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A new hybrid approach for the solution of nonconvex economic dispatch problem with valve-point effects

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ABSTRACT

Economic dispatch (ED) generally formulated as convex problem using optimization techniques by approximating generator input/output characteristic curves of monotonically increasing nature results in an inaccurate dispatch. The genetic algorithm has previously been used for the solution of problem for economic dispatch but takes longer time to converge to near optimal results. The hybrid approach is one of the methodologies used to fine tune the near optimal results produced by GA. This paper proposes new hybrid approach to solve the ED problem by using the valve-point effect. The approach we propose combines the genetic algorithm (GA) with active power optimization (APO) based on the Newton's second order approach (NSO). The genetic algorithm acts as a global optimizer giving near optimal generation schedule, which becomes the input for generation buses in APO algorithm. This algorithm acting as local search technique dispatching the generated active power of units for minimization of cost and gives optimum generation schedule. Three machines 6-bus, IEEE 5-machines 14-bus, and IEEE 6-mchines 30-bus systems have been tested for validation of our approach. Results of the proposed scheme compared with results obtained from GA alone give significant improvements in the generation cost showing the promise of the proposed approach.

1. Introduction

Economic dispatch (ED) problem is considered necessary and a vital step in power system operation. If the supply of the load is total and in a most economic way, in addition to being exposed to the inequality and equality constraints, then it is the generation allocation problem and is defined as the process of calculating the generation of the from generating units [1]. In system operation studies generators are represented by input–output curves. The accurate economic dispatch depends mainly upon the accurate representation of these curves. The characteristics for input–output are naturally nonlinear and non-smooth because of valve-point effect, multi fuels and operational constraints such as prohibited operating zones.

The ED problem may be broadly classified as convex and nonconvex economic dispatch. In convex economic dispatch input–output characteristics are assumed piecewise linear and monotonically increasing and includes optimization algorithms that are based on mathematical programming such as λ iteration, base point participation method, as well as Gradient and Newton's methods [2]. The nonconvex ED problem represents the complete, realistic problem having non-smooth (discontinuous, non-differentiable and nonlinear) characteristic. This problem requires a fast, accurate and robust solution methodology.

Many approaches are presented in the literature for formulating and solving power ED [3] problem. The convex ED problem has been solved comprehensively using mathematical programming based optimization methods, but nonconvex ED problem cannot be handled effective by such approaches. Dynamic programming has been used but it has dimensionality problem [4]. Generally, heuristic search methods are used as tools for the solution of complex optimization problems because of their strength to overcome the shortcomings of the traditional optimization methods. The genetic algorithm is a potential heuristic tool for ED problems [5,6]. It has the inherent ability to reach the global minimum region of search space in a short time, but then takes longer time to converge. Hybrid approach is one of the methodologies to get around this problem. Some GA based hybrid approaches have been presented [7,8] previously for solving the ED problem.

In this paper, the hybrid approach based on sequential combination of GA and active power optimization using Newton's second order approach is presented to provide the solution for ED with

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