International Journal of Electrical and Electronics Engineers
Vol. No.8 Issue 01, January-June 2016
www.arresearchpublication.com
IJEEE ISSN 2321 - 2055

COMBINED HEAT AND POWER ECONOMIC DISPATCH USING HYBRID CONSTRICTION PARTICLE SWARM OPTIMIZATION

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ABSTRACT

The Combined Heat and Power Economic Emission Load Dispatch (CHPEED) is an optimization problem to minimize the cost and emission while ensuring the fulfilling the power and heat demand and feasible constraints. This paper presents Particle Swarm Optimization (PSO) technique and other to solve CHPEED with bounded feasible operating region. The main potential of this technique is that it proper the balance between global and local search. A comparative analysis of the (RCGA), (NSGAII), (SPEA2) is presented.

Keywords— Combined Heat and Power Economic Emission Load Dispatch (CHPEED), Combined Heat and Power Economic Load Dispatch (CHPED), Particle Swarm Optimization (PSO)

I INTRODUCTION

Combined Heat and Power is one of the most competent and reliable method for generation of heat and power. The generated heat can be efficiently used to support local industry development and thus increasing the overall efficiency of the power plant. In combined heat and power, the heat and power demands are to be met simultaneously which make the problems arising the Combined Heat and Power Economic Emission Dispatch more complex.

But generation of power from these fossil fuels result in release of various gases in the atmosphere. Main concern out of these gases is regarding the green house gases like NO_x, SO_x, and CO_2 that causes pollution in the environment. The emission of these pollutants causes global warming that affect not only humans but also other forms of living beings like plants and animals. Thus it is required to produce electricity at minimum possible cost as well as at minimum level of pollution. Combined heat and power economic emission dispatch using non-dominated sorting genetic algorithm-II.

II OPTIMIZATION TECHNIQUES

There are three types of optimization technique:

1. Classical method
2. Stochastic search techniques
3. Hybrid techniques

Classical method is totally dependent on the parameter selection i.e. the step size with which the number of iteration vary. Thus for any inappropriate value of step size, it drives the whole system to oscillations. Newton- raphson method can be used to obtain the solution of non-linear equation in which the problem of change in the control variables can be satisfied by using Taylor series expansion using hessian matrix [3]. All such mathematical programming based algorithms such as lambda iterative method, Lagrange relaxation, gradient based method etc does not prove to be applicable for non-linear or non-convex cost functions [2]. Such techniques involve a derivative approach which does not converge. Moreover constraint handling is an issue of interest which cannot be successfully met using mathematical programming techniques. Lung *et al.* [6] have presented ELD using direct search method. Dynamic programming provides an effective solution to handle the operating limits of generators. But DP approach fails to converge in case of highly dimensional problems. Thus, these classical methods does not provide solution in large scale optimization problem.

A new method based on recursive algorithm to solve the economic dispatch (ED) problem for thermal unit systems which involve combined cycle (CC) units was introduced by [13]. Benders decomposition (BD) algorithm was implemented for combined heat and power economic dispatch problems for cogeneration units [12]. In this method, CHPED problem divided into two parts as master and sub problem in which master problem, used as inequality constraint is added to the previous constraints and sub problem generates the Benders cuts. [10] Proposed PSO algorithm to solve ED problem with generation constraints in which non-linear characteristic of generator such as ramp rate limits, valve-point zones, and non smooth cost functions are considered for practical generator operation. The valve-point effect and multi-fuel effect of practice ED problem are represented as non-smooth and non-convex equality and inequality constraints therefore it become difficult to obtain the global optimal solution. PSO is an influential search technique, which is based on intelligence and search of the optimal solution is based on velocity of the particle but due to instability of the velocity particles, velocity is either rapidly raises or fall therefore the step size is increased and the search particle move out the search space. To overcome the problem [18] developed a term i.e. constriction factor, it can reduce the step size so, explosion is prevented and stability is ensured. The superiority of constriction factor PSO (CPSO) over inertia weigh PSO is showed in [19] in which the maximum velocity V_{max} is limited in dynamic range of the variable. Modified PSO (MPSO) is developed by [15] to overcome the non-smooth cost function problem in ED problem. To solve non-convex economic dispatch (NCED) problem [16] uses the PSO with time varying acceleration coefficient in which accelerating coefficient is varied to efficiently control the local and global search and to avoid premature convergence. [17] Implemented time varying acceleration coefficients particle swarm optimization (TVAC-PSO) algorithm is used to solve CHPED problem. In this approach the quality of original PSO and premature merging problem is reduced by varying the acceleration coefficients along the iterations [20] proposed CPSO to solve ELD problem with valve point loading effect which have non-smooth cost functions with equality and inequality constraints. [21] presented PSO with constriction factor and inertia weigh approach (PSO-CFIWA) algorithm is applied to IIR adaptive system design problem. CPSO is also applied in reactive power dispatch (RPD) problem to enhance the velocity of the particle and showed the better result is compared with standard PSO (SPSO) and inertia based PSO (IPSO) [22].

III METHOD USED(PSO)

Kennedy & Eberhart in 1995 introduced PSO which is stochastic search algorithm [9]. In the PSO, population is consisted of randomly initialized and moved around in the N- dimensional search space according to fitness function [10].

The velocity of the particle is given by

$$v^{k+1}_{i,j}=w\times v^{k}_{i,j}+C_1\times ran\times(X^{best}_{i,j}-X^{k}_{i,} \qquad (13)$$

The inertia weight (W) can be expresses as:

(14)

(15)

when (16)

$$v^{k+1}_{i,j}=K\times(w\times v^{k}_{i,j}+C_1\times ran\times(X^{best}_{i,j}-X^{k}_{i,j})+(\qquad (17)$$

The position of the particles keeps on updating by utilizing earlier positions and velocities

(18)

I. (I=1,2,3….PR;J=1,2,:

IV CONCLUSION

This paper has presented HCPSO algorithm for solving combined heat and power economic emission dispatch problem. The problem has been formulated as multi-objective optimization problem with competing production cost and emission objectives. Results obtained from the HCPSO algorithm have been compared with those obtained from RCGA2, NSGA-II, SPEA-2. It is seen from the comparison that the HCPSO algorithm provides a competitive effectiveness in terms of solution quality and a better performance in terms of CPU time.

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