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Intelligent Grey Wolf Optimizer - Development and Application for Strategic Bidding in Uniform Price Spot Energy Market

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Abstract

Restructuring of power system has enabled generating companies to sell the power in energy markets. To avail maximum profit, every generating company frame strategies and bid in competitive energy markets. Prediction of rival behavior and information of future energy price is a major difficulty, while exercising the profit making strategies. A powerful optimization tool is required to handle the profit maximization process in dynamically changing market; keeping this fact in consideration, a new variant of grey wolf optimizer (GWO) named as intelligent grey wolf optimizer (IGWO) is proposed. This variant employs two mathematical frameworks first an efficient sinusoidal truncated function and another one is oppositional based learning concept for ensuring the better exploration and exploitation properties. The accuracy of IGWO is tested and compared with other contemporary algorithms on 22 benchmark functions. Once proved, the proposed algorithm is applied for framing bidding strategy in uniform and dynamically changing market conditions. The results of IGWO are compared with GWO, oppositional-GWO (OGWO) and PSO. The rivals behaviors are modeled through normal distribution of the bids and two cost models are prepared. Further, Monte Carlo simulations are performed. It is observed that profit obtained from IGWO is more from OGWO, GWO and PSO for both a single trading hour and a trading day. A considerable amount of profit can be earned by a generation company by employing proposed methodology.

Keywords: Bidding strategies, Electricity market, Market clearing price, Monte carlo simulation, Grey wolf optimization.

1. Introduction

In competitive electricity market, Generating Companies (Gencos) participate in energy trading on the basis of framed bidding strategies. These strategies are helpful for a company as they can have impact on profits; in addition to that these strategies also drive market

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