A Comparative Study between Non-Iterative Zero Tolerance Method with Genetic Algorithm Method for Economic Load Dispatch

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***Abstract*—This paper outlines the Optimization problem of real power and presents the new algorithm for studying the optimum load scheduling problem where a portion of the transmission Losses can be neglected.**
The paper describes a novel and time saving method and to obtain the optimum power dispatch This optimization procedure is free from iteration. The results are compared with the results found from Genetic Algorithm Technique.

***Index Terms*—iterative technique, optimization, economic load dispatch.**

I. INTRODUCTION

Economic Dispatch (ED) problem is one of the fundamental issues in power system operation. In essence, it is an optimization problem and its main objective is to reduce the total generation cost of units, while satisfying Constraints. [1] A bibliographical survey on ELD methods reveals that various numerical optimization techniques have been employed to approach the ELD problem. ELD is solved traditionally using programming based on optimization techniques such as lambda iteration, gradient method, dynamic programming (DP) and so on [1,3-6]. Recently modern heuristic methods (such as simulated annealing, genetic algorithms, evolutionary algorithms, adaptive tabu search, particle swarm optimization, etc [2]) are used to solve Economic Load dispatch problem. [7-8]. The main drawback of these used methods is that the accuracy of the result depends upon tolerance value and number of iterations, when the difference between actual and calculated value is less than tolerance, the program executes or terminates with the optimum result.

Bakirtzis et al. [9] have proposed a simple genetic algorithm solution to optimize the economic load dispatch problem. Here also the accuracy of the result depends upon the tolerance value.

This paper introduces a new non-iterative technique to solve economic Load dispatch problem. To get the exact major processes of fitness evaluation, selection, recombination and creation of a new population. Each chromosome within the population represents a Candidate solution. A chromosome must represent a generation solution, we have to set a tolerance value of zero which is not possible for iterative techniques as in linear programming method or in any other heuristic method. and always there is a deviation between exact value and calculated value.

In this proposed method a different computing technique based on Lagrangian Multiplier is used to solve the Economic Load Dispatch problem. The advantage of this technique is that it is non iterative and requires no tolerance value, we can get the exact solution. The results and simulation time are compared with the results found by using Genetic Algorithm.

II. ELD PROBLEM FORMULATION

A. Nomenclature and Acronyms

N	Number of units of a system
F(Pi)	Fuel cost of *i*th unit
P_{Oi}	Optimum Output for ith unit.
Pd	Power Demand
Pmax	Maximum output limit of *i*th unit
Pmin	Minimum output limit of *i*th unit
λ	Lagrange Multiplier/Incremental Fuel Cost
α_i , $ß_i$ & γ_i	Fuel Cost Coefficient for ith unit

B. Economic Dispatch using Genetic Algorithm

Genetic algorithms are search algorithms based on the process of biological evolution. In genetic algorithms, the mechanics of natural selection and genetics are emulated artificially. The search for a optimum to an optimization problem is conducted by moving from an old population of individuals to a new population using genetics-like operators. Each individual represents a candidate to the optimization solution. An individual is modeled as a fixed length string of symbols, usually taken from the binary alphabet. An evaluation function, called fitness function, assigns a fitness value to each individual within the population. This fitness value is measure for the quality of an individual. The basic optimization procedure involves nothing more than processing highly fit individuals in order to produce better individuals as the search progresses.

scheduling in order to solve the economic dispatch

In the economic dispatch problem, the unit power output is used as the main decision variable, and each unit's loading range is represented by a real number. The representation takes care of the unit minimum and maximum loading limits since the real representation is made to cover only the values between the limits.

The main objective of the economic dispatch is to minimize fuel costs while satisfying constraints such as the power balance equation. The most fit individuals will have the lowest cost of the objective function of the economic dispatch problem. The fitness function is used to transform the cost function value into a measure of relative fitness. For the economic dispatch problem, In order to produce two offspring, an arithmetic crossover operator is used. After crossover is completed, mutation is performed. In the mutation step, a random real value makes a random change in the *m*-th element of the chromosome. After mutation, all constraints are checked whether violated or not. If the solution has at least one constraint violated, a new random real value is used for finding a new value of the *m*-th element of the chromosome. Then, the best solution so far obtained in the search is retained and used in the following generation. The genetic algorithm process repeats until the specified maximum number of generations is reached.

C. Economic Dispatch using Non iterative Zero tolerance method

Initially the technique is applied for Two generating system, later the technique will be applied so that it can be applied for n number of generating system.

We have considered Two generating units sharing load, the fuel cost function of two units can be written as

$$F_1 (P_1) = \alpha_1 + \beta_1 * P_1 + \gamma_1 * P_1^2$$

$$F_2 (P_2) = \alpha_2 + \beta_2 * P_2 + \gamma_2 * P_2^2$$

The Optimal Loading for unit 1 is Po_1 and for unit 2 is Po_2 and the Power Demand is P_d

Then, $Po_1+Po_2 = P_d$

Incremental Fuel Cost i.e. Lagrange Multiplier $\lambda=dF_1/dP_1 = dF_2/dP_2$

$dF_1/dP_1= \beta_1 +2 \gamma_1 * Po_1$

$dF_2/dP_2= \beta_2 +2 \gamma_2 * Po_2$

$\lambda= \beta_1 +2 \gamma_1 * Po_1 = \beta_2 +2 \gamma_2 * Po_2 = (\gamma_2 \beta_1 +2 \gamma_2*\gamma_1 * Po_1)/ \gamma_2$

$= (\gamma_1 \beta_2 +2 \gamma_1*\gamma_2 * Po_2)/ \gamma_1$

$= (\gamma_2 \beta_1 + \gamma_1 \beta_2 + 2 \gamma_2*\gamma_1 * Po_1+ 2 \gamma_1*\gamma_2 * Po_2) /(\gamma_2 + \gamma_1)$

$= (\gamma_2 \beta_1 + \gamma_1 \beta_2 + 2 \gamma_2*\gamma_1 *(Po_1+ Po_2) /(\gamma_2 + \gamma_1)$

$= \{\gamma_2 \beta_1 + \gamma_1 \beta_2 + 2 \gamma_2*\gamma_1 *(P_d)\}/ (\gamma_2 + \gamma_1)$

$= (\gamma_2 \beta_1 + \gamma_1 \beta_2) / \gamma_2\gamma_1 + 2 P_d)/ \{(\gamma_2 + \gamma_1)/ \gamma_2\gamma_1\}$

$= (T+2P_d)/ S$

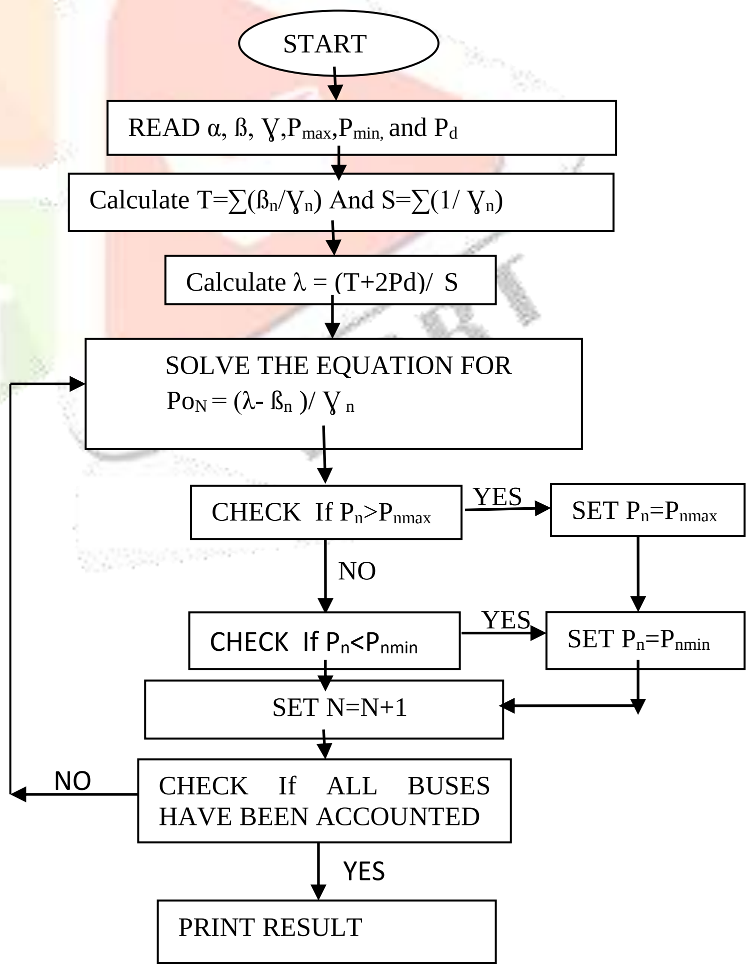
Where $T= (\gamma_2 \beta_1 + \gamma_1 \beta_2) / \gamma_2 \gamma_1 = \beta_1/\gamma_1+ \beta_2/\gamma_2$

$S= (\gamma_2 + \gamma_1)/ \gamma_2\gamma_1 = 1/\gamma_1+1/\gamma_2$

By observation it is seen that when N nos. of Generating units are sharing their common load then

$$T=\sum_{n=1}^{N} (\beta_n/ \gamma_n) \quad \text{and} \quad S=\sum_{n=1}^{N} (1/ \gamma_n)$$

Flow Chart of the proposed method is shown below:



III. SIMULATION RESULTS

The cost function of the 6 units are given as follows

$F_1 = 0.15240P_1^2+38.53P_1+756.79886$ Rs/Hr

$F_2 = 0.10587P_2^2+46.15916P_2+451.32513$ Rs/Hr

$F_3 = 0.02803P_3^2+40.39655P_3+1049.9977$ Rs/Hr

$F_4 = 0.03546P_4^2+38.30553P_4+1243.5311$ Rs/Hr

$F_5 = 0.02111P_5^2+36.32782P_5+1658.5596$ Rs/Hr

$F_6 = 0.01799P_6^2+38.27041P_6+1356.6592$ Rs/Hr

The unit operating ranges are

$10 \text{ MW} \leq P_1 \leq 125 \text{ MW}$

$10 \text{ MW} \leq P_2 \leq 150 \text{ MW}$

$35 \text{ MW} \leq P_3 \leq 225 \text{ MW}$

$35 \text{ MW} \leq P_4 \leq 210 \text{ MW}$

$130 \text{ MW} \leq P_5 \leq 325 \text{ MW}$

$125 \text{ MW} \leq P_6 \leq 315 \text{ MW}$

Results for ELD Solution for 6 unit System Using GA Technique are given by :

SL. NO.	Demand (MW)	P1	P2	P3
1	600	32.25	10	73.32
2	700	25.10	10	105.3
3	800	29.16	10	126.0
4	850	32.24	10	132.27
5	900	32.34	10	145.09

P4	P5	P6	Ft (Rs./hr.)
96.68	208.50	188.21	31447.1
99.00	231.07	229.37	36010.7
117.90	263.36	253.52	40679.43
132.62	273.38	269.00	43059.3
143.09	286.93	282.58	45464.21

Results for ELD Solution for 6 unit System Using Non iterative Zero tolerance Technique are given by:

SL. NO.	Demand (MW)	P1	P2	P3
1	600	21.19	10	82.09
2	700	24.97	10	102.664
3	800	28.77	10	123.24
4	850	30.66	10	133.53
5	900	32.51	10.61	143.68

P4	P5	P6	Ft (Rs./hr.)
94.37	205.36	186.99	31446.4
110.63	232.67	219.066	36003.5
126.9	259.99	251.1	40676.1
135.03	273.65	267.13	43053.2
143.06	287.17	282.97	45464.1

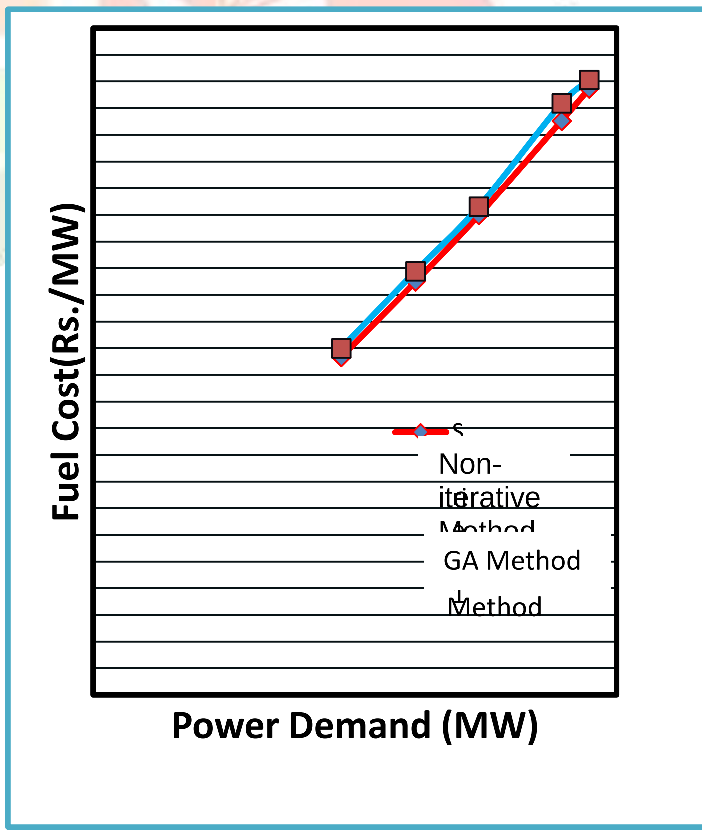


Fig : Cost Curve for two different method

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SCOPE OF FUTURE WORK:

This technique can also be applied for Reactive Power optimization and also modified including the losses of the transmission line.