Abstract—This paper presents the application of Genetic Algorithm (GA) to economic load dispatch of the power system. The ELD problem has been solved through many traditional optimization methods including: gradient based techniques, newton methods, linear programming and quadratic programming. The economic dispatch reduces the system cost by allocating the real power among online generating units.

GA are implemented in a computer simulation programming and modeling in which a population of synopsis representation (called re combination) of candidate solution (called individuals / creatures / phenotypes) to an optimization problematic evolves towards best solutions.

Index Terms— economic load dispatch, genetic algorithm

I. INTRODUCTION

In Power System, Economic Load Dispatch (ELD) is generally used for get the optimal total generation cost. Economic Load Dispatch attempts to a temporally organized plan for matters to be attended to the generation with potentiality of minimizing the total operating cost function under unit operating limits. The functional cost can be reducing by employing any optimization technique for solving Economic Load Dispatch (ELD).

Many conventional methods applied to solve ELD problems through mathematical programming and optimization techniques. The main conventional methods are the lambda iteration method, base point and participation factor method, gradient method etc. From all these methods, the lambda iteration method uses frequently and this can be applied easily also.

To reduce the generating cost of power that problem is called Economic Load Dispatch problem. It is short term determination of optimal output of many generation facility. ELD Problem is solved by the specialized computer software like MATLAB.

The introduction of Particle Swarm Optimization (PSO) was given by James Kennedy and Russell Eberhart. It optimizes the nonlinear function. It was inspired by the helping nature of particle (birds, fishes) while searching for food.

II. COST OF ELECTRICAL ENERGY

The total cost of electrical energy generated can be classified into three parts

Fixed cost: This cost is independent to maximum demand and unit generation.

Semi-fixed cost: This cost is depending upon maximum demand but independent it is independent of unit generation.

Running or operational cost: This cost is depending upon the number of units generated.

III. GENETIC ALGORITHM

A Genetic Algorithm (GA) is a search technique, which is used in computing to discover exact or approximate (close together) results to optimization of search difficulties. GA are implemented in a computer simulation programming and modelling in which a population of synopsis representations (called recombination) of candidate solutions (called individuals / creatures / phenotypes) to an optimization problematic evolves toward best solutions.

For solving the genetic algorithm there are some genetic operators are used.

1. Selection
2. Crossover
3. Mutation

IV. METHODOLOGY

A. Problem Formulation

In Economic Load Dispatch Problem, the main objective is to minimize total fuel cost of the generation.

\[ \text{Min } C_T = \sum_{i=1}^{N} C_i (P_i) \]  \hspace{1cm} (1)

Subject to,

\[ P_D + P_L \leq \sum_{i=0}^{N} P_i \] \hspace{1cm} (2)

B. Economic Load Dispatch Problem with Active Power Transmission Losses

Economic load dispatch problem including Active power transmission line losses will be calculated from equation,

\[ P_L = \sum_{i=0}^{N} P_i * B * P_i' \] \hspace{1cm} (3)
Start

Define the objective function to be minimized

Initialize the value of Pmin & Pmax for each generating unit, and parameters of genetic operators

Evaluate PL and update the value of Power demand

Check power generation is not more than power demand

YES

NO

Calculate the fuel cost of the generator

Select the method Roulette wheel / Tournament

Check power generation is not more than power demand

YES

NO

Calculate Selected Probability

Crossover

Select Parents Indices

Mutation

Update Worst cost

Trunction

Best Solution

END

The cost function of any generation unit is represented by $C_i$

$$C_i = a_i P_i^2 + b_i P_i + c_i$$

(4)

The cost function of 6 generation units in $$/hr is given below.

$$C1 = 0.15240 \times P1^2 + 38.53973 \times P1 + 756.79886$$

$$C2 = 0.10587 \times P2^2 + 46.15916 \times P2 + 451.32513$$

$$C3 = 0.02803 \times P3^2 + 40.39655 \times P3 + 1049.9977$$

$$C4 = 0.03546 \times P4^2 + 38.30553 \times P4 + 1243.5311$$

$$C5 = 0.02111 \times P5^2 + 36.32782 \times P5 + 1658.5596$$

$$C6 = 0.01799 \times P6^2 + 38.27041 \times P6 + 1356.6592$$

The unit operating inequality constraints are:

$$10 \text{ MW} \leq P1 \leq 125 \text{ MW}$$

$$10 \text{ MW} \leq P2 \leq 125 \text{ MW}$$

$$35 \text{ MW} \leq P3 \leq 125 \text{ MW}$$

$$35 \text{ MW} \leq P4 \leq 125 \text{ MW}$$

$$130 \text{ MW} \leq P5 \leq 125 \text{ MW}$$

$$125 \text{ MW} \leq P6 \leq 125 \text{ MW}$$

For Active Power Transmission losses, $B$ – Coefficient matrix are:

$$B = 1 \times \exp(-5) \times \begin{bmatrix} 14 & 1.7 & 1.5 & 1.9 & 2.6 & 2.2 \\ 1.7 & 6 & 1.3 & 1.6 & 1.5 & 2 \\ 1.5 & 1.3 & 6.5 & 1.7 & 2.4 & 1.9 \\ 1.9 & 6 & 1.7 & 7.1 & 3 & 2.5 \\ 2.6 & 1.5 & 2.4 & 3.0 & 6.9 & 3.2 \\ 2.2 & 2 & 1.9 & 2.5 & 3.2 & 8.5 \end{bmatrix}$$

Proposed method for solving Economic Load Dispatch Problem are follows different steps, which is represent in flow chart of Genetic Algorithm.

Step 1 - Define the objective function
Step 2 - Initialize the value of inequality constraints and genetic operators
Step 3 - Calculate transmission losses and Update value of Power demand
Step 4 - Calculate the fuel cost of each generating unit
Step 5 - Choose the selection method
Step 6 - Crossover
Step 7 - Mutation
Step 8 - Update worst cost for selection of minimum cost
Step 9 - Truncation for getting only minimum cost
Step 10 - Get best solution

V. RESULT

The Table-1, shows the cost coefficients and maximum and minimum generation limits of given generating units in IEEE-30 Bus Test System and Table-2, represents the active power transmission losses coefficients of given test system.
VI. CONCLUSION AND FUTURE SCOPE

Genetic Algorithm shows superior result including high quality solution and stable convergence characteristics. The solution of Genetic Algorithm is always close to that of the conventional method but gives better solution in case of higher order system.

REFERENCES


