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An Efficient FNN Model with Chaotic Oppositional Based SCA to Solve Classification Problem

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ABSTRACT

In recent years, many studies have been used in feed-forward neural network (FNN) to develop decision-making systems. The primary objective is to get the least error by finding the best combination of control parameters. It has been observed that FNNs using meta-heuristics techniques always converges very quickly towards the optimal positions but suffers from slow searching speeds at later stages of generation. Due to slow convergence, it is a prevalent phenomenon that traditional optimization does not ensure to find global optima. As a result, it falls under local optima. Recently, another meta-heuristic optimization-based algorithm called sine cosine algorithms (SCA) was introduced to solve the aforementioned issues. The algorithm is fundamentally predicated on two trigonometric functions, one being sine and the other being cosine. However, like other traditional approaches, SCA has a tendency to be stuck in sub-optimal regions due to poor exploration and exploitation capabilities. This paper proposes an improved version of SCA named chaotic oppositional SCA (COSCA) by integrating with chaos theory and oppositional based learning into the SCA optimization process. It is an incipient training method employed to train an FNN. Three benchmark problems are used to examine the precision and performance of FNNs equipped with COSCA, COPSO, OSCA, SCA, PSO, and backpropagation. The experimental results showed that, relative to other meta-heuristic optimization techniques, the COSCA technique is able to improve performance.

KEYWORDS

Chaotic oppositional Sine cosine algorithm; Feed-forward neural network; Sine cosine algorithm

1. INTRODUCTION

The conception of feed-forward neural network (FNN) is fundamentally predicated on the concept of human neurons by making the right connections. FNN can be built up by three types of layers. These are the input layer, hidden layer, and output layer. The first one is the input layer, which consists of the input data. The second layer or middle layer is a hidden layer knows for specific computation as the intermediate layer between input and output. The last one is the output layer, and it produces the result for a given input. An FNN may have more than one hidden layer. The important feature of an FNN is an activation function. It decides whether a neuron should be activated or not. The learning process defines the efficiency of a neural network by using its parameters. The main aim is to determine a good combination of organizational parameters (weights and biases) to achieve the highest efficiency. It has been broadly accepted by many works of literature that if any non-linearity exists, it can be identified by the network in an operative way to uncover this relationship. In the last few years, FNNs have been followed by many Deep learning and machine learning applications, used for complex research problems, and provides better flexibility. Since FNNs [1] are the most successful modeling in deep learning due to the ability to learning values of their connected weight(s), bias (es), and adjust themselves. In this way, FNNs are structured and learn efficiently. FNN, which is the main focus of this literature, is broadly applied in different fields like Image Classification, Regression, Image recognition, Audio recognition, etc. Researchers of [2, 3] used self-organized FNN to solve the group method of data handling (GMDH) threshold algorithms for their neurons. Sahlol *et al.* [4] used FNN regressor to predict an Antioxidant status in the fish farm. The author utilized several mathematical validations such as mean squared error (MSE) evaluating the average squared error, mean absolute error (MAE), which is a quantification of distinction between two continuous variables. In contrast, root mean squared