



ECONOMIC LOAD DISPATCH USING ARTIFICIAL BEES COLONY ALGORITHM

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ABSTRACT

The economic load dispatch plays an important role in the operation of power system, and several models by using different techniques have been used to solve these problems. Several traditional approaches, like lambda-iteration and gradient method are utilized to find out the optimal solution of non-linear problem. More recently, the soft computing techniques have received more attention and were used in a number of successful and practical applications. This paper *presents* an Artificial Bee Colony (ABC) *algorithm* based method for solving the economic load dispatch (ELD) problem. The objective is to minimize the nonlinear function, which is the total fuel cost of thermal generating units, subject to the usual constraints. The purpose of this work is to find out the minimum cost by using Bee's Algorithm using the data of five generating units.

1.INTRODUCTION

From olden days, the electricity industry is fully regulated with a centrally controlled structure. The power system operator has full control over the operation and maintenance of power system equipment as well as the information regarding the cost and technical aspects. Now a days, many countries are going through the privatization of their electricity industries by unbundling the integrated power system into a number of separate deregulated business entities. The preventive maintenance of power system equipment in the restructured electricity industries is no longer controlled centrally, and none of these entities currently have explicit accountability for maintenance activities. There were some non-ideal approaches used to schedule the maintenance activities in the centralized system for addressing the new deregulated environments. In recent years a few research publications has been reported in this area.

The deregulation is a current trend in electric power industries around the world. The power company is not a vertically-integrated structure again; power transmission under such a structure becomes more complicated. Also, how to securely and reliably operate the power system under deregulated environment becomes a challenge.

Since an engineer is always concerned with the cost of products and services, the efficient optimum economic operation and planning of electric power generation system have always occupied an important position in the electric power industry. With large interconnection of the Electric networks, the energy crisis in the world and continuous rise in prices, it is very essential to reduce the running charges of the electric energy. A saving in the operation of the system of a small percent represents a significant reduction in operating cost as well as in the quantities of fuel consumed. The classic problem is the economic load dispatch of generating systems to achieve minimum operating cost.

The recent research work, to solve economic load dispatch optimization problem suggested in the literature are outlined. Economic dispatch is generation allocation problem and defined as the process of calculating

the generation of the generating units so that the system load is supplied entirely and most economically subject to the satisfaction of the constraints

1.2 THE ECONOMIC OPERATION OF POWER SYSTEM

The efficient optimum economic operation and planning of electric power generation system have always occupied an important position in the electric power industry. It is very essential to reduce the running charges of the electric energy due to the large interconnection of electric networks, the energy crisis in the world and the continuous rise in prices. A significant reduction in the quantity of fuel and the operating cost can be obtained by reducing the operation of system within a small limit. Our main aim is to achieve minimum operating cost for the economic load dispatch of generating systems.

The economic load dispatch now includes the dispatch of systems to minimize pollutants and conserve various forms of fuel, as well as achieve minimum cost as the public has become concerned with the environmental issues. The need of expanding the limited economic optimization problem become increased so as to incorporate constraints on the system to ensure security and this can prevent the system from collapsing by unforeseen conditions. Economic dispatch problem is known as a problem of proper commitment of any array of units out of a total array of units to serve the expected load demands in an optimal manner. For the purpose of optimum economic operation of this large scale system, modern system theory and optimization techniques are being applied with the expectation of considerable cost savings. In this project using ARTIFICIAL BEES COLONY (ABC).

2.ECONOMIC LOAD DISPATCH

Economic Load Dispatch (ELD) is one of the important optimization problems in modern Energy Management Systems (EMS). ELD determines the optimal real power settings of generating units in order to minimize total fuel cost of thermal plants. Various mathematical programming methods and optimization techniques have previously been applied for solution of ELD. These include Particle swarm optimisation method, Artificial bees colony algorithm and gradient methods. ELD problems in practice are usually hard for traditional mathematical programming methodologies because of the equality and inequality constraints.

2.1 ELD WITH PIECEWISE LINEAR COST FUNCTION

In this method economic load dispatch problem of those generators are solved whose cost functions are represented as single or multiple segment linear cost functions. Here for all units running, we start with all of them at P_{min} , then begin to raise the output of the unit with the lowest incremental cost segment. If it hits P_{max} , we then find the unit with the next lowest incremental cost segment and raise its output. Eventually, we will reach a point where a units output is being raised and the total of all unit outputs equal the load, or load plus losses. At that point, we assign the last unit being adjusted to have a generation which is practically loaded for one segment to make this procedure very fast. This is an extremely fast form of economic dispatch.

2.2 COST FUNCTION

Let C_i mean the cost, expressed for example in dollars per hour, of producing energy in the generator unit I . the total controllable system production cost therefore will be

$$C = \sum_{i=1}^N C(i) \$/h$$

The generated real power P_{Gi} accounts for the major influence on c_i . The individual real generation are raised by increasing the prime mover torques, and this requires an increased expenditure of fuel. The reactive generations Q_{Gi} do not have any measurable influence on c_i because they are controlled by controlling by field current. The individual production cost c_i of generators unit I is therefore for all practical purposes a function only of P_{Gi} , and for the overall controllable production cost, we thus have

$$C = \sum_{i=1}^N ci(PGi) \quad (2.1) \text{ When the cost}$$

function C can be written as a sum of terms where each term depends only upon one independent variable.

2.3 UNIT COMMITMENT

Cost function is the part of unit commitment, its include the startup cost, shutdown cost and different type of constraints are 1. Ramp rate 2. Must run 3. Reserve 4. Crew and 5. Maintenance

2.4 OBJECTIVE FUNCTION FOR ELD

Minimise the total cost of generation,

$$\text{Total cost} = C_i \sum_{n=1}^N P_{gi} \quad (2.2)$$

$$\text{Constrain, } P_D = \sum_{n=1}^N P_{gi} \quad (2.3)$$

(Total demand = total generation)

2.5 SYSTEM CONSTRAINTS:

Broadly speaking there are two types of constraints

- i) Equality constraints
- ii) Inequality constraints

The inequality constraints are of two types (i) Hard type and, (ii) Soft type. The hard type are those which are definite and specific like the tapping range of an on-load tap changing transformer whereas soft type are those which have some flexibility associated with them like the nodal voltages and phase angles between the nodal voltages, etc. Soft inequality constraints have been very efficiently handled by penalty function methods.

- *Equality constraints*

That cost function is not affected by the reactive power demand. So the full attention is given to the real power balance in the system. Power balance requires that the controlled generation variables P_{Gi} obey the constraints equation,

$$P_d = \sum_{n=1}^N P_{Gi} \quad (2.4)$$

- *Inequality constraints*

- i) Generator:

The KVA loading in a generator is given by $P^2 + Q^2$ and this should not exceed a pre-specified value of power because of the temperature rise conditions. • The maximum active power generation of a source is limited again by thermal consideration and also minimum power generation is limited by the flame instability of a boiler. If the power output of a generator for optimum operation of the system is less than a pre-specified value P_{min} , the unit is not put on the bus bar because it is not possible to generate that low value of power from the unit. Hence the generator power P cannot be outside the range stated by the inequality

$$P_{min} \leq P \leq P_{max}$$

- Similarly the maximum and minimum reactive power generation of a source is limited. The maximum reactive power is limited because of overheating of rotor and minimum is limited because of the stability limit of machine. Hence the generator powers Q cannot be outside the range stated by inequality, i.e. $Q_{min} \leq Q \leq Q_{max}$

- *Voltage Constraints:*

It is essential that the voltage magnitudes and phase angles at various nodes should vary within certain limits. The normal operating angle of transmission lies between 30 to 45 degrees for transient stability reasons. A lower limit of delta assures proper utilization of transmission capacity.

- *Running Spare Capacity Constraints:*

These constraints are required to meet

- a) The forced outages of one or more alternators on the system and
- b) The unexpected load on the system

The total generation should be such that in addition to meeting load demand and losses a minimum spare capacity should be available i.e.

$$G \geq P_d + \text{PSO}$$

Where G is the total generation and PSO is some pre-specified power. A well planned system is one in which this spare capacity PSO is minimum.

- *Transmission Line Constraints:*

The flow of active and reactive power through the transmission line circuit is limited by the thermal capability of the circuit and is expressed as.

$$C_p \leq C_{p \max}$$

Where $C_{p \max}$ is the maximum loading capacity of the P_{TH} line.

- *Transformer taps settings:*

If an auto-transformer is used, the minimum tap setting could be zero and the maximum one, i.e.

$$0 \leq t \leq 1.0$$

Similarly for a two winding transformer if tapping are provided on the secondary side,

$$0 \leq t \leq n$$

Where n is the ratio of transformation.

- *Network security constraints:*

If initially a system is operating satisfactorily and there is an outage, may be scheduled or forced one, It is natural that is an outage, may be scheduled or forced one, it is natural that some of the constraints of the system will be violated. The complexity of these constraints (in terms of number of constraints) is increased when a large system is under study. In this a study is to be made with outage of one branch at a time and then more than one branch at a time. The natures of constraints are same as voltage and transmission line constraints.

ELD WITHOUT LOSSES

The economic load dispatch problem is defined as

$$\text{Min } F_T = \sum_{n=1}^N F_n \tag{2.5} \text{ Subjected to } P_D =$$

$$\sum_{n=1}^N P_n \tag{2.6}$$

Where F_T is total fuel input to the system, F_n the fuel input to nth unit, P_D the total load demand and P_n the generation of nth unit. By making use of Lagrange multiplier the auxiliary function is obtained as

$$F = F_T + \lambda(P_D - \sum_{n=1}^N P_n) \tag{2.7}$$

Where λ is the Lagrange multiplier. Differentiating F with respect to the generation P_n and equating to zero gives the condition for optimal operation of the system.

$$\frac{\partial F}{\partial P_n} = \frac{\partial F_T}{\partial P_n} + \lambda(0 - 1) = 0$$

$$\begin{aligned} & \frac{\partial F_T}{\partial P_n} \\ & = \frac{\partial F_T}{\partial P_n} - \lambda = 0 \end{aligned}$$

Since $F_T = F_1 + F_2 + F_3 + \dots + F_n$

$$\frac{\partial F_T}{\partial P_n} = \frac{dF_n}{dP_n} = \lambda \tag{2.8}$$

And therefore the condition for optimum operation is

$$\frac{dF_1}{dP_1} = \frac{dF_2}{dP_2} = \dots = \frac{dF_n}{dP_n} = \lambda$$

$$dP_1 \quad dP_2 \quad dP_N$$

Here $\frac{dF_n}{dP_n}$ = incremental production cost of plant n in Rs. per MW hr.

The incremental production cost of a given plant over a limited range is represented by

$$\frac{dF_{Pn}}{dP_n} = F_n P_n + f_n \tag{2.9}$$

Where F_n = slope of incremental production cost curve f_n = intercept of incremental production cost curve
 The equation mean that the machine be so loaded that the incremental cost of production of each machine is same. It is to be noted here that the active power generation constraints are taken into account while solving the equations which are derived above. If these constraints are violated for any generator it is tied to the corresponding limit and the rest of the load is distributed to the remaining generator units according to the equal incremental cost of production.

ELD WITH LOSSES

The optimal load dispatch problem including transmission losses is defined as

$$\text{Min } F_T = \sum_{n=1}^N F_n \tag{2.10}$$

Subject to $P_D + P_L - \sum_{n=1}^n P_n$

Where P_L is the total system loss which is assumed to be a function of generation and the other term have their usual significance. Making use of the Lagrange multiplier λ the auxiliary function is given by

$$F = F_T + \lambda (P_D + P_L - \sum P_n) \tag{2.11}$$

The partial differential of this expression when equated to zero gives the condition for optimal load dispatch, i.e.

$$\frac{\partial F}{\partial P_n} = \frac{\partial F_T}{\partial P_n} + \lambda \left(\frac{\partial P_L}{\partial P_n} - 1 \right) = 0$$

$$\frac{dF}{dP_n} + \lambda \frac{\partial P_L}{\partial P_n} = \lambda \tag{2.12}$$

Here the term $\frac{dP_L}{dP_n}$ is known as the incremental transmission loss at plant n and λ is

known as the incremental cost of received power in Rs.perMW hr. The equation is a set of n equations with (n+1) unknowns .Here n generations are unknown and λ is also unknown. These 35 equations are known as coordination equations because they coordinate the incremental transmission losses with the incremental cost of production. To solve these equations the loss formula equation is expressed in terms of generations and is approximately expressed as

$$P_L = \sum_m \sum_n P_m B_{mn} P_n \tag{2.13}$$

Where P_m and P_n are the source loadings, B_{mn} the transmission loss coefficient. The formula is derived under the following assumptions;

1. The equivalent load current at any bus remains a constant complex fraction of the total equivalent load current.
2. The generator bus voltage magnitudes and angles are constant
3. The power factor of each source is constant.

The solution of coordination equation requires the calculation of $\frac{dP_L}{dP_n} = 2 \sum_m B_{mn} P_m$

Also $\frac{dF_{Pn}}{dP_n} = f_{nn} P_n + f_n$

The coordination equation can be rewritten as

$$F_{nm}P_n + f_n + \lambda \sum_m 2 B_{mn}P = \lambda \quad (2.14)$$

Solving for P_n we obtain

$$P_n = \frac{1 - \frac{f_n}{\lambda} - \sum_{m \neq n} 2 B_{mn} P}{\lambda \sum_m 2 B_{mn}} \quad (2.15)$$

3.1 ABC ALGORITHM

ABC is an optimisation tool. In computer science and operations research, the Bees Algorithm is a population-based search algorithm which was developed in 2005. It mimics the food foraging behaviour of honey bee colonies. In its basic version the algorithm performs a kind of neighbourhood search combined with global search, and can be used for both combinatorial optimization and continuous optimization. The only condition for the application of the Bees Algorithm is that some measure of topological distance between the solutions is defined. The effectiveness and specific abilities of the Bees Algorithm have been proven in a number of studies.

Artificial Bee Colony optimization algorithms are formulated on the basis of natural foraging behaviour of honey bees. ABC was first developed by Dr. Korba. Some artificial ideas are added to construct a robust ABC. Very unlike to classical search and optimization methods ABC starts its search with a random set of solutions (Colony size), instead of single solution just like GA. Each population member is then evaluated for the given objective function and is assigned fitness. The best fits are entertained for next generation while the others are discarded and compensated by a new set of random solutions in each generation. The only stopping criterion is the completion of maximum no of cycles or generations. At the end of cycles the solutions with best fit is the desired solution. ABC is applied for solution of ELD. A generating unit based encoding scheme is used, however when applied to large size systems, the number of maximum iterations or generations has to be increased proportionally. The solution time grows approximately linearly with problem size rather than geometrically.

STEPS IN BEES ALGORITHM

Step1: Deploying bees initially at random locations

The initial step involved is deploying the bees in a feasible solution space subject to constraints imposed on the solution variables. Here position of a bee refers to one complete solution of set to the problem

Step 2: Evaluation of objective function value

The objective function value $F(\Phi)$ at each bee position is evaluated using equation

$$F(\Phi) = \sum (w_r^* - w_r)^2 \quad (3.1) \quad \text{Step 3: Computation of duration of dance of each bee}$$

The duration of dance of the j -th bee in the m -th location at iteration k is given by equation (3.2).

$$D_{(j)(m)}(k) = 1 - \frac{F(\Phi)^{1/(j)(m)(k)}}{F(\Phi)^{1/(j)(m)(k)}} \quad (3.2)$$

Step 4: Identification of elite bees.

The bee, whose location gives maximum value for D_d is designated as elite bee. Thus elite bee b_e in the k -th iteration is given by equation (3.2) $b_e(k)=b_{(j)}(k)$ having $\text{Max}(D_{d(j)(m)}(k))$

The bees are now arranged in the decreasing order of duration of dance and the bee in the top of list is called “elite bee”, and the next bee immediately below the elite bee is called as “second elite bee”. The bee which is in the bottom of the list-the one whose location-gives least duration of dance-is termed as “worst bee”.

Step 5: Movement of Bees

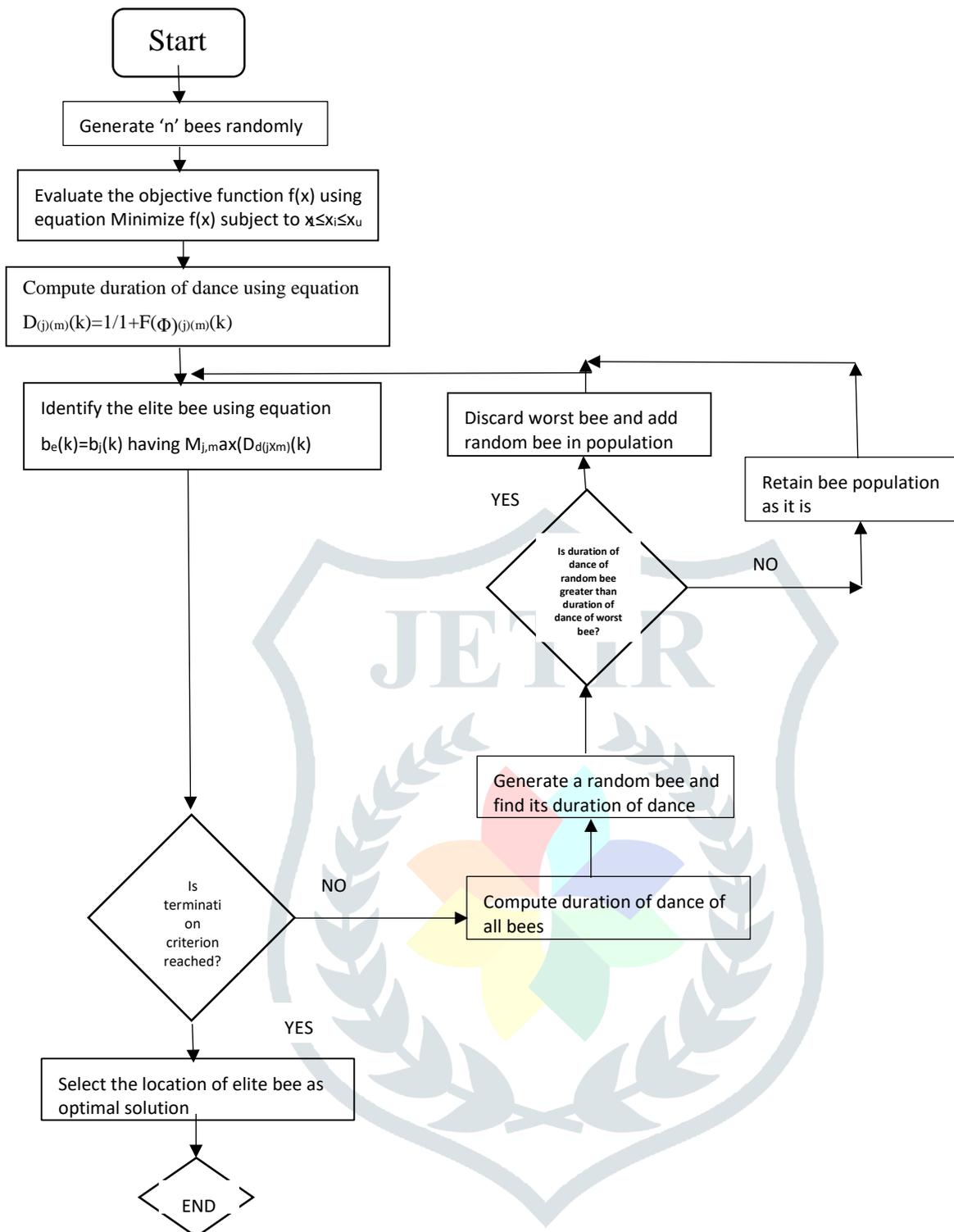
Majority of bees follow the elite bee; however few bees may fly to other flower patches too. Hence the movement of bees can be thought of based on a probability. When all bees make a flight of distance one iteration is completed.

Step 6: End the program, if termination criterion is reached; else go to step7

Step 7: Evaluate duration of dance of each bee using the equation (3.2). Identify the worst bee. Generate a random bee, and if its duration of dance is higher than the worst bee, worst bee is discarded and randomly generated bee is added to population of bees; else retain the population as it is. Then go to step 4.



FLOW CHART



4.1 DEREGULATED ENVIRONMENT

Deregulation is an act by which the government regulation of a particular industry is reduced or eliminated in order to create and foster a more efficient marketplace. These "restrictions" include taxes, quotas, laws to protect workers' rights, the environment, the welfare of the public. Deregulation is usually enacted to weaken government influence and forge greater competition. By this token, deregulation also creates an economic environment favourable to upstart companies that were unable to enter the industry prior to the passing of deregulation. It is also widely held that deregulation often serves as a catalyst for increased innovation and mergers among weaker competitors. Deregulation is often driven by lobbyists and lobbying groups that represent various industries and business interests. Industries that have undergone deregulation include communications, banking, securities, transportation, as well as power and utility. Although deregulation might purge government influence all together, some government oversight usually remains.

During the 1990s, many developed and developing countries began to restructure their electric power sectors to improve their performance. The restructuring programs have included privatization of state-owned enterprises, the separation of potentially competitive segments (generation and retail supply) from natural monopoly segments (distribution and transmission), the creation of competitive wholesale and retail markets. Deregulation in power sector is a process by which government remove or reduce restriction on power industry and invite private sector to invest in the power industry. A de-regulated system consists of generating companies (GENCOS), transmission companies (DISCO) and distribution companies (TRANSCO).

f the transmission systems and to provide a common carrier for electricity trade.

4.2 ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- a) Lower cost for residential consumer
- b) Increase jobs and benefit local communities
- c) Benefit to the environment
- d) Increase service reliability.

DISADVANTAGES

- a) Competition
- b) Compromised Service
- c) Marketplace Instability

4.3 COMPANIES IN INDIA

- Adani Power
- Bombay Electric Supply & Tramways Company Limited
- Delhi Transco Limited
- Gujarat Energy Transmission Corporation Limited
- Indraprastha Power Generation
- NTPC Limited:

Presently, NTPC generates power from Coal and Gas. With an installed capacity of 36,014 MW, NTPC is the largest power generating major in the country. It has also diversified into hydro power, coal mining, power equipment manufacturing, oil & gas exploration, power trading & distribution. With an increasing presence in the power value chain, NTPC is well on its way to becoming an “Integrated Power Major.”

○ Nuclear Power Corporation of India:

NPCIL is presently operating 20 nuclear power reactors with an installed capacity of 4780 MW.

○ Reliance Infrastructure:

13 medium and large sized power projects with a combined planned installed capacity of 28,200 MW, one of the largest portfolios of power generation assets under development in India.

○ Tata Power:

Tata Power has an installed generating capacity of 5297 MW and a presence across the entire value chain in generation (thermal, hydro, solar and wind) transmission, distribution and trading.

5. RESULTS AND DISCUSSION

Artificial bee colony algorithm is used to solve economic load dispatch problem in regulated and deregulated environment.

5.1 CASE 1: REGULATED SYSTEM WITHOUT LOSS

Five generators are considered having details as follows

Bus no.	α_2	α_1	α_0	Pmin(MW)	Pmax(MW)
1	0.05	13	0.0	0.0	400.0
3	0.07	16	0.0	0.0	250.0
4	0.06	14	0.0	0.0	300.0
5	0.08	18	0.0	0.0	400.0
7	0.09	19	0.0	0.0	350.0

Table 5.1

Total demand is taken as 800MW. Solution obtained using artificial bee colony is shown below. 15 initial bees are randomly generated within the feasible range. . If the no of particles are increased then cost curve converges faster. It can be observed the loss has no effect on the cost characteristic.

ABC METHOD

Result obtained by solving ELD without loss using ABC is shown in Table 5.2

GEN 1	200.237 MW
GEN 2	177.7758 MW
GEN 3	247.5736 MW
GEN 4	120.72 MW
GEN 5	53.69361 MW
COST	Rs.21426.6 Rs

Table 5.2

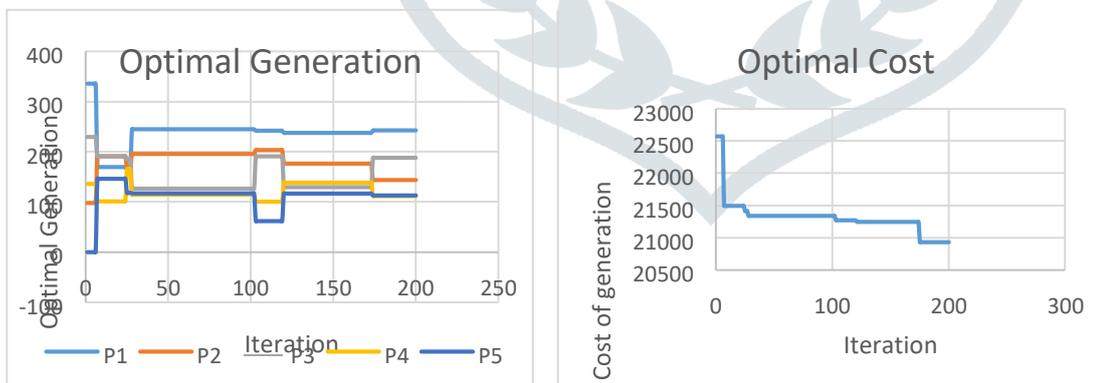


Fig.5.1 optimal generation curve

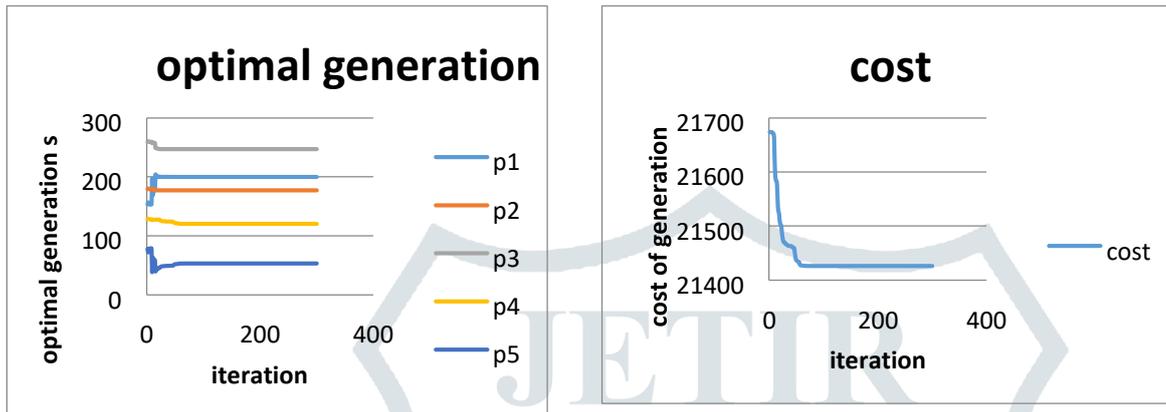
Fig.5.2 cost curve for quadratic cost function

5.1.2 PSO METHOD

Result obtained by solving ELD without loss using PSO is shown in Table 5.3

GEN 1	242.9067
GEN 2	143.9966
GEN 3	188.210
GEN 4	111.840
GEN 5	113.0453
COST	20935.50605Rs

Table 5.3



ig.5.3 optimal generation curve

Fig.5.4 cost curve for quadratic cost function It shows that ABC technique gives near optimal solution. Hence it can be used for ELD problems effectively.

COMPARISON

METHOD	ABC	PSO
OPTIMAL COST	20935.5	21426.6
TIME OF CONVERGENCE	0.55sec	1.34sec

Table 5.4

Without considering losses we can see that ABC method gives more optimal solution.

5.2 CASE 2: REGULATED SYSTEM WITH LOSS USING ABC METHOD

Same system is used for study with loss function used as

$$L = .00014p_1^2 + .00015p_2^2 + .00004p_3^2 + .00014p_4^2 + .00014p_5^2$$

GEN 1	235.7409
GEN 2	153.55
GEN 3	173.68
GEN 4	154.35
GEN 5	82.697
COST	21062.3Rs

Table 5.5

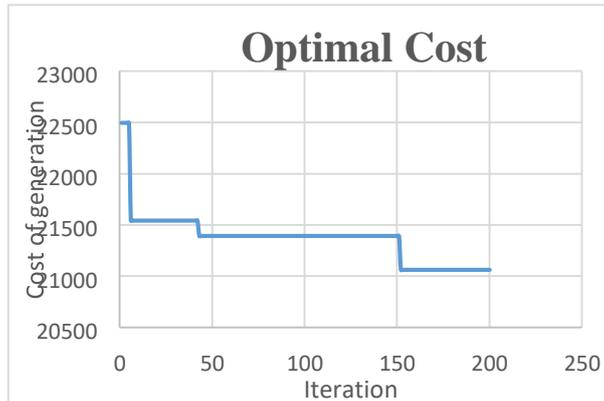
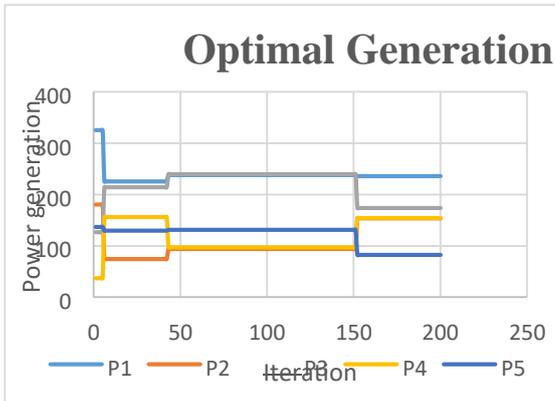


Fig.5.5 optimal generation curve

Fig.5.6 cost curve

USING PSO METHOD

GEN 1	270.8952 MW
GEN 2	143.2205 MW
GEN 3	158.3751 MW
GEN 4	126.5901 MW
GEN 5	100.9191 MW
COST	21035.14 Rs

Table 5.6

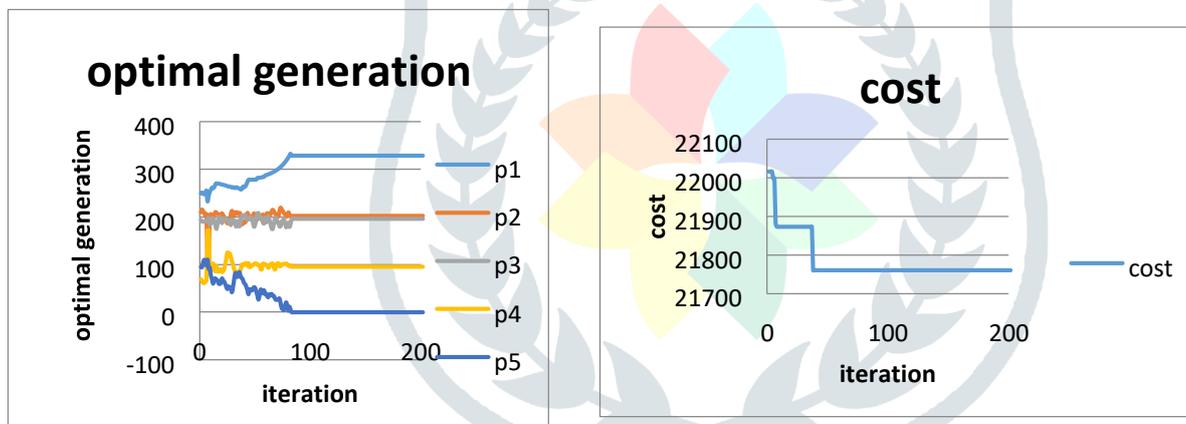


Fig.5.7 optimal generation curve

Fig.5.8 cost curve

COMPARISON

METHOD	ABC	PSO
OPTIMAL COST	21062.3	21035
TIME OF CONVERGENCE	.38 sec	.52sec

Table 5.7

It can be seen that after losses are included both method gives similar optimal solutions. But time of convergence is lesser in ABC method

5.3 CASE 3: DEREGULATED SYSTEM WITHOUT LOSS

Bid function considered for study is

Gen.No	Bid No	1	2	3	4	5
Generator 1	MW	100.0	150.0	200.0	300	400
	cost	18.0	20.5	30.5	38.0	48.0
Generator 3	MW	50.0	100.0	150.0	200	250
	cost	19.5	26.5	33.5	40.5	47.5
Generator 4	MW	100.0	150	200	250	300
	cost	20.0	29.0	35.0	41.0	47.0
Generator 5	MW	50.0	150.0	200.0	300	400
	cost	18.0	34.0	46.0	58.0	74.0
Generator 7	MW	50.0	150.0	200	300	350
	cost	19.0	37.0	50.5	59.5	82.0

Table 5.8

Total demand is taken as 800MW. Total demand is taken as 800MW. Solution obtained using artificial bee colony is shown below. 15 initial bees are randomly generated within the feasible range. . If the no of particles are increased then cost curve converges faster. It can be observed the loss has no effect on the cost characteristic.

USING ABC METHOD

GEN 1	148.0405
GEN 2	167.969
GEN 3	185.922
GEN 4	148.6061
GEN 5	149.4622
COST	27667.76Rs

Table 5.9

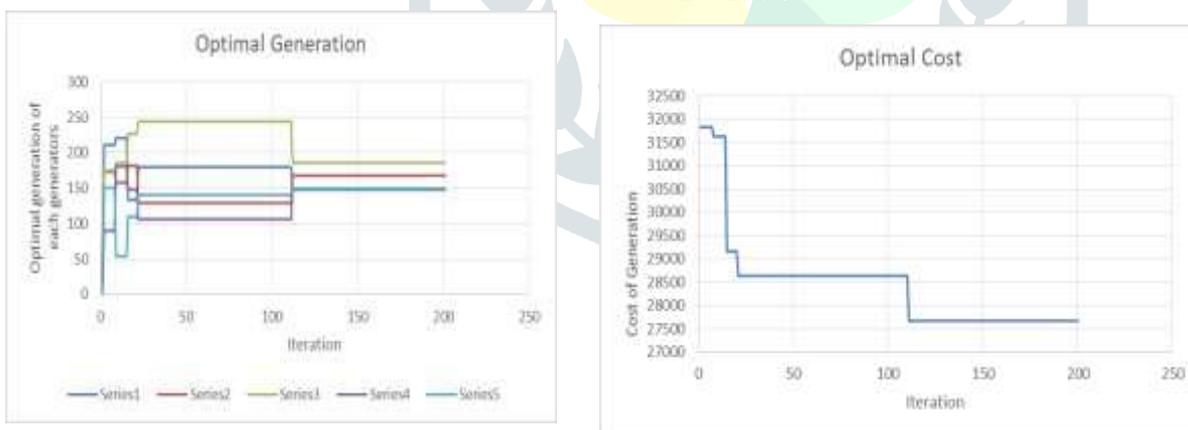


Fig.5.9 optimal generation curve

Fig.5.10 cost curve

USING PSO METHOD

GEN 1	247.1248 MW
GEN 2	148.063 MW
GEN 3	149.7051 MW
GEN 4	145.4058 MW
GEN 5	109.7008 MW
COST	Rs.27695.5Rs

Table 5.10

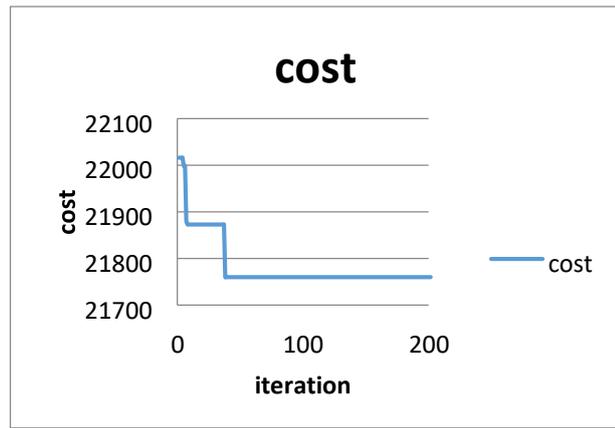
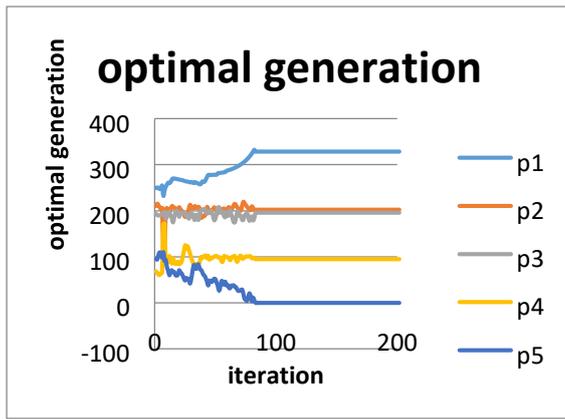


Fig.5.11 optimal generation curve

Fig.5.12 cost curve COMPARISON

METHOD	ABC	PSO
OPTIMAL COST	27667.76	27695.5
TIME OF CONVERGENCE	0.398sec	.49sec

Table 5.11

5.4 CASE 4: DEREGULATED SYSTEM WITH LOSS

Same system is used for study with loss function used as

$$L = .00014p_1^2 + .00015p_2^2 + .00004p_3^2 + .00014p_4^2 + .00014p_5^2$$

USING ABC METHOD

GEN 1	165.6508
GEN 2	199.4214
GEN 3	130.3042
GEN 4	143.2437
GEN 5	161.3799
COST	29927.71Rs

Table 5.12

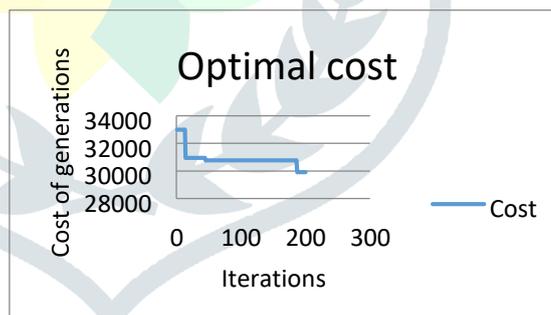
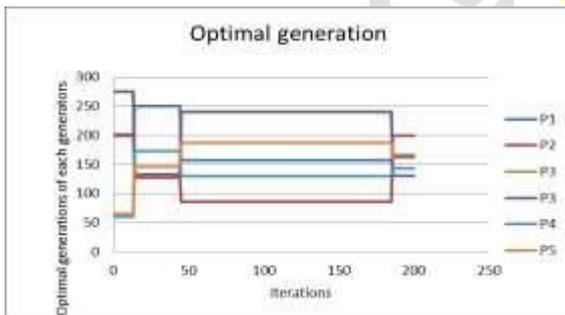


Fig.5.13 optimal generation curve

Fig.5.14 cost curve

USING PSO METHOD

Solution obtained using PSO choosing C1=.5,C2=1.5 is shown below.

GEN 1	148.6870 MW
GEN 2	169.2533 MW
GEN 3	195.4648 MW
GEN 4	184.3509 MW
GEN 5	117.4709 MW
COST	29570.68 Rs

Table 5.13

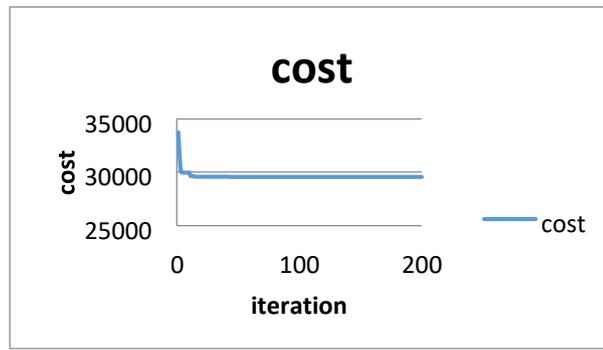
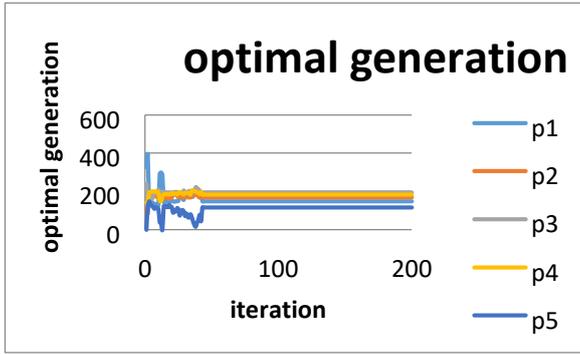


Fig.5.15 optimal generation curve

Fig.5.16 cost curve COMPARISON

METHOD	ABC	PSO
OPTIMAL COST	29927.71	29570.68
TIME OF CONVERGENCE	0.4014	.598

Table 5.14

CONCLUSION

In electric power sector, economic load dispatch is an important task, as it is required to supply the power at the minimum cost which mainly aims in profit-making. As the efficiency of newly added generating units are more than the previous units the economic load dispatch has to be efficiently solved for minimizing the cost of the generated power. Load dispatch problem here solved for two different cases. One with quadratic cost function and other with step cost function. Each problem is in the MATLAB environment. When transmission losses are considered Artificial bees colony methods gives a better result than the Particle Swarm Optimization method. From the results it was observed that the time of convergence was less for Artificial bees colony algorithm.

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