Chapter 3
Evolutionary Algorithm Applied to Economic Load Dispatch

ABSTRACT

This chapter introduces various evolutionary algorithms, namely grey wolf optimization (GWO), teaching-learning-based optimization (TLBO), biogeography-based optimization (BBO), krill herd algorithm (KHA), chemical reaction optimization (CRO) algorithms, for solving the economic load dispatch (ELD) problem of various power systems. To demonstrate the superiority of the proposed approaches in solving non-convex, non-linear and constrained ELD problem, the aforesaid approaches are implemented on 10-unit, 15-unit, 40-unit, 80-unit, and 140-unit test systems. It is observed from the simulation results that HCRO exhibits significantly better performance in terms of solution quality and convergence speed for all the cases compared to other discussed algorithms. Furthermore, the statistical results confirm the robustness of the proposed HCRO algorithm.

INTRODUCTION

Economic load dispatch (ELD) (Lokeshgupta & Sivasubramani 2018) is one of the most important tasks to be performed in the operation and planning of a power system that decides the generation schedule of generating units with an objective of minimizing the total fuel cost. During the last decades, the

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electrical power market became more and more liberal and highly competitive. The main objective of ELD is to optimize the operation cost while fulfill the load demands of customers. The economic operation of the generating systems has always occupied an important position in the electric power industry. ELD is defined as the process of allocating generation levels to the generating units in such a manner so that the system load is supplied entirely and most economically. A good load dispatch reduces the production cost, increases the system reliability, and maximizes the energy capability of thermal units. But, for practical purposes, it is necessary to go for alternate sources of energy. The fuel cost characteristics of modern generating units are highly nonlinear with demand for solution techniques having no restrictions on to the shape of the fuel cost curves. The purpose of this work is to present a solution strategy to solve ELD problem in an efficient way while considering several aspects of ELD. From the viewpoint of these perspectives, numerous investigations have been undertaken and, time-to-time, reported in the literature. In essence, it is a complex non-linear optimization problem with a mixture of linear and non-linear constraints.

LITERATURE SURVEY

The ELD problem is one of the most practical subjects in electrical power engineering and is always under high attention of several researchers. A lot of optimization methods including classical and stochastic search approaches have been applied to solve ELD problem. A bibliographical survey of existing literature on ELD methods reveals that various numerical optimization techniques are employed to solve the ELD problem. Previously, a number of derivative-based approaches such as gradient method (GM) (Dodu et al., 1972), lambda iteration method (LIM) (Chen & Wang, 1993; Aravindhababu & Nayar, 2002), linear programming (LP) (Parikh & Chattopadhyay, 1996), Newton's method (Ramanathan, 1985), quadratic programming (QP) (Fan & Zhang, 1998), Lagrangian multiplier method (Nanda et al., 1994), interior point algorithm (IPA) (Yan & Quintana, 1997), classical technique based on co-ordination equations (El-Keib et al., 1994) were applied to solve ELD problems. Because of highly nonlinear characteristics of the problem with many local optimum solutions and a large number of constraints, the classical calculus-based methods cannot perform satisfactorily for solving ELD problems. These methods ignore the portions of incremental cost curve that are not continuous or monotonically increasing. Because of highly nonlinear characteristics of the