Electrical Power and Energy Systems 33 (2011) 115–123

Contents lists available at ScienceDirect

Electrical Power and Energy Systems

journal homepage: www.elsevier.com/locate/ijepes

A hybrid multi-agent based particle swarm optimization algorithm for economic power dispatch

Rajesh Kumar *, Devendra Sharma, Abhinav Sadu

Department of Electrical Engineering, Malaviya National Institute of Technology, Jaipur 302 017, India

ARTICLE INFO

Article history:
Received 25 January 2009
Received in revised form 9 December 2009
Accepted 7 June 2010

Keywords:
Economic power dispatch
PSO
Valve-point effect
Multi-agent system

ABSTRACT

This paper presents a new multi-agent based hybrid particle swarm optimization technique (HMAPSO) applied to the economic power dispatch. The earlier PSO suffers from tuning of variables, randomness and uniqueness of solution. The algorithm integrates the deterministic search, the Multi-agent system (MAS), the particle swarm optimization (PSO) algorithm and the bee decision-making process. Thus making use of deterministic search, multi-agent and bee PSO, the HMAPSO realizes the purpose of optimization. The economic power dispatch problem is a non-linear constrained optimization problem. Classical optimization techniques like direct search and gradient methods fails to give the global optimum solution. Other Evolutionary algorithms provide only a good enough solution. To show the capability, the proposed algorithm is applied to two cases 13 and 40 generators, respectively. The results show that this algorithm is more accurate and robust in finding the global optimum than its counterparts.

1. Introduction

Economic power dispatch (EPD) is the scheduling of the committed generating unit outputs so as to meet the load demand at minimum operating costs while satisfying all units and system equality and inequality constraints. The main aim in the economic dispatch problem is to minimize the total cost of generating real power (production cost) at various stations while satisfying the loads and the losses in the transmission links [1,2]. EPD is thus one of the most important problems to be solved in the operation of power system. Since modern unit's input–output characteristics are highly non-linear due to valve-point loading, multiple-fuel effects and other constraints, a continuous search for better solver is going on [3–5].

A lot of classical methods have been developed and are being used for optimization problem. Golden section search, Fibonacci search, Newton's method and Secant method are some one dimension search method. Gradient methods, Newton's method, conjugate direction method and neural networks are commonly used for unconstrained optimization [2]. These methods are problem specific and use gradients. Consequently they are applicable to a much smaller classes of optimization problem.

A genetic algorithm (GA) is a probabilistic search technique that has its roots in the principles of genetics. It gives more emphasis on natural selection of surviving species and process of reproduction of new offspring. The algorithm works on process of mutation and crossover to create new population [6]. Since its conception, genetic algorithm has been used widely as a tool in computer programming, artificial intelligence and optimization.

Mimicking the behavior of intelligence available in various swarms a new intelligence comes into existence which is known as swarm intelligence (SI). Swarm intelligence is artificial intelligence which based on the collective behavior of decentralized, self-organized systems which mimics natural behavior of organisms. SI systems are typically made up of a population of simple agents interacting locally with one another and with their environment. The agents follow very simple rules, and although there is no centralized control structure dictating how individual agents should behave, local interactions between such agents lead to the emergence of complex global behavior [7]. A natural example of SI includes ant colonies, bird flocking, animal herding, bacterial growth, and fish schooling. Various algorithms derive from SI are Ant Colony Optimization (ACO), GA and particle swarm optimization (PSO) [6–8].

Particle swarm optimization (PSO) algorithm is based on social behavior of groups like flocking of birds or schooling of fish. It is a stochastic, population-based evolutionary computer algorithm for problem solving. It is a kind of swarm intelligence that predicts each individual solution as "particles" which evolve or change their positions with time. Each particle modifies its position in search space in accordance with its own experience and also that of neighbouring particle by remembering the best position visited by itself and its neighbours, then calculating local and global positions. These techniques are free from use of

* Corresponding author. Tel.: +91 141 2713372; fax: +91 141 2529092.
E-mail addresses: rk.rlab@gmail.com (R. Kumar), devendra.sharma11@gmail.com (D. Sharma), abhinavsadu@gmail.com (A. Sadu).

0142-0615/$ - see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ijepes.2010.06.021