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Solving Practical Economic Dispatch Problems Using Improved Artificial Bee Colony Method

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Abstract— This paper presents an improved artificial bee colony (IABC) optimization method to solving practical economic dispatch taking into account the nonlinear generator characteristics such as valve-point loading effects. In order to exploit the performance of this new variant based ABC method to solving practical economic dispatch, a new local search mechanism (LSM) associated to the original ABC algorithm; it allows exploiting effectively the promising region to locate the best solution. The proposed approach has been examined and applied to many practical electrical power systems, the 13 generating units, and to the large electrical system with 40 generating units considering valve point loading effects. From the different case studies, it is observed that the results compared with the other recent techniques demonstrate the potential of the proposed approach and show clearly its effectiveness to solve practical and large ED.

Index Terms— Global optimization, Artificial bee colony, Economic dispatch, Optimal power flow, Valve point effect, Prohibited zones, Local search.

I. Introduction

During the last two decades, the interest in applying global optimization methods in power system field has grown rapidly. Economic dispatch strategy is one of the fundamental issues of power system operation and planning, its main objective is to schedule the committed generating units of a power system by optimizing a particular objective function, while satisfying certain specified operating constraints. In its most general formulation, the economic power dispatch (EPD) is a nonlinear, nonconvex, large-scale problem with both continuous and discrete control variables. It becomes even more complex when practical generators constraints (prohibited zones, valve point effects, pollution control) are taken in consideration [1]. The literature on the application of the global optimization in the OPF problem is vast and [1] represents the major contributions.

Huge number mathematical optimization techniques have been employed for solving the economic dispatch problem, this first category includes, linear programming (LP), nonlinear programming (NLP), quadratic programming (QP), and interior point methods [2-3]. All these techniques rely on initial condition and convexity to find the global optimum; methods based on these assumptions do not guarantee to find the global optimum when considering practical of generator constraints (Prohibited zones, Valve point effect, and multi-fuel options), in [4], authors present a review of the major contributions in this area.

The second category includes many heuristique and stochastic optimization methods known as global optimization techniques (GOT). Many evolutionary algorithms such as the genetic algorithm (GA) [5], particle swarm optimization (PSO) [6], simulated annealing (SA) [7], tabu search (TS) [8], ant colony optimization (ACO) [9], and differential evolution (DE) [10], were proposed to solve the practical economic dispatch problem. In [1]-[11], authors present the major contributions of this second category in power system operation and control.

The third category includes, a variety of hybrid methods based conventional methods (mathematical methods) and global optimization techniques, like genetic algorithm (GA) and quadratic programming (GA-QP), or combination of artificial techniques with metaheuristic methods, like: Fuzzy logic and genetic algorithm (Fuzzy-GA), artificial neural network and genetic algorithm (ANN-GA), Fuzzy logic and particle swarm optimization (Fuzzy-PSO) [12]. In the literature various modified global optimization methods have been proposed to solving various problems related to power system operation and control, the major contributions related to this category reviewed by authors in [11].

Recently, a new family of global optimization methods, have been developed and applied with success to solving complex optimization methods such as; Harmony search [13], biogeography based optimization method [14], honey bee algorithm [15], teaching learning based optimization (TLBO) [16], and Fuzzy-TLBO [17]. Artificial Bee Colony (ABC) algorithm [18-19-20] is one of the most recently introduced swarm-based algorithms. ABC simulates the intelligent foraging behavior of a honey bee swarm. This paper presents an improved artificial bee colony algorithm for the solution of practical and large economic dispatch considering valve point loading effects and power transmission loss.

