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ORIGINAL ARTICLE

Solving practical economic dispatch using hybrid GA–DE–PS method

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Abstract This paper presents an efficient flexible hybrid method based two global optimization methods such as; genetic algorithm, differential algorithm dynamically coordinated with a local search method known as pattern search to enhance the solution of the economic dispatch problem considering valve point effects. The main idea introduced in this proposed hybrid method is that the best solutions found by GA and DE at different stages are sent to PS to exploit new region around this solution, alternatively the new solution achieved by PS is also communicated to GA and DE and considered as the new initial search space, this interactive mechanism search between global and local search is to balance the exploitation and exploration capability which allows individuals to react more by changing experiences. The robustness of the proposed approach is tested and validated on the Algerian 114-bus electrical network test by solving the economic dispatch considering quadratic cost function and fixed power losses, to the 13 and 40 generating units considering valve-point effects. Comparison results with the standard global optimization methods such as GA, DE and to many other recent techniques showed the superiority of the proposed hybrid technique and confirmed its potential for solving practical economic dispatch.

Keywords Differential evolution · Economic dispatch · Valve-point effect · Pattern search · Genetic algorithm · Hybrid methods

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1 Introduction

The main objective of economic dispatch strategy is to determine the optimal operating state of a power system by optimizing a particular objective function while satisfying certain specified physical and security constraints. The economic dispatch becomes even more complex when many conflicting objectives (fuel cost, gaz emission, real power loss, voltage deviation, and voltage stability) and practical generators constraints (multi fuel, valve point effect and prohibited zones) are considered (Mahdad and Srairi 2013).

The drawbacks associated with using conventional optimization (Sttot and Marinho 1979; Alsac and stott 1974; Momoh and Zhu 1999) for solving complex engineering problems have contributed to the development of alternative techniques. During the last two decades; the interest in applying new metaheuristic optimization methods in power system field has grown rapidly. In the literature many standard optimization methods and hybrid variants based metaheuristic algorithms have been proposed and applied with success for solving many complex problems related to power system operation and control like: quantum genetic algorithm (QGA) (Lee et al. 2011), artificial immune system (AIS) (Hemamalini and Simon 2011), adaptive particle swarm optimization (APSO) (Panigrahi et al. 2008), improved PSO (IPSO) (Yuan et al. 2009), improved chaotic particle swarm optimization (ICPSO) (Wang et al. 2010), and Gravitational search algorithm (Güvenç et al. 2012). These methods and many other techniques have a better searching ability in finding near global optimal solution compared to mathematical methods and to the standard evolutionary algorithms. Based on experience and many research presented by authors confirmed that each global