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A Review on Combined Economic Load and Emission Dispatch Problem

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***Abstract* - Economic load dispatch is one of the main functions of electrical power management systems. The main objective of economic load dispatch is to minimize the fuel cost while satisfying the required equality and inequality constraints. Economic Load Dispatch is a well known problem and has been a major concern for researchers and industrialists all around the world. The problem consists of division of formulation of the model for fuel consumption and then development of the minimizing algorithm and applying the same on the economic load dispatch problem. It is not as simple as is sounds as the solutions not only have to find the global minima but also are constrained. Thus it forms a constrained optimization problem.**

***Index terms* - load dispatch, CEED, EED.**

I. INTRODUCTION

The economic dispatch problem relates to optimum generation scheduling of present generators in power system to minimize total fuel cost while to satisfy the load demand and operational constraints. The economic dispatch problem plays a vital role in planning operation and control of the modern power systems. The goal of emission dispatch is to determine the generation schedule that has the minimum emission cost. Thus, we are facing with a bi-objective optimization problem to deal with. Traditionally, electric utilities dispatch generation using minimum fuel cost as the main criterion. However the best economic dispatch does not lead to minimum emission and vice versa. The two criteria are contradictory to each other and are in trade-off relationship. It therefore makes it difficult to handle such problem by conventional approaches that optimize a single objective function. One feasible approach to solve this kind of problem using conventional optimization method is to convert the bi-objective into a single objective function by giving relative weighting values. In this case the emission dispatch is added as a second objective to the economic dispatch problem which leads to Combined Economic Emission Dispatch (CEED). Environmental issues add complexity to the solution of the economic dispatch problem due to the nonlinear characteristics of the mathematical models used to represent emissions. In addition, the Economic Emission Dispatch (EED) problem can be complicated even further if non-smooth and non-convex fuel cost functions are used to model generators, such as valve-point loading effects. All these considerations make the EED problem a highly nonlinear and a multimodal optimization problem. Over last few years, a number of approaches were developed for solving operation using classical mathematical programming methods. Moreover, classical optimization methods are largely sensitive to initial point and converge frequently to local optimization solution or diverge altogether. Linear programming methods are fast and reliable but main disadvantages associated with the piecewise linear cost approximation.

The bibliographical study on economic load dispatch suggests, lately as opposed to the mathematical techniques, various heuristic optimisation strategies similar as genetic algorithm and variant real-coded Gravitational Algorithm, tabu search, simulated annealing, ant colony optimisation, fuzzy systems, neural network, particle swarm optimisation, hybrid evolutionary programming and biogeography-based optimisation have capable of generating high-quality economic load dispatch solutions. Although heuristic techniques did not guarantee to discover globally the optimal solutions in the finite time, they mainly offer fast and reasonable solutions. After analyses existing methods like Hopfield neural network do consider piecewise quadratic prohibited zones and fuel cost, the convergence rate are slow causing usage of sigmoid function. Gravitational Algorithm method is usually mainly faster than SA tech due to parallel search capabilities. Although, when objective parameters were highly related to each other, the chromosomes tend to express the similar structure and average fitness become higher. Although Gravitational search algorithm is capable of generating good solution, however, the performance is largely dependent on parameter sensitivity or balancing between the local and global search capabilities. Most of the methods are mentioned above used quadratic fuel cost that is an approximation of higher order fuel cost.

1.1 Load Dispatch Problem

The objective of economic load dispatch operation is to decrease the generation cost that usually comprises fuel cost. It considers the valve-point effects of complementary component of an objective function. Thus the objective function is defined as superposition of quadratic function and sinusoidal functions. The quadratic fuel cost function can be shown as

$$FC_i(P_i) = a_i + b_iP_i + c_iP_i^2 \quad (1)$$

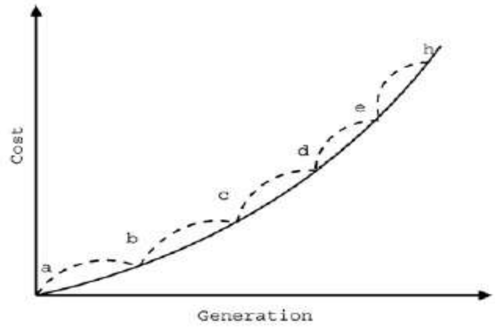

Fig.1: Load Flow Problem

where FC_i is the fuel cost function of generation i= a_i, b_i and c_i Cost function curve for economic load dispatch operation with the valve-point effect are cost coefficients of generator i and P_i displays the power of ith generator. The dotted-line is generated to consider the valve-point effects. The sharp increase in losses causing wire drawing effects results in phenomena. In order to explain such sinusoidal functions, effects are added with fuel cost function. Therefore using the modified cost function is used, which is

$$FC_i(P_i) = a_i + b_iP_i + c_iP_i^2 + |e_i \times \sin(h_i \times (P_i^{\min} - P_i))| \quad (2)$$

e_i and h_i are valve-point effects coefficients of fuel cost for ith generator. Since generation extends over specific period of time, the real objective of economic load dispatch is to decrease total production cost, which is displayed.

$$F = \min \sum_{t=1}^{T} \sum_{i=1}^{N} FC_i(P_i(t)) \quad (3)$$

Although, all formulations extended to produce the more accurate result with minimum approximation to consider higher order of fuel cost function. This scenario is taken by simply reforming

$$FC_i(P_i) = \sum_{j=1}^{\phi} \alpha_i^j P_i^j \quad (4)$$

Where f is a order of fuel cost function.

II. LITERATURE SURVEY

In this paper, **Balamurugan R** proposed an efficient scheme with hybrid integer differential evolution – dynamic programming approach is used to solve economic dispatch problem with several fuel options. A dynamic programming has based on the simplified recursive algorithm which has developed for a fixed scheduling of generating units in economic dispatch problem. The hybrid approach has been developed that an ICDE is working as a optimizer to search an optimal fuel options, and the dispatch problem is acting to search the fitness of agent in population of the integer coded differential evolution that makes a fast decision to direct search towards fixed region. In this paper, **Apostolopoulos, Theofanis** proposed a reliable and efficient power production which is important to meet both profitability of the power systems electricity demand and operations, taking into account concerns about emissions generated by fossil-fuelled power plants. The economic load dispatch problems have defined and apply a deal with optimization of two conflicting objectives, which minimizes both emission and fuel cost of generating units. It describes a solution to famous problem while using a newest meta heuristic nature-inspired algorithm, which is called firefly algorithm. In this paper, **Rayapudi, S. Rao et.al** proposed ELD is a technique to determine low-cost, reliable operation and most efficient power system to dispatch present electricity generation resources to transfer the load on system. The main objective of economic dispatch is to decrease total cost of generated operational constraints of presently generation resources.

In this paper, **Sinha, Nidul et.al** proposed a hybrid method which integrates the all major features of evolutionary programming and gravitational search algorithm for solution of non-convex ELD problems having non-linearities such as valve point loadings. In this paper, **Park, J** proposed a method to solve a problem of EPD with the piecewise quadratic cost function while using

Hopfield neural network. Additionally a cost function for each generator is supposed. Though more realistic to display cost function as piecewise quadratic function rather to the convex function. In this paper, **Baskar, G**. proposed an objective to involve effective and simple methods to economic load dispatch problem with security constraints in thermal units that are obtaining economic scheduling for the utility system. In this, improved gravitational search algorithm method, a newest velocity equation has been formulated for large scale system or characteristics of constriction factor approach are also incorporated into this approach. In this paper, **Basu, M**. proposed multi-objective optimization technique for ELD of fixed thermal plants and head hydro plants with emission level functions and non-smooth fuel cost is presented. The problem deals with economic and emission as the competing objectives.

In this method, **Bhattacharya Aniruddha** proposed biogeography-based optimization algorithm to solve non-convex and convex economic load dispatch problems of thermal generators of power system. The methodology easily takes care to solve non-convex economic dispatch problems to consider individual constraints like ramp rate limits, transmission losses prohibited operating zones and multi-fuel options. In this thesis **Chakraborty.S**. Proposed the ELD a vital part in economic operation of power system. The Economic load dispatch problem is a non-linear constrained optimization problem. This problem has become non-smooth and non-convex when generators' have valve-point effect and prohibited zones. In this paper, **Nanda. J** Proposed emission load dispatch problem that measures for minimization both emission and cost which is multiple, conflict objective of function problem. A goal programming technique has suitable for these type of problems. In this, emission load dispatch problem can be solved with non-linear and linear goal programming algorithms. The application and validity of the proposed algorithms are demonstrated for a system having six generators.

III.CONCLUSION

REFERENCES

[1] Balamurugan, R., and S. Subramanian. "Hybrid integer coded differential evolution–dynamic programming approach for economic load dispatch with multiple fuel options." *Energy Conversion and Management* 49.4 (2008): 608-614.
[2] Apostolopoulos, Theofanis, and Aristidis Vlachos. "Application of the firefly algorithm for solving the economic emissions load dispatch problem."*International Journal of Combinatorics* 2011 (2010).
[3] Rayapudi, S. Rao. "An intelligent water drop algorithm for solving economic load dispatch problem." *International Journal of Electrical and Electronics Engineering* 5.2 (2011): 43-49.
[4] Sinha, Nidul, and B. Purkayastha. "GSA embedded evolutionary programming technique for nonconvex economic load dispatch." *Power Systems Conference and Exposition, 2004. IEEE PES*. IEEE, 2004.
[5] Baskar, G., and M. R. Mohan. "Security constrained economic load dispatch using improved gravitational search algorithm suitable for utility system."*International Journal of Electrical Power & Energy Systems* 30.10 (2008): 609-613.
[6] Basu, M. "A simulated annealing-based goal-attainment method for economic emission load dispatch of fixed head hydrothermal power systems." *International Journal of Electrical Power & Energy Systems* 27.2 (2005): 147-153.
[7] Bhattacharya, Aniruddha, and Pranab Kumar Chattopadhyay. "Solving complex economic load dispatch problems using biogeography-based optimization." *Expert Systems with Applications* 37.5 (2010): 3605-3615.
[8] Park, J. H., et al. "Economic load dispatch for piecewise quadratic cost function using Hopfield neural network." *Power Systems, IEEE Transactions on* 8.3 (1993): 1030-1038.
[9] Chakraborty, S., et al. "Solving economic load dispatch problem with valve-point effects using a hybrid quantum mechanics inspired particle swarm optimisation." *Generation, Transmission & Distribution, IET* 5.10 (2011): 1042-1052.