Application of Genetic Algorithm for Solving Optimum Power Flow Problems

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ABSTRACT

An efficient and optimum economic operation and planning of electric power generation systems is very important. The basic requirement of power economic dispatch (ED) is to generate adequate electricity to meet load demand at the lowest possible cost under a number of constrains. Genetic Algorithms (GA) represents a class of general purpose stochastic search techniques which simulate natural inheritance by genetics. In this paper, the principles of genetics involving natural selection and evolutionary computing applied for producing an economic dispatch. By simulating "Survival of the fittest" among chromosomes, the optimal chromosome is searched by randomized information exchange. In every generation a new set of artificial chromosomes is created using bits and pieces of the fittest of old ones while randomized.

Keywords: Economic Dispatch(ED), Genetic Algorithm (GA), Genetics, Optimal Chromosomes, Power Flow Problems, Stochastic Search Techniques

INTRODUCTION

Economic dispatch (ED) is an optimization problem, which allocates the generation among the generators in a power system so that total cost of generation is minimized maintaining the system operating constraints. Traditional economic dispatch methods minimize the total fuel cost.

Power generators may possess some prohibited operating zone between their minimum and maximum generation limits, because of the practical limitations of the power plant elements. Operating in those zones may cause amplification of vibrations in a shaft bearing, which must be avoided in practice. This economic dispatch problem (EDP) becomes a non convex optimization problem because the prohibited regions separate the decision space into disjoint subsets constituting a non convex solution space.

The EDP is to optimally allocate the load demand among the running units while satisfying the power balance equations and units operating limits. The principal objective in economic dispatch of thermal generators in a power system is to determine the economic loadings of the generators so that the load demand can be met and the loadings are within the feasible operating regions of the generators. It is therefore of great importance to solve this problem as quickly and accurately as possible. Conventional techniques offer good results but when the search space is nonlinear and has discontinuities these techniques become difficult to solve with a slow convergence ratio and not always seeking to the optimal solution. New numerical methods are then needed to cope with these difficulties, specially, those with high speed search to the optimal and not being trapped in local minima. Since the mid-fifties of the twentieth century, several heuristic global search techniques inspired by biologic evolution have been suggested. Most of these evolutionary algorithms (EAs), such

as evolutionary programming (EP), evolution strategy (ES), and GAs, have been proved to be successful for numerical optimization problems (Liang *et al.,* 2007).

Several classical optimization techniques such as lambda iteration method, gradient method, Newton's method, linear programming (LP), interior point method and dynamic programming (DP), have been used to solve the EDP .Most of the classical optimization techniques need derivative information of the objective function to determine the search direction. But the actual fuel cost functions are nonlinear, non convex and non differentiable because of prohibited operating zones. Meta heuristic techniques solved many of the techniques solved many of the difficulties associated with optimization methods.

LITERATURE REVIEW

The optimal unit commitment allocation of the electric power system has caught the attention of researchers in recent years. The EDP is commonly formulated as an optimization problem, which aim to minimize the total generation cost of the power system while satisfying specified constraints. For this purpose, generators are commonly modeled using smooth quadratic functions, which relate power output to production cost.

Many methods were proposed to solve the EDP, which resulted in optimal power system units generation scheduling. Chen and Chen (2001) used the conventional LaGrange relaxation approach, where the first order gradient method and multi-pass dynamic programming were combined together. Moreover, the authors stated that the proposed method has no restrictions on generator cost function, and it performs a direct search of the feasible solution at each step. Various mathematical programming methods such as dynamic programming, linear programming, homogenous linear program-

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