*th element of loss coeffcient of symetric matrix B*

B_{0i} *ith element of loss coefficient vector of the symetric matrix B*

B_{00} *is the loss coeffcient for normal function conditions*

ARTIFICIAL BEE COLONY OPTIMIZATION

For millions of years, Social insects are living on earth. The nest is constructed; production of solution is organized and fetches food[13]. The social insects in the colonies are highly flexible, it can easily fix to the environment which is alters occasionally. Hence, social insects of the colony need to be strong and it should have the ability to handle disturbance occurred disturbances [14]. The interactions are calculated multitude of variety of signal generated by chemical and/or physical signals. The final outcome of various actions and interactions [15] denotes the behavior of social insect colony. The dance is staged to obtain the food and the performance of dance denotes the direction of the food source and it the signal is generated to other insects in colony [16]. The bees have the ability to travel long distance in order to collect the food sources. In general, flower patches with good amounts of nectar is gathered by consuming less effort , where other nectar is less can be receive fewer bees [17]. The looting process initiates by scout bees and when they are sent to find for effective flower patches and it moves from one flower to another. The scout bee initiated the waggle dance in front of bees to describe the better food sources to provide better communication [18]. Once the process of dance is completed the dancer will return back to flower patch with follower bees. The scout bee which has more number of followers are consider to be more proficient patches, where it can easily collects the food. In ABC algorithm, the population of bees classified into two groups, scout and employed bees. The scout bees look out for a new food source and the role employed bees is to identify a food source within the neighborhood. The sharing of information with other bees is carried in a better way. The [Fig. 1] shows the flowchart of Artificial Bee Colony Optimization algorithm with ns scout bees randomly distributed in the search space. The quality of nectar amounts of sites is considered to be the visited sites of scout bees. The sites which contain high amount of nectar are selected for neighborhood search. To have proper exploration the recruit bee is selected and the nectar amounts are calculated with high nectar amounts. Select m sites which have the highest nectar amounts from sites to form the next bee population. The onlooker bees calculate the information about the food sources based on the probability value using

$$P_i = \frac{fit_i}{\sum_{j=1}^{N_{FS}} fit_i} \ldots\ldots (7)$$

where fit_i denotes fitness value of the solution i , and N_{FS} is the sum of food sources that are same to the employed bees quantity, ne. Now the onlookers generate a modification in the chosen position and evaluate the nectar amount of the new source:

$$v_{ij} = x_{ij} + \phi_{ij}\left(x_{ij} - x_{kj}\right) \ldots\ldots (8)$$

K∈ {1, 2, 3,...., N_{FS}} *and* j∈ {1, 2, 3,...., D} are randomly chosen. The value of K should be different from i and it need to be random. ϕ_{ij} is random and it is selected from $[-1,1]$. The onlooker bee updates the new position, when the quantity of nectar of the new source is greater than that of the previous nectar amount. If this condition fails, then that food source is falls under abandoned, pairing of the employed bee with that particular food source becomes a scout. The abandoned source can be calculated by using the equation

$$x_{ij} = x_{jmin} + rand\ (0,1) * \phi_{ij}\left(x_{jmax} - x_{jmin}\right) \ldots\ldots (9)$$

x_{jmin} x_{jmax} *are the lower and upper bound* Limit of the parameter to be optimized. The main control parameters in the ABC algorithm are the sun of employed bees, onlooker bees, the Limit Value, and the maximum cycle number [12]. In ABC algorithm the process of balancing the exploration and exploitation process is done by employed, onlooker bees and scouts bees.

Pseudo code of EABC algorithm for EDP

In this section, an ABC algorithm is used to resolve the optimal output of each generating power unit for a specified demand, in order to reduce the power loss and to reduce total generation cost [19]. The possible solution is described by the position of a food source. The amount nectar of a food source depends to the quality or fitness of the associated solution [20]. The procedure for the proposed method is as described as.

Step1: Determine the generator cost efficient, generated power limits and parameters of ABC are initialized.

Step2: The population is initialized with random generated solutions and the dimension D is mapped number of generator unit G , the size of the population is described as N. Each solution consist of Xi=[Pi1,Pi2,...,Pij...PiD] where i=(1,2,....,N) and j=(1,2,...,D), here D is referred to number of generators of the population N. The each solution of elements is referred to xij is the real power output of generating units (Pgi).

$$P_{ij} = P_{j\,min} + rand(0,1) * (P_{j\,max} - P_{j\,min}) \ldots\ldots (10)$$

Step3: The fitness calculation for the population is generated for each position of food equivalent to employed bees in the colony. Fix the cycle count as one and the following steps repeated until the MCN is done.

$$fit_i = \frac{1}{1+f_i} \text{ if } f_i \geq 0 \ldots\ldots (11)$$

$$fit_i = 1 + abs(f_i) \text{if } f_i < 0 \ldots\ldots (12)$$

Step 4: The employed Bees illustrates about the changes of position and site selection for identifying the new food source. Inorder to find the new food source to improve the exploration is

$$v_{i,j} = (x_{h1,j} + x_{h2,j})/2 + \phi_{i,j}(x_{h1,j} - x_{h2,j}) * \mathrm{M} + \varphi_{i,j}(x_{best,j} - x_{h1,j}) \text{ where}$$

$$\mathrm{M} = \frac{f(x_{h2}) - f(x_{h1})}{f(x_{h1}) + f(x_{h2})} \ldots\ldots (13)$$

where $h1$ *and* $h2$ are various integers chosen in [1,SN]. $\phi_{i,j}$ *and* $\varphi_{i,j}$ *is a random number gnereated unfirmoly within* [0,0.5] *and* [0,1], $x_{best,j}$ to find the best solution for jth element. Here midpoints between the two random points are calculated. By using the above equation exploitation is improved and the performance of the exploration is enhanced. The two random integer's parameters $\phi_{i,j}$ and $\varphi_{i,j}$ which controls the step size for search. The exploration process is carried if the value of $\phi_{i,j}$ *is higher* and if the exploitation is carried if the value of $\phi_{i,j}$ is smaller.The range [0, 0.5] is defined inorder to avoid the search in the local optima. $\varphi_{i,j}$ is a random number generated uniformly within [0,1] to makes the search process contributes to the current best solution. The comparison of old position with fitness value for the changed position is computed

Step 5: It impose the modifications of position by onlookers, here step 4 procedure gives input to the onlookers bee. The amount of nectar for the candidate source is calculated and it checks old nectar source, if the new one is better than previous one, then it is restored. If not the previous one is retained and greedy selection mechanism is incorporated for carrying the selection process.

Step 6: An Abandon source exploited by the bees and this process is carried if a solution is not improvised in a predefined number of trials. The scout bee process is initiated to identify new food source to be replaced with previous one. This process is carried by using the equation

$$x_{ij} = x_{jmin} + rand\ (0,1) * \phi_{ij}(x_{jmax} - x_{jmin}) \dots \dots \dots (14)$$

Step 7: The best solution is memorized and the cycle count is incremented.

Step 8: Once the termination constraints are achieved, ending of the process is initiated if the termination criteria are satisfied. If the process is not completed go to Step 4 to find best fitness and food source with equivalent position. Then the termination criteria is choose as the optimum output powers of generating units for ED procedure for that time interval.

RESULTS AND DISCUSSION

The ABC algorithm is incorporated for practical applications and it is tested on different test cases such as 6, 15, 20 and 38 unit systems. The [Table 1] represent the parameters settings used for all systems. Here we consider transmission cost, transmission loss for all four cases. A moderate B-loss coefficients matrix of power system network is used, for evaluating the transmission loss and computational time. A system with core i7 and 8 GB of RAM is utilized to run the code in Matlab 16.

Table 1: Parameters setting used with Test Systems

S.No	Number of Iterations	Population Size	C
6 -unit	1200	10	0.2
15-Unit	3000	10	0.2
38-Unit	13000	10	0.2

Case 1: Six Unit System

In this system consist of six power generating units with the total load demand on the system. The constrained power system load demand (*PD*) is mentioned 1263 MW and the coefficients of fuel cost [14,18].The loss coefficients in the power transmission line (matrix *B*) are shown. In this case, randomly generated of P1,P2,...,P6 of generator power output for each individual is calculated. The population is mapped and it is compared with other variants of SA [21], TS, PSO[22], GA, and NPSO-LRSto the proposed EABC. The best results are compared with the above mentioned algorithm and the result is shown in the [Table 2]. It shows the proposed method satisfy the constraints of system constraints, such as generator power limits and prohibited zones of units [23]. [Table 2] listed the statistic results that involved the minimum fuel cost and transmission loss generation cost, evaluation value.

Table 2: Simulation Results for 6 Unit Systems

Method	Min. (S/hr)	Mean (S]hr)	Max. (S/hr)	TFE	Time (sec.)	Standard deviation
SA [15]	15461.1	15488.98	15545.5	NA	50.36	28.367
TS[15]	15454.89	15472.56	15498.05	NA	20.55	13.719
PSO[15]	15450.14	15465.83	15491.71	1,00,000	6.82	10.15
GA[16]	15459	15469	15524	20,000	41.58	0.057
NPSO-LRS[17]	15450	15454	15492	20,000	14.89	0.002
EABC	15443.2	15450.3	15499.4	10,000	4.32	0.001

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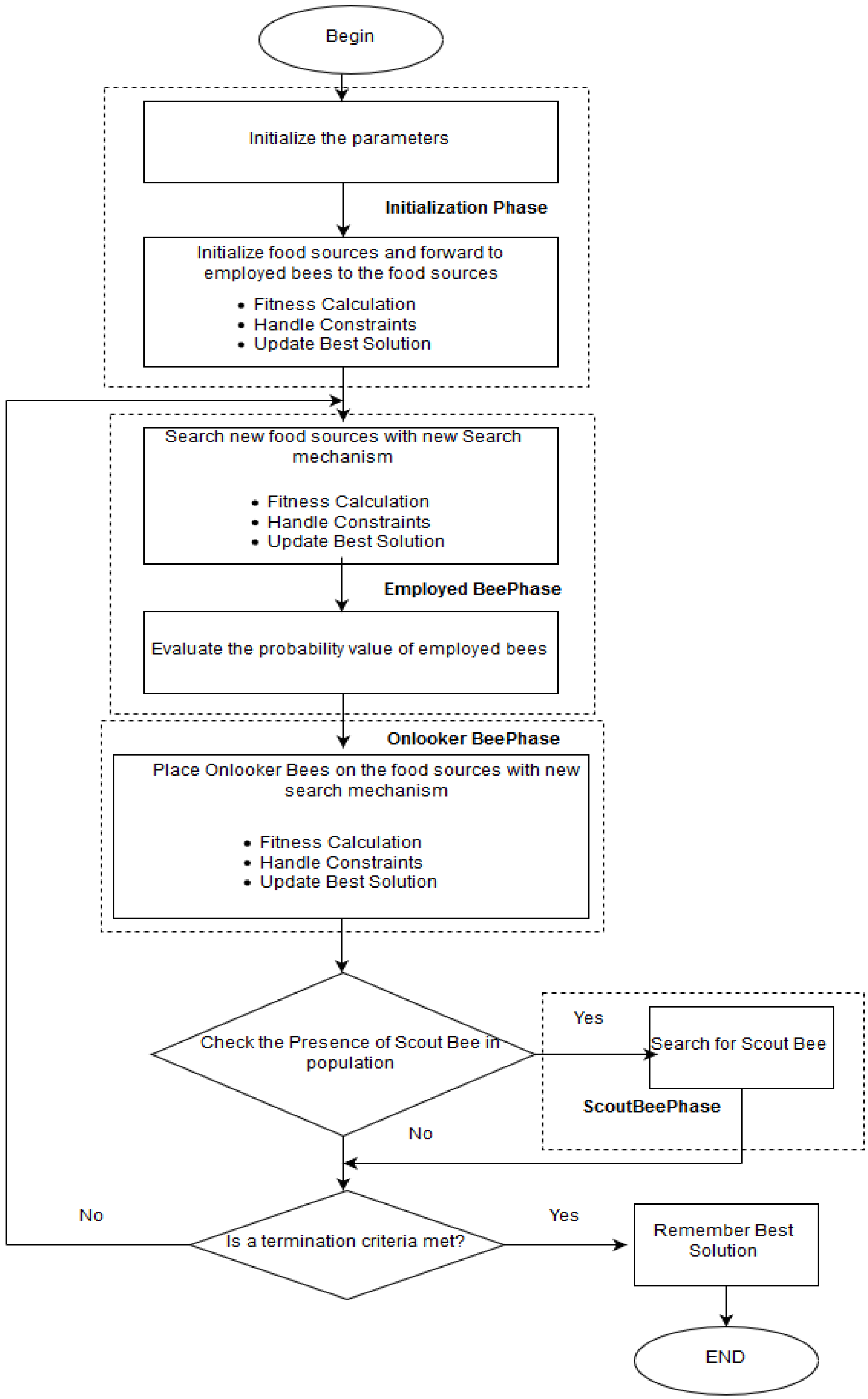

Fig. 1: Workflow for enhanced ABCO

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Case 2: 20 Unit systems

In Case 2 the 20 generating system is incorporated with the constraints such as generating load demand and the transmission loss. The system input data is referred from the valve loading effect is not taken to the count, but the loss of transmission is noted. The total demand load for this use case is 2500 MW. The best results are compared with the algorithm and the outcome is shown in the [Table 3]. It shows the proposed method satisfy the constraints of system constraints, such as generator power limits and prohibited zones of units. [Table 3] listed the statistic results that involved the minimum fuel cost and transmission loss generation cost, evaluation value [23]. It is compared to the other Evolutionary algorithms [24,25] for effective results.

Table 3: Simulation Results for 20 Unit Systems (2500 MW)

Unit Power output(MW)	BBO	LI	HM	IABC	GABC	EABC
P1	513.09	512.78	512.78	325.3754	277.4268	360.2834
P2	173.35	169.10	169.10	174.2311	87.40052	113.9078
P3	126.92	126.89	126.89	50	50	50
P4	103.33	102.87	102.87	50	65.6027	50
P5	113.77	113.64	113.68	78.18726	121.0221	81.74645
P6	73.07	73.57	73.57	20	28.50667	28.57458
P7	114.98	115.29	115.29	118.1033	118.0878	118.0681
P8	116.42	116.40	116.40	50	50	50
P9	100.69	100.41	100.41	121.1041	156.9833	93.05378
P10	100.00	106.03	106.03	43.54856	77.50294	30
P11	148.98	150.24	150.24	241.1593	241.1436	241.0568
P12	294.02	292.76	292.76	423.9738	422.4694	425.9739
P13	119.58	119.12	119.12	96.81424	150.1453	152.0103
P14	30.55	30.83	30.83	78.48479	53.49366	99.72673
P15	116.45	115.81	115.81	168.2717	81.21983	117.4553
P16	36.23	36.25	36.25	33.32164	33.32311	33.33886
P17	66.86	66.86	66.86	49.89571	39.7736	35.56004
P18	88.55	87.97	87.97	30	50.86036	44.00757
P19	100.98	100.80	100.80	43.0362	43.02828	105.8806
P20	54.27	54.31	54.31	30	30	30
Total generation (MW)	2592.10	2591.97	2591.97	2225.507	2177.99	2260.644
Total transmission loss (MW)	92.10	91.97	91.97	274.4929	322.01	239.356
Total generation cost (S/h)	62456.78	62456.64	62456.63	60213.47	60216.32	60191.41

Case 3:38 Unit systems

The 38 generating system is used without valve point loading and other two constraints such as generating load demand and the transmission loss. The input data is referred from the [26] and for the load demand is 6000 for MW. The best results are compared with the algorithm and the outcome is shown in the [Table 4]. It shows the proposed method satisfy the constraints of system constraints, such as generator power limits and prohibited zones of units [27,28]. [Table 3] listed the statistic results that involved the minimum fuel cost and transmission loss generation cost, evaluation value.

Table 4: Simulation Results for 38 Unit Systems (6000MW)

Unit Power output(MW)	DE/BBO	BBO	PSO-TVAC	NEW-PSO	EP-EPSO	EABC
P1	426.60606	422.230586	443.659	550	318.0777	349.5643
P2	426.606054	422.117933	342.956	512.263	475.117	324.0509
P3	429.663164	435.779411	433.117	485.733	399.1265	325.8652
P4	429.663181	445.48195	500	391.083	500	500
P5	429.663193	428.475752	410.539	443.846	500	327.0012
P6	429.663164	428.649254	492.864	358.398	500	327.3221
P7	429.663185	428.119288	409.483	415.729	500	326.9571
P8	429.663168	429.900663	446.079	320.816	500	326.9238
P9	114	115.904947	119.566	115.347	114	114
P10	114	114.115368	137.274	204.422	132.7826	114

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P11	119.768	115.418662	138.933	114	114	114
P12	127.0728	127.511404	155.401	249.197	114	114
P13	110	110.000948	121.719	118.886	110	110
P14	90	90.0217671	90.924	102.802	90	90
P15	82	82	97.941	89.039	82	82
P16	120	120.038496	128.106	120	120	120
P17	159.598	160.303835	189.108	156.562	141.9435	147.2366
P18	65	65.0001141	65	84.265	65	65
P19	65	65.000137	65	65.041	65	65
P20	272	271.999591	267.422	151.104	120	272
P21	272	271.872268	221.383	226.344	272	272
P22	260	259.732054	130.804	209.298	260	260
P23	130.648618	125.993076	124.269	85.719	80	96.42769
P24	10	10.4134771	11.535	10	10	10
P25	113.305034	109.417723	77.103	60	92.9577	85.23205
P26	88.0669159	89.3772664	55.018	90.489	55	72.21293
P27	37.5051018	36.4110655	75	39.67	35	35
P28	20	20.009888	21.682	20	20	21.20601
P29	20	20.0089554	29.829	20.985	20	20
P30	20	20	20.326	22.81	20	20
P31	20	20	20	20	20	20
P32	20	20.0033959	21.84	20.416	20	20
P33	25	25.0066586	25.62	25	25	25
P34	18	18.0222107	24.261	21.319	18	18
P35	8	8.0000426	9.667	9.122	8	8
P36	25	25.006066	25	25.184	25	25
P37	21.782	22.0005641	31.642	20	38	20
P38	21.0621792	20.6076309	29.935	25.104	20	20
Cost ($/h)	94,17,235.79 [21]	94,17,633.64 [21]	95,00,448.31 [22]	95,96,448.31 [22]	93,87,925.5 0 [22]	90,13,940

CONCLUSION

In this paper, an Enhanced Artificial Bee colony optimization is discussed and this searching technique provides better convergence, where generally the optimization algorithms should have the ability to balance both exploration and exploitation. The algorithm helps to improve the exploration and it avoids trapping in the local optimum. This method is incorporated for solving the complex problem in Economic dispatch. Here we impose the proposed algorithm in three cases inorder to prove its performance such as 6 generation unit system, 15 generation unit system and 38 generation power system. The proposed method helps to minimize the transmission loss and reduce the generation cost with short computational time. The results are compared with other traditional approaches and the displayed results illustrates that the proposed algorithm outperforms the results of other approaches. It tells the proposed algorithm can be easily used to solve the complex issues occur in the economic dispatch.

CONFLICT OF INTEREST

There is no conflict of interest

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