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Harris Hawk Optimization-Based Deep Neural Networks Architecture for Optimal Bidding in the Electricity Market

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Abstract: In the power sector, competitive strategic bidding optimization has become a major challenge. Digital plate-form provides a superior technical base as well as backing for the optimization's execution. The state-of-the-art frameworks used for simulating strategic bidding decisions in deregulated electricity markets (EM's) in this article are bi-level optimization and neural networks. In this research, we provide HHO-NN (Harris Hawk Optimization-Neural network), a novel algorithm based on Harris Hawk Optimization (HHO) that is capable of fast convergence when compared to previous evolutionary algorithms for automatically searching for meaningful multilayered perceptron neural networks (MPNNs) topologies for optimal bidding. This technique usually demands a considerable amount of time and computer resources. This method sets up the problem in multi-dimensional continuous state-action spaces, allowing market players to get precise information on the effect of their bidding judgments on the market clearing results, as well as implement more valuable bidding decisions by utilizing a whole action domain and accounting for non-convex operating principles. Due to the use of the MPNN, case studies show that the suggested methodology delivers a much larger profit than other state-of-the-art methods and has a better computational performance than the benchmark HHO technique.

Keywords: electricity market; optimal bidding; Harris Hawk Optimization; multi layered neural network; bi-level optimization; strategic bidding

MSC: 68T01; 68T05; 68T07; 68T09; 68T20; 68T30

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1. Introduction

Many economic systems used in the power sector's research are centralized, optimize the objective of the system (e.g., maximizing social welfare) and assume that market participants behave in a perfectly competitive (price-taking) manner. However, increasing attempts to deregulate the power industry have resulted in increased competition among several self-interested (profit-driven) market competitors, particularly in the production and supplier domains. Due to the fact that self-interested market player's nature is not always allied with global targets, existing centralized frameworks are no longer able to give accurate perspectives. Consequently, emerging market methods that are useful are capable of tracking the strategic (price-making) behavior of self-interested market players as well as recognizing the market outcomes that result from their interactions [1].