Research Paper

Volume : 4 | Issue : 4 | April 2015 • ISSN No 2277 - 8179

A Technological Literature Survey on Economic Load Dispatch Using Different Techniques

Engineering

KEYWORDS : Economic load dispatch, Fuel Cost, Genetic Algorithm

CHIRAGKUMAR K. PATEL	Electrical power system, LDRP Institute of Technology and Research, Gandhinagar (GUJARAT)
RAKESHKUMAR B. SHAH	Lecturer, Electrical Engineering Department, R. C. Technical Institute, Sola, Ahmedabad
MINAXI L. PATEL	Assistant Professor, Electrical Engineering Department, Government Engineering College, Dahod. (GUJARAT)

ABSTRACT

Economic load dispatch (ELD) is a process of finding optimal generation scheduling of available generators in an interconnected power system to meet the demand on the system, at lowest possible cost, while satisfying various operational constraints on the system. This paper presents introduction of economic load dispatch. Also presents technical review on economic load dispatch using different techniques.

1.INTRODUCTION

Economic load dispatch (ELD) problem is the one of the most important optimization problem in power system. Main goal of economic load dispatch problem is allocation of power generation to different thermal units to minimize total fuel cost while satisfying the load demand and operating constraints. Traditionally in ELD problems, the cost function for generating units has been approximated as a quadratic function[1].

Several techniques have been introduced to solve the optimization of ELD, which can be divided into conventional and stochastic methods. Conventional methods use a deterministic approach, such as the LaGrange multiplier, Linear Programming (LP) and Dynamic Programming (DP) [2]. These methods have limitations or drawbacks when coping with more complex problems. The DP method has a problem when the number of generators is increased and higher accuracy is needed [3].

Recent techniques have been developed using stochastic approaches for solving optimization problems. Examples are an Adaptive Hopfield Neural Network [4], the Simulated Annealing method [5], and Genetic Algorithms (GA), amongst others. These new methods offer alternative techniques which attempt to overcome the drawbacks of conventional methods.

2. LITERATURE REVIEW

Allen J. Wood & Bruce F. Wollenberg analyzed that the basic purpose of economic operation of power system is to reduce fuel cost for the operation of power system, economic operation is achieved when the generation in system share load to minimize overall generation cost. The main economic factor in the power system operation is the cost of generating real power.

K. F. Man, Member, IEEE, K. S. Tang, and S. Kwong, Member, IEEE(1996) analyzed that genetic algorithms (GA) as a complete entity, in which knowledge of this emerging technology can be integrated together to form the framework of a design tool for industrial engineers. An attempt has also been made to explain "why" and "when" GA should be used as an optimization tool. He concluded that attempt to outline the features of GA in terms of the genetic functionality of operators, the problem formulation, the inherent capability of GA for solving complex and conflicting problems, as well as its various practical applications, is given in this paper.

W.Warsono, Dr.C.S.Ozveren, Dr,David J King,Prof. D. Bradley (2008)
analyzed that this paper presents a review of many previous papers on the use of genetic algorithms (GA) for solving the problem of economic load dispatch (ELD) for power systems. He concluded that Due to its attractive properties, the GA has become very popular for use in various power system applications, including ELD. The other interesting point is that the GA method can be easily improved and combined with other methods, such as the Simplex Technique from the Direct Search method, Fuzzy systems, ANN, amongst others, forming a hybrid method. By using a hybrid method, the advantages or superior properties of other methods can be utilized to increase the capability and effectiveness of the GA. However, the hybrid GA algorithms become more complicated than those of simple GA methods.

Sunil Kumar Sing, Lobzang Phunchok , Khwairakpam Chaoba singh , Y R Sood(2012) analyzed that this paper presents an efficient optimization method to solve economic load dispatch problem using Genetic Algorithm (GA), which is a heuristic technique for solving computational problems. Genetic Algorithm is a stochastic searching algorithm which is inspired from the mechanics of genetic and natural selection. The proposed technique is tested and analyzed on 3 generating unit system and results are compared with other methods. The comparison shows that the proposed technique has merits in obtaining optimal solution. . He concluded that proposed method (Genetic Algorithm) is easier and computational efficiency is better as compared to conventional methods.

Koustav Dasgupta , Sumit Banerjee (2014) analyzed that the economic load dispatch (ELD) plays an important role in power system operation and control. Different techniques have been used to solve these problems. Recently, the soft computing techniques have widely used in practical applications. This paper shows successful implementation of four evolutionary algorithms, namely particle swarm optimization (PSO), particle swarm optimization with constriction factor approach (PSOCFA), particle swarm optimization with inertia weight factor approach (PSOIW A) and particle swarm optimization with constriction factor and inertia weight factor approach (PSOCFIWA) algorithms to economic load dispatch problem. Power output of each generating unit and optimum fuel cost obtained using all four algorithms have been compared. He concluded that the test results shows that PSOCFA algorithm converge to optimal fuel cost.

Rahul Dogra , Nikita Gupta , Harsha Saroa(2014) analyzed that Economic Load Dispatch (ELD) is one of an important optimization tasks and operational decision which provides an economic condition for power systems. This paper presents overview of economic load dispatch problems and solution methodologies. MATLAB program-

ming of different methods used for solving economic load dispatch problem was done and results are given in tabular form. Lambda iteration method is implemented for three cases of (1) Without generation limits and losses (2) With generation limits and without losses and (3) With generation limits and losses. Newton's and the dynamic programming methods were put into action for coding. He concluded that Conventional method like lambda iteration method converges rapidly but complexities increases as system size increase also lambda method always requires that one be able to find the power output of a generator, given an incremental cost for that generator.

Arunpreet Kaur, Harinder Pal Singh and Abhishek Bhardwaj(2014) analyzed that Genetic algorithm is a versatile method in the field of optimization over the past few years. This paper presents an economic load dispatch problem of thermal generator using Genetic Algorithm (GA) method. The proposed method has been applied on 3 generator system and 6 generator systems. The system considered here is the lossless system. The results obtained show a significant improvement in generator fuel cost while at the same time satisfying various equality and inequality constraints. He concluded that genetic algorithm is capable of optimizing any kind of problems irrespective of load demand.

3. ECONOMIC LOAD DISPATCH

3.1 Economic load dispatch

The Economic Dispatch can be defined as the process of allocating generation levels to the generating units, so that the system load is supplied entirely and most economically. For an interconnected system, it is necessary to minimize the expenses. The economic load dispatch is used to define the production level of each plant, so that the total cost of generation and transmission is minimum for a prescribed schedule of load. The objective of economic load dispatch is to minimize the overall cost of generation.

3.2 Generator Operating Cost

The total cost of operation includes the fuel cost, cost of labour, supplies and maintenance. Generally, costs of labour, supplies and maintenance are fixed percentages of incoming fuel costs. The power output of fossil plants is increased sequentially by opening a set of valves to its steam turbine at the inlet. The throttling losses are large when a valve is just opened and small when it is fully opened.

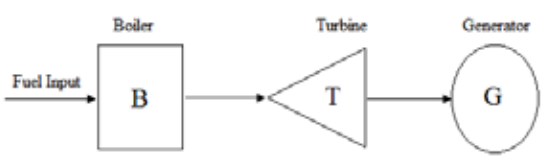
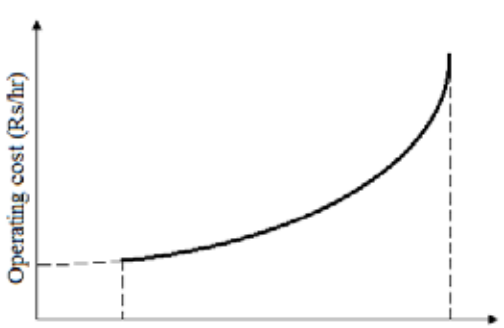


Figure 1 Simple model of a fossil plant

Figure 1.shows the simple model of a fossil plant dispatching purposes. The cost is usually approximated by one or more quadratic segments. The operating cost of the plant has the form shown in Figure 2.



P_{gi} min P_{gi} max**Figure 2 Operating costs of a fossil fired generator**

The fuel cost curve may have a number of discontinuities. The discontinuities occur when the output power is extended by using additional boilers, steam condensers, or other equipment. They may also appear if the cost represents the operation of an entire power station, and hence cost has discontinuities on paralleling of generators. Within the continuity range the

incremental fuel cost may be expressed by a number of short line segments or piece-wise linearization. The Pgi min is the minimum loading limit below which, operating the unit proves to be uneconomical (or may be technically infeasible) and Pgi max is the maximum output limit[6].

4. PROBLEM FORMULATION

4.1 Objective Function

The objective of the economic dispatch problem is to minimize the total fuel cost while satisfying the constraints.

Fuel cost function of each thermal generating unit is expressed as a quadratic function. In terms of real power output, total cost can be expressed as the following

F(Pgi)=aiPgi*2+biPgi+ciRs/ hr.....(1)

Where ai, bi, ci, are cost coefficients for ith unit. Fi(Pgi) is the total cost of generation. Pgi is the generation of ith unit.

4.2 Constraints

4.2.1 Power balance constraints

Generated power should be the same as the total load demand PD (in MW). In this case, the active power balance is given by

PD = ...
..(2)

The transmission and generator losses have been neglected.

4.2.2 Generation limits

The output power of each generating unit has a lower and upper bound so that it lies in between these bounds.

$P_{gi\ min} \le Pgi \le Pgi\ max$ .....(3)

Where Pgi min and Pgi max are the minimum and maximum output of generator i, respectively.

5. CONCLUSION

This paper gives overview of economic load dispatch problems and solution methodologies.

Also studied literature survey on Economic load dispatch using different techniques.

Volume : 4 | Issue : 4 | April 2015 • ISSN No 2277 - 8179

REFERENCE

[1] Koustav Dasgupta , Sumit Banerjee. "An Analysis of Economic Load Dispatch using Different Algorithms". Proceedings of 2014 1st International Conference on Non Conventional Energy (ICONCE 2014). | | [2]. Deschamps, D.. Optimization in power system planning. In: El-Abiad, AH. Ed. Power system analysis and planning. London: Hemishpere Publishing Corporation. 1981. Pp.201-208 | | [3]. Bakirtzis, A. etal. Genetic algorithm solution to the economic dispatch problem. IEE proceedings- generation, transmission and distribution. Jul 1994. Volume: 141. Issue: 4. pp.: 377-382 | | [4]. Lee, K.Y. etal. Adaptive hopfield neural network for economic dispatch. IEEE transactions on power systems. Vol. 18, NO. 2. Feb. 2003 pp. 519-529 | | [5]. Simopoulos, D., and Contaxis, G. 2004. Unit commitment with ramp rate constraint using stimulated annealing algorithm. IEEE Melecon. May 12-15. Dubrovnik, Croatia. Pp. 845-849 | | [6]. Arunpreet Kaur,Harinder Pal Singh, Abhishek Bhardwaj, "Analysis of Economic Load Dispatch Using Genetic Algorithm",Interational Journal Of Application or Innovation in Engineering & Management,Volume 3,Issue 3, March 2014 | | [7]. J. Wood and B. F., "Wollenberg, Power generation, operation and control", New York: John Wiley Inc., 1984.