A Review on Economic Load Dispatch by using ABC Algorithm

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Abstract— In this paper enlightening the problem valve point loading effect for economic load dispatch above purpose is to reduce the consumption of fuel and simultaneously reduce the cost factor. A simple and efficient algorithm is proposed for solving the economic dispatch problem of power system with valve In point discontinuities employing a particle swarm optimization based approach. Evolutionary methods such as GA and PSO are known to perform better than conventional gradient based optimization methods for non-convex optimization problems. The performance of the proposed method has been compared with Real-coded genetic algorithm (RGA) results for validation. The effectiveness of the algorithm has been tested on a test system having three generating.

Key words: ABC Algorithm; Economic Optimization

I. INTRODUCTION

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.

This problem area has taken a subtle twist as the public has become increasingly concerned with environmental matters, so that economic dispatch now includes the dispatch of systems to minimize pollutants and conserve various forms of fuel, as well as achieve minimum cost. In addition there is a need to expand the limited economic optimization problem to incorporate constraints on system operation to ensure the security of the system, thereby preventing the collapse of the system due to unforeseen conditions. However closely associated with this economic dispatch problem is the problem of the 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.

A. Economic Load Dispatch

ECONOMIC dispatch is one of the main functions of modern energy management system. It is formulated as an optimization problem with the objective of minimizing the total fuel cost while satisfying the specified constraints. Conventionally, input-output characteristics of generators, known as cost functions, are approximated using quadratic or piecewise quadratic functions, assuming that the incremental cost curves of generators are monotonically increasing [1]. However, in practice, this assumption is not valid because the cost functions exhibit higher order non-linearities and discontinuities due to valve point loading effects in units fired by fossil fuels [2].

The cost function needs to be more realistically expressed as a piecewise non-linear function rather than a single quadratic function. The ELD problem with valve point effects is denoted as a non-smooth optimization problem having complex and non-convex characteristics which make the challenge of obtaining the global minima, very difficult. Therefore, conventional gradient based optimization methods fail in such cases and result in inaccurate dispatches.

II. OBJECTIVES

The salient objectives of the present study have been identified as follows:

1) The economic load dispatch problems has been discussed.
2) Artificial bee colony algorithm (ABC) concept is explained. Benefits of ABC over conventional statistical methods are briefed. Basic parameters of ABC are explained
3) Research technology and algorithm to solved ELD problem

III. NEED FOR THE PROPOSED WORK

To resolve the problem of economic load dispatch during power generation

1) ABC Population based algorithm
2) Increase fuel efficiency.
3) Decrease the cost of fuel.
4) The efficient optimum economic operation and planning of electric power generation.

IV. LITERATURE REVIEW

In Author [32], author so economic load dispatch which 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 author presents a review of some methods for solving the economic load dispatch problem.

Economic load dispatch in electric power sector is an important task, as it is required to supply the power at the minimum cost which aids in profit-making. As the efficiency of newly added generating units are more than the previous units the economic load dispatch as to be efficiently solved for minimizing the cost of the generated power. In

comparison to conventional optimization techniques, PSO has given improved results. Author summarized the work reported in literature in the field of economic dispatch using many algorithms, but still further improvement in algorithms are required.

The Economic Dispatch(ED) problems [33], are the major consideration in electric power generation systems in order to reduce the fuel cost their by reducing the total cost for the generation of electric power. Author presents an Efficient and Reliable Firefly Algorithm (FA), for solving ED Problem. The main objective is to minimize the total fuel cost of the generating units having quadratic cost characteristics subjected to limits on generator true power output & transmission losses. The FA is a stochastic Meta heuristic approach based on the idealized behaviour of the flashing characteristics of fireflies. Author presents an application of the FA to ED for different Test Case system. ED is applied and compared its solution quality and computation efficiency to Simulated Annealing (SA), Genetic algorithm (GA), Differential Evolution (DE), Particle swarm optimization (PSO), Artificial Bee Colony optimization (ABC), and Biogeography-Based Optimization (BBO) optimization techniques. The simulation results show that the proposed algorithm outperforms previous optimization methods.

The proposed FA to solve ED problem by considering the practical constraints has been presented in Author. From the comparison table it is observed that the proposed algorithm exhibits a comparative performance with respect to other population based techniques. It is clear from the results that Biogeography Based Optimization algorithm is capable of obtaining higher quality solution with better computation efficiency and stable convergence characteristic. The effectiveness of FA was demonstrated and tested. From the simulations, it can be seen that FA gave the best result of total cost minimization compared to the other methods. In future, the proposed FA can be used to solve ED with considering the valve point effects, which is still in the progress of the research work.

In Author [34] Economic Load Dispatch (ELD) problems in power generation systems is to reduce the fuel cost by reducing the total cost for the generation of electric power. Author presents an efficient Modified Firefly Algorithm (MFA), for solving ELD Problem. The main objective of the problems is to minimize the total fuel cost of the generating units having quadratic cost functions subjected to limits on generator true power output and transmission losses. The MFA is a stochastic, Meta heuristic approach based on the idealized behaviour of the flashing characteristics of fireflies. Author presents an application of MFA to ELD for six generator test case system. MFA is applied to ELD problem and compared its solution quality and computation efficiency to Genetic algorithm (GA), Differential Evolution (DE), Particle swarm optimization (PSO), Artificial Bee Colony optimization (ABC), Biogeography-Based Optimization (BBO), Bacterial Foraging optimization (BFO), Firefly Algorithm (FA) techniques. The simulation result shows that the proposed algorithm outperforms previous optimization methods.

The proposed MFA to solve ELD problem by considering the practical constraints has been presented in Author. From the comparison table it is observed that the proposed algorithm exhibits a better performance with respect to all other techniques. The effectiveness of MFA was demonstrated and tested in this research. From the simulations, it can be seen that MFA gave the best result of total cost minimization compared to all other optimization methods. In future, the proposed MFA can be used to solve ELD considering the valve point loading effects.

Author [35], illustrates successful implementation of three evolutionary algorithms, namely- Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC) and Bacterial Foraging Optimization (BFO) algorithms to economic load dispatch problem (ELD). Power output of each generating unit and optimum fuel cost obtained using all three algorithms have been compared. The results obtained show that ABC and BFO algorithms converge to optimal fuel cost with reduced computational time when compared to PSO for the two example problems considered.

The application of PSO, ABC and BFO algorithms to constrained three-generator ELD problems has been successfully demonstrated with two examples. The test results show that ABC and BFO algorithms converge to optimal fuel cost with reduced computational time when compared to PSO. This is primarily due to the role of scout bees in ABC and the dispersal feature in BFO that introduce randomness during the optimization process resulting in significant computational time reduction. In further research work may focus on analysing convergence rates by applying variants of the aforementioned algorithms and developing novel algorithms with higher efficacy.

V. DESCRIPTION OF STRUCTURAL MODEL

A simple ABC was applied to find out the optimal generation allocation for thee generating unit [42] power system with power balance and unit operating constraint. The cost function defined by is employed as evaluation function of ABC. Cost coefficients and limits on generating units are listed in Table 6.1. The B coefficients for loss evaluation are given below.

$$[B] = \begin{bmatrix} 0.031 & 0.17 & 0.15 \\ 0.02 & 0.042 & 0.13 \\ 0.3 & 0.3 & 0.15 \end{bmatrix}$$

Steps which are followed for arriving at the optimal solution. The parameters employed for tuning ABC algorithm have been given in Table 6.2 and the GA parameters have been listed in Table 6.3. Result for three generating unit system for three different demand levels are compared with classical lamda iteration method and real coded GA.

VI. RESULTS & DISCUSSIONS

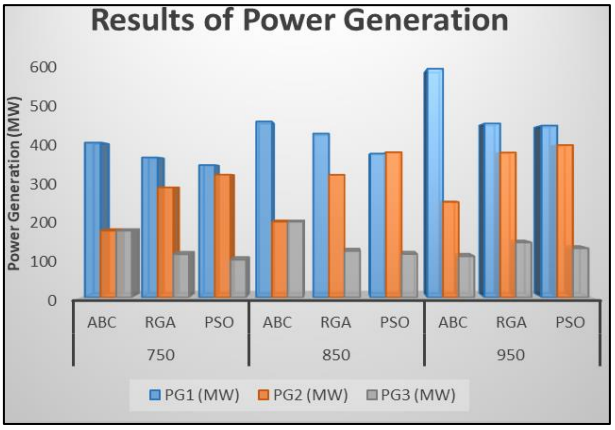

Fig. 1; Results of Generation Allocation

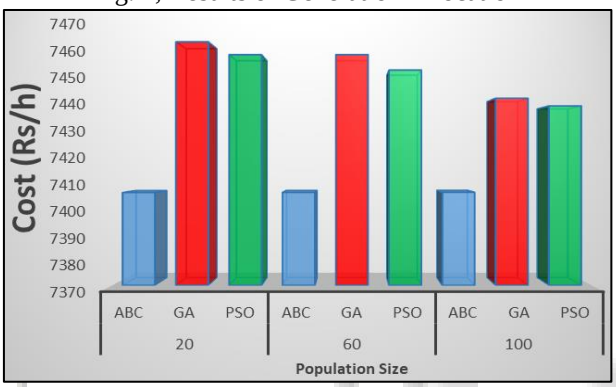

Fig. 2: Effect of Population Size on ABC Performance

VII. CONCLUSIONS

It is observed that these methods achieve solutions very near to the global minima, in a very short time due to their simplicity. ABC is found to produce high quality solution in a shorter time, as compared to RGA based approach. Test results demonstrate that the ABC algorithm is not much dependent on the initial population and size of population as it is able to achieve near global results for all the tested cases.

This research work compared with PSO and GA algorithm but our algorithm given best result from both method and it also has been shown by conducting different trials that the results obtained by ABC are quite consistent and have a small standard deviation from the average cost achieved.

VIII. FUTURE WORK

The generator cost function in this case is non smooth which makes the problem a complex one with multiple minima. And classical gradient based methods cannot be applied in such cases so develop a new method which can solved this problem.

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