ABC Analysis For Economic operation of power system

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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

Keywords— *ABC Algorithm; economic optimization;*

INTRODUCTION

In ABC, a population based algorithm, the position of a food source represents a possible solution to the optimization problem and the nectar amount of a food source corresponds to the quality (fitness) of the associated solution. The number of the employed bees is equal to the number of solutions in the population. At the first step, a randomly distributed initial population (food source positions) is generated. After initialization, the population is subjected to repeat the cycles of the search processes of the employed, onlooker, and scout bees, respectively. An employed bee produces a modification on the source position in her memory and discovers a new food source position. Provided that the nectar amount of the new one is higher than that of the previous source, the bee memorizes the new source position and forgets the old one. Otherwise she keeps the position of the one in her memory. After all employed bees complete the search process, they share the position information of the sources with the onlookers on the dance area. Each onlooker evaluates the nectar information taken from all employed bees and then chooses a food source depending on the nectar amounts of sources. As in the case of the employed bee, she produces a modification on the source position in her memory and checks its nectar amount. Providing that its nectar is higher than that of the previous one, the bee memorizes the new position and forgets the old one. The sources abandoned are determined and new sources are randomly produced to be replaced with the abandoned ones by artificial scouts. 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. A classical approach to solve the ELD problem with valve point loading is dynamic programming. [3] In which all possible solutions are enumerated while choosing for an optimal dispatch. This method suffers from the problem of dimensionality and excessive evaluation at each stage.

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

NEED FOR THE PROPOSED WORK

To resolve the problem of economic load dispatch during power generation

i) ABC Population based algorithm

ii) Increase fuel efficiency.

iii) Decrease the cost of fuel.

iv) The efficient optimum economic operation and planning of electric power generation.

LITERATURE REVIEW

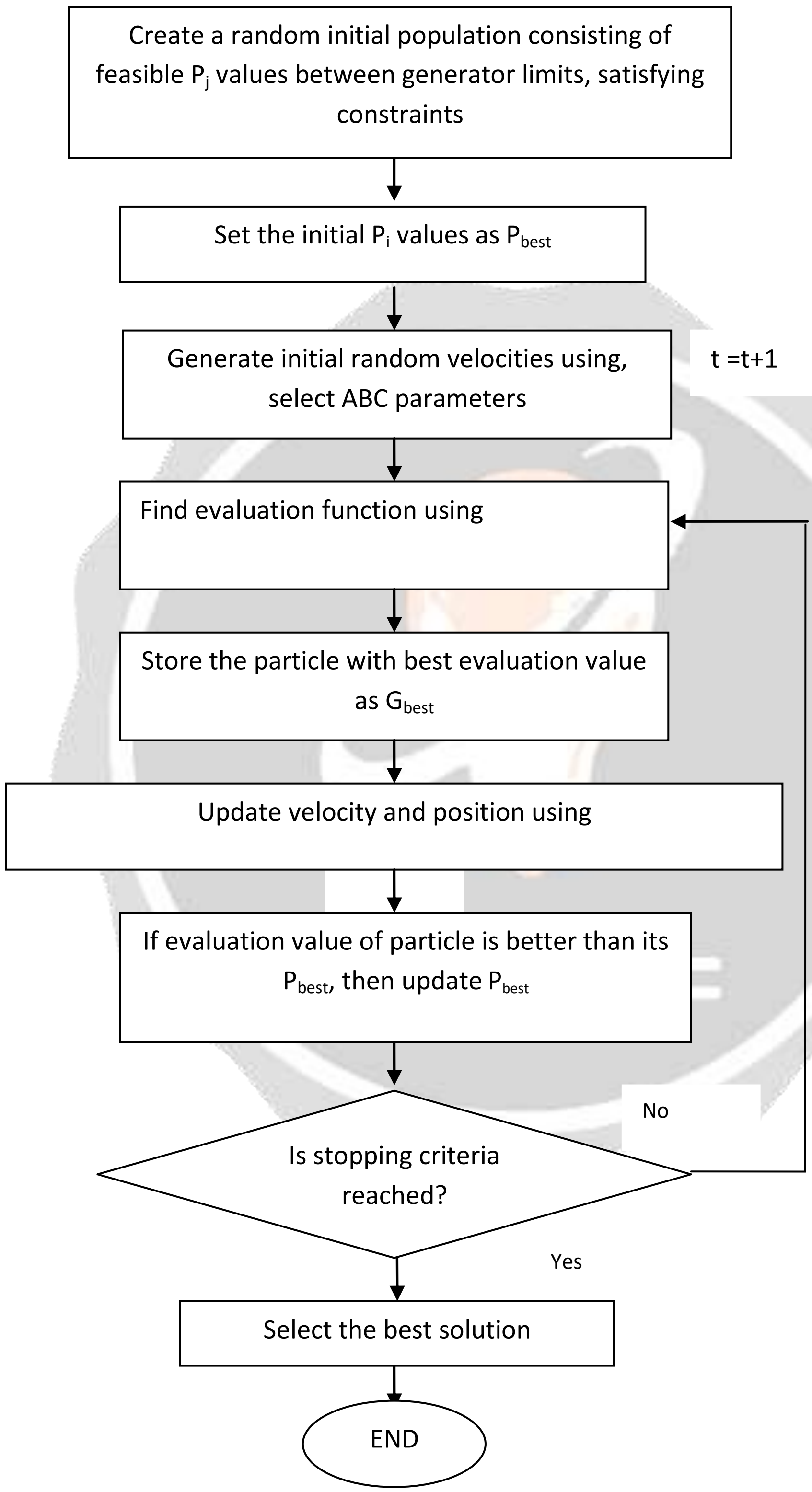
The increasing penetration of distributed generation resources demands better economic performance of micro grids under the smart-grid era. In Author [28], a comprehensive environmental-economic dispatch method for smart micro grids is proposed, with the objective for minimizing the summation of generation and emission costs in the system. As the proposed model belongs to a large-scale nonlinear and no convex programming problem, a hybrid heuristic algorithm, named variable step-size chaotic fuzzy quantum genetic algorithm (VSS QGA), is developed. The algorithm utilizes complementarity among multiple techniques including the variable step size optimization, the rotation mutational angle fuzzy control, and the quantum genetic algorithm and combines them so as to solve problems with superior accuracy and efficiency. The effectiveness of the proposed model is demonstrated through a case study on an actual micro grid system and the advantages in the performance of VSS QGA is also verified through the comparison with genetic algorithm(GA), the evolutionary programming approach (EP), the quantum genetic algorithm (QGA), and the chaotic quantum genetic algorithm (CQGA). They proposed EED model for SMG considers the minimization of generation and emission Costs as the objective while taking different constraints such as energy balance, operation limits of power sources, and network characteristics into account. To get faster and better optimization performance, without changing the searching mechanism of the QGA, VSS QGA introduces the variable step size optimization and the rotation mutational angle fuzzy control method into the algorithm, which improves the evolution speed and enables the optimization immune to the local optima. The effectiveness of the proposed methods is confirmed by comparing the results with the most recently reported literatures, including QGA, EP, and GA. The corresponding results show that the optimal scheduling plan obtained by the proposed EED model will produce greater economic benefit and social benefits, particularly for the large-scale applications. Furthermore, VSS QGA has superior convergence, robustness, and less computational complexities as compared to other methods.

In Author [29], Economic Dispatch is an important optimization task in power system. It is the process of allocating generation among the committed units such that the constraints imposed are satisfied and the energy requirements are minimized. More just, the soft computing method has received supplementary concentration and was used in a quantity of successful and sensible applications. Here, an attempt has been made to find out the minimum cost by using Particle Swarm Optimization (PSO) Algorithm using the data of three generating units. In this work, data has been taken such as the loss coefficients with the max-min power limit and cost function. PSO and Simulated Annealing (SA) are applied to find out the minimum cost for different power demand. When the results are compared with the traditional technique, PSO seems to give a better result with better convergence characteristic. All the methods are executed in MATLAB environment. The effectiveness and feasibility of the proposed method were demonstrated by three generating unit's case study. The experiment showed encouraging results, suggesting that the proposed approach of computation is capable of efficiently determining higher quality solutions addressing economic dispatch problems. Author [30], presents a Biogeography-Based Optimization (BBO) algorithm to solve various types of Economic Load Dispatch (ELD) problems of the thermal power plants in a power system. The proposed methodology can handle economic load dispatch problems having constraints like transmission losses, prohibited operating zones, etc. Biogeography basically is the science of geographically distribution of the biological species. The mathematical model of the biogeography describes the process how species arise, migrate from one place to another and gets vanish

BASIC THEORY OF ELD AND ABC

The Engineers have been very successful in increasing the efficiency of boilers, turbines and generators so continuously that each new added to the generating unit plants of a system operates more efficiently than any older unit on the system. In operating the system for any load condition the contribution from each plant and from ach unit within a plant must be determined so that the cost of the delivered power is a minimum.

Proposed ABC algorithm for ELD



MODEL CONSIDERED FOR ANALYSIS

ABC based ELD solution

Economic load dispatch problem is allocating loads to plants for minimum cost while meeting the constraints. It is formulated as an optimization problem of minimizing the total fuel cost of all committed plant while meeting the demand and losses .The variants of the problems are numerous which model the objective and the constraints in different ways. The basic economic dispatch problem can described mathematically as a minimization of problem of minimizing the total fuel cost of all committed plants subject to the constraints.

Step 1. In the ELD problem the number of on-line generating units is the 'dimension' of this problem. The particles are randomly generated between the maximum and the minimum operating limits of the generators. For example, if there are *N* units, the i^{th} particle is represented as follows:

$$P_i = \left(P_{i1}, P_{i2}, P_{i3}..................P_{iN}\right) \quad (5.4)$$

These initial particles must be feasible solutions of the problem.

$$Minimize \sum_{i=1}^{n} \mathrm{F_i}(P_i) \quad (5.5)$$

$F_i(P_i)$ is the fuel cost equation of the 'i'th plant. It is the variation of fuel cost ($ or Rs) with generated power (MW).Normally it is expressed as continuous quadratic equation.

$$F_{ij}(P_i) = a_i P_i^2 + b_i P_i + c_i, \quad P_i^{\min} \le P_i \le P_i^{\max} \quad (5.6)$$

The total generation should meet the total demand and transmission loss. The transmission loss can be determined form either B_{mn} coefficients or power flow.

$$\sum_{i=1}^{n} P_i = D + P_l \quad (5.7)$$

$$P_l = \sum_{i}^{n} \sum_{j}^{n} B_{ij} P_i P_j \quad (5.8)$$

Step 2. Choose a reference plant .Here we consider a first plant. Convert the constrained optimization problem as an unconstrained problem by manipulating the equations 5.7 & 5.8.

Step 3. Now the problem has only n-1 variable unconstrained problem.

$$Minimize$$

$$\sum_{i=1}^{n} \mathrm{F_i}(P_i) + 1000 * abs(\sum_{i=1}^{n} P_i - D - \sum_{i=1}^{n} \sum_{j=1}^{n} B_{ij} P_i P_j)$$

Step 4. These values are set as the initial Pbest value of the Particles.

Step 5. The best value among all the Pbest values, gbest, is identified.

Step 6. New velocities for all the dimensions in each particle are calculated using Eq. (5.1).

Step 7. The position of each particle is updated using Eq. (5.2).

Step 8. The objective function values are calculated for the updated positions of the particles. If the new value is better than the previous Pbest, the new value is set to Pbest.

Step 9. If the stopping criteria are met, the positions of particles represented by gbest are the optimal solution.

RESULTS

Experimental Results

Variable / Generator	ai	bi	Ci	ei	fi	Pimax	Pimin
Unit1	.00156	7.92	561	300	.031	600	100
Unit2	.00194	7.85	310	200	.042	400	100
Unit3	.00482	7.97	78	150	.063	200	50

Table ,1 Generator Operating Limits and Cost Coefficients

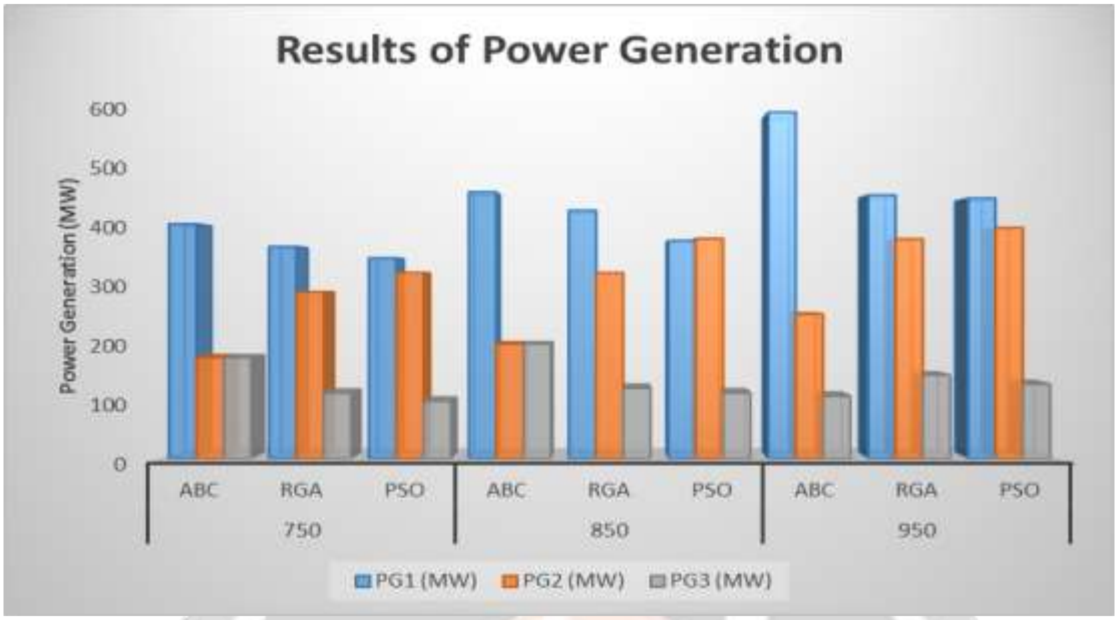


Fig.1. Results of generation allocation

CONCLUSIONS

This Thesis presents an Artificial Bee Colony (ABC) Algorithm based approach for solving the economical dispatch problem. The generator cost function in this case is non smooth which makes the problem a complex one with multiple minima. Classical gradient based methods can not be applied in such cases. On the other hand, evolutionary programming methods such as GA and ABC due to their stochastic nature, do not always converge to the same minima. However, 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.

REFERENCES

[1] A.J. Wood and B.F. Wollenberg, "Power generation, operation and control", (Book), New York, Wiley, 1984.

[2] N.Sinha, R.Chakrabarti, and P.K.Chattopadhyay, "Evolutionary programming techniques for economic load dispatch", IEEE Transactions on Evolutionary Computation, vol. 7, No. 1, February 2003, pp. 83-94.

[3] R.R. Shoults et al, "A dynamic programming based method for developing dispatch curves when incremental heat rate curves are non-monotonically increasing", IEEE Trans. Power system., vol 1, February 1986, pp.10-16.

[4] D.C. Walter and G. B. Sheble, "Gentic algorithm solution of economic load dispatch with valve point loading" , *IEEE Trans Power Syst*., vol. 8, pp.1325-1332, Aug 1993.

[5] Ioannis G Damousis, Anastasios G. Bakirtzis and Petros S. Dokopolous, "Network constrained economic dispatch using real-coded genetic algorithms", *IEEE Trans. Power system*,. Vol. 18, no. 1, Feb. 2003, pp.198-205.

[6] P. Venkatesh, R. Gnannadassa and E. Pandimeena, "G. Ravi, R. Chakrabarti and S. Choudhary, "A, improved evolutionary programming based economic load dispatch of generators with prohibited operating zones" , *Journal of institution of engineers(India)*, pt EL,vol 86, pp. 39-44, June2005.

[7] A. Pereira-Neto, C. Unsihuay and O.R.Saavedra, “Efficient evolutionary strategy optimization procedure to solve the non-convex economic dispatch problem with generator constraints”, IEE proceeding, Generation, Transmission and Distribution, vol. 152, No. 5, September 2005, pp. 653-660.

[8] D.N.Jeyakumar, T. Jayabarathi,and T. raghunathan, “Particle swarm optimization for various types of economic dispatch problems”, *International Journal of Electric Power and Energy Systems*, Vol.28, No 1, 2006, pp.36-42.

[9] A.J. Wood and B.F. Wollenberg, Power Generation, Operation, and Control, John Wiley and Sons., New York (1984).

[10] P. Aravindhababu and K.R. Nayar, Economic dispatch based on optimal lambda using radial basis function network, Elect. Power Energy Syst,. 24 (2002), pp. 551–556.

[11] IEEE Committee Report, Present practices in the economic operation of power systems, IEEE Trans. Power Appa. Syst., PAS-90 (1971) 1768–1775.

[12] B.H. Chowdhury and S. Rahman, A review of recent advances in economic dispatch, IEEE Trans. Power Syst, 5 (4) (1990), pp. 1248–1259.

[13] J.A. Momoh, M.E. El-Hawary and R. Adapa, A review of selected optimal power flow literature to 1993, Part I: Nonlinear and quadratic programming approaches, IEEE Trans. Power Syst., 14 (1) (1999), pp. 96–104.

[14] D.C. Walters and G.B. Sheble, Genetic algorithm solution of economic dispatch with valve point loading, IEEE Trans. Power Syst., 8 (August (3)) (1993), pp. 1325–1332.