Front. Energy 2014, 8(4): 449–458
DOI 10.1007/s11708-014-0316-8

RESEARCH ARTICLE

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Artificial bee colony optimization for economic dispatch with valve point effect

Abstract In recent years, various heuristic optimization methods have been proposed to solve economic dispatch (ED) problem in power systems. This paper presents the well-known power system ED problem solution considering valve-point effect by a new optimization algorithm called artificial bee colony (ABC). The proposed approach has been applied to various test systems with incremental fuel cost function, taking into account the valve-point effects. The results show that the proposed approach is efficient and robust when compared with other optimization algorithms reported in literature.

Keywords artificial bee colony (ABC) algorithm, economic dispatch (ED), valve-point effect, optimization

1 Introduction

In general, economic dispatch (ED) problem is one of the most important problems in the operation of power systems. The objective of the ED problem of electric power generation is to schedule the outputs of all generating units so as to meet the load demand at the minimum total operating fuel cost, subject to equality constraints on power balance and inequality constraints on power outputs. This makes the ED problem a large-scale highly nonlinear constrained optimization problem. Improvements in the scheduling of the generator power outputs can lead to very important fuel cost savings [1,2].

Received October 18, 2013; accepted December 29, 2013

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Previous efforts on solving ED problems have been applied classical mathematical programming techniques such as interior point algorithm, linear programming and dual quadratic programming [3,4]. In these mathematical techniques, the main assumption is that the fuel cost curve is considered as a monotonically increasing one.

However, when the problem is highly nonlinear or has non-smooth cost functions, some of these techniques may not be able to produce good solutions.

Approximately for the past 20 years, many researchers have used heuristic optimization techniques unlike conventional mathematical techniques in solving ED problems in power systems [5,6]. Dakuo et al. [7] proposed a hybrid genetic algorithm approach based on differential evolution algorithm to solve the ED problem with valve-point effect. Coelho and Mariani [8] utilized the particle swarm approach based on quantum mechanics and harmonic oscillator potential to solve economic load dispatch with valve-point effects. Al-Sumait et al. [9] used pattern search method to solve this problem. Su and Lin [10] investigated to solve this problem using the Hopfield model. Zhang [11] proposed the quantum behaved particle swarm optimization algorithm for economic load dispatch in power system. Bhattacharya and Chattopadhyay [12] utilized the biogeography-based optimization algorithm to solve complex economic load dispatch problems. Hosseini et al. [13] used a novel mathematical-heuristic method for non-convex dynamic ED. Subramanian and Anandhakumar [14] attempted to provide a dynamic ED solution using composite cost function. And Hooshmand and Mohammadi [15] investigated the emission and the ED problem.

Artificial bee colony (ABC) optimization algorithms are formulated based on the natural foraging behavior of honey bees. ABC was first developed by Dr. Karaboga [16,17]. Some artificial ideas are added to construct a robust ABC. Unlike classical search and optimization methods, ABC starts its search with a random set of solutions (colony size), instead of a single solution just like genetic algorithm (GA). Each population member is then evaluated for the given objective function and is assigned