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ECONOMIC LOAD DISPATCH USING PARTICLE SWARM OPTIMIZATION-A REVIEW

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Abstract— Economic load dispatch is one of the primary functions of power system management. The objective of economic load dispatch is to minimize the fuel cost while maintaining the required Constraints of power system. Economic Load Dispatch is a commonly known challenge in front of power system operators and a major concern for researchers and industrialists across the world. The economic dispatch problem plays a vital role in planning operation and control of the modern power systems. The goal of ELD is to determine the generation schedule that has the minimum emission cost. Over last few years, a number of approaches were developed for solving operation using classical mathematical programming methods. In this paper a bibliographical survey of ELD problem related literature is given.

Keywords – ELD, Genetic Algorithm, PSO

I. INTRODUCTION

The primary concern of power system is to generate electrical energy at minimum cost while satisfying all the limits imposed on generating units. Economic Load dispatch (ELD) is the one of the optimization problem in power industry. ELD discovers the solution of optimal power generation to have minimum generation cost while meeting the load demand. ELD is the method of determining the most efficient low cost and reliable operation of a power system by dispatching the available electricity generation resources to supply the load on the system. The main objective of ELD is to schedule the committed generating units output to meet the required load demand at minimum cost while satisfying all unit and system operational constraints. Conventionally various kinds of intelligent algorithms are widely used in ELD optimization because of their good global convergence and non-restricted by the object function, which include ant colony algorithm, simulated annealing algorithm, chaos algorithm and so on.

II. PARTICLE SWARM OPTIMIZATION

PSO is a fast, simple and efficient population-based optimization method which was proposed by Eberhart and Kennedy in the year 1995. It is an exciting new methodology in evolutionary computation and a population based optimization tool like Genetic algorithm. It has been motivated by the behavior of organisms such as fish schooling and bird flocking. It requires less computation time and less memory because of its inherent simplicity. The basic assumption behind the PSO algorithm is that birds find food by flocking and not in dividedly. This leads to the assumption that information is owned jointly in the flocking. The swarm initially has a population of random solutions. Particle Swarm has two primary operators: Velocity update and Position update. During each generation each particle is accelerated toward the particles previous best position and the global best position. At each iteration a new velocity value for each particle is calculated based on its current velocity, the distance from its previous best position, and the distance from the global best position. The new velocity value is then used to calculate the next position of the particle in the search space. This process is then iterated a set number of times or until a minimum error is achieved.

$$V_i^{j+1} = wV_i^j + C_1 * r_1 * P_i^j - X_i^j + C_2 * r_2 * GB_j - X_i^j \quad (1)$$

$X_i^{j+1} = X_i^j + V_i^{j+1}$
(2)
Where w is the inertia weight;
r_1 , r_2 = random values between 0 and 1;
C_1 , C_2 = acceleration constants;
j = iteration number
i = population

III. LITERATURE SURVEY

Bhattacharya A.et al. [1] presented a novel particle swarm optimizer combined with roulette selection operator to solve the economic load dispatch problem of thermal generators of a power system. Several factors such as quadratic cost functions with valve point loading, transmission Loss, generator ramp rate limits and prohibited operating zone are considered in the computation models. This new approach provided a new mechanism to restrain the predominating of super (global best) particles in early stage and can effectively avoid the premature convergence problem and speed up the convergence property

Ren Zihui et al. [2] modified the basic structure of the original PSO algorithm. It proposed that the particle's position have relationship with the one particle's and the whole swarm's perceive extent in the processing of this time and last time, and presents the inertial weight based on simulated annealing temperature. So New Particle Swarm Optimization algorithm (NPSO) was proposed. It cannot improve the one particle's and the whole swarm's perceivable extent and improve the searching efficient but also increase variety of particles and overcome the defect of sinking the local optimal efficiently. At the same time the convergence condition given for this new algorithm. The algorithm of PSO and NPSO and LPSO were tested with four well-known benchmark functions. The experiments showed that the convergence speed of NPSO was significantly superior to PSO and LPSO. The convergence accuracy was increased.

Omaranpour H. et al. [3] presented a local extremum escape approach to Particle Swarm Optimization (PSO) method. Here previous worst positions of the particles are also considered in he velocity update equation which makes the convergence of algorithm faster & capable to escape from local minimum. For many optimization problems where other PSO variants are stuck in local optimal solution, but the proposed method has been tested on standard bench mark functions and gave superior results.

Adhinarayanan T. et al. [4] presented an efficient and reliable particle swarm optimization algorithm for solving the economic dispatch problems with smooth cost functions as well as cubic fuel cost functions. The practical ED problems have non -smooth cost functions with equality and inequality constraints that made the problem of finding the global optimum difficult using any mathematical approaches. For such cases, the PSO was applied to the ED problems with real power of generator in a system as state variables. However when the incremental cost of each unit was assumed to be equal, the complexity involved in this may be reduced by using the incremental cost as state variables. The proposed PSO algorithm had been tested on 3 generator systems with smooth cost functions and 3 generator systems, 5 generator systems and 26 generator systems with cubic fuel cost function. The results were compared with genetic algorithm (GA) and showed better results and computation efficiency than genetic algorithm.

Ratnaweera Asanga , Halgamuge Saman K. [5] introduced a novel parameter automation strategy for the particle swarm algorithm and two further extensions to improve its performance after a predefined umber of generations. Initially, to efficiently control the local search and convergence to the global optimum solution, Time -varying acceleration coefficients (TVAC) were introduced in addition to the time varying inertia weight factor in particle swarm optimization. From the basis of TVAC, two new strategies were discussed to improve the performance of the PSO. First, the concept of Mutation was introduced to the Particle Swarm Optimization along with TVAC (MPSO-TVAC), by adding a small perturbation to a randomly selected modulus of the velocity vector of a random particle by predefined probability. Second, it had introduced a novel particle swarm concept "Self-organizing Hierarchical Particle Swarm Optimizer with TVAC (HPSO-TVAC)." Under this method, only the "social" part and the "cognitive" part of the article swarm strategy were considered to estimate the new velocity of each particle and particles were reinitialized whenever they were stagnated in the search space

Jun Sun et al. [6] introduced random drift particle swarm optimization (RDPSO) algorithm for solving economic dispatch ED problems of power system areas. This method is inspired by the free electron model in metal conductors placed in an external electric field and it employs a novel set of evolution equations that can enhance the global search ability of the algorithm. The proposed method is used in particle for optimizing the

generators' operation. The performance of the RDPSO method is evaluated on three different power system, and compared with that of other optimization method in terms of the solution quality, robustness, and convergence performance. The experimental results shows that the RDPSO method perform better in solving the ED problem that any other tested optimization techniques.

Karthikeyan V et al. [7] made an attempt 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 maximum 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 experiment showed encouraging results, suggesting that the proposed approach of computation is capable of efficiently determining higher quality solutions.

Bishnu Sahu et. al. [8] applied the evolutionary algorithm with transmission losses on IEEE 14 bus system and IEEE 30 bus system using MATLAB and find out the optimal fuel cost of the systems. They show the convergence graph for IEEE 14 bus test system, and represent best fitness and mean fitness in graph between fuel cost Vs generation. They also compare the best solution between Quadratic Programming (QP) and Genetic Algorithm (GA) in both systems.

F. Benhamida et al. [9] work with Economic load dispatch problem for 6 unit and 20 unit generation system including a renewable wind energy. Also compare the result of two different methods, which is particle swarm optimization and general algebraic modelling system (GAMS) and calculate the minimum generating cost of the system without calculating the active power transmission losses.

Vijay Kumar et. al. [10] works on genetic algorithm to solve Economic Load Dispatch Problem (ELD). This paper explain the terms involved in genetic algorithm to solve the ELD problems, also discuss about the formulation of economic load dispatch problem, and also explain the calculation of transmission losses in power system.

Chirag kumar K. Patel et. al. [11] applied the Lambda iteration method and genetic algorithm IEEE 30 bus system and find out the optimal solution of economic load dispatch (ELD)problem and compare the results. This implementation is done usingMATLAB programming.

Naveen Kumar et. al. [12] considered two different type of test systems like IEEE 30 bus system and also considered transmission losses of the system. In this paper short term scheduling of thermal generation is done for IEEE 30 bus system, and compare the results of that system with a Conventional method like lambda iteration method (LIM) or genetic algorithm and found better results from the Genetic Algorithm (GA).

IV. CONCLUSION

In this paper through survey of the previous literature in the field of ELD is presented with various optimization techniques. Mainly the application of evolutionary techniques like PSO, GA with various variants is discussed in the paper.

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