Chapter 8
Meta-Heuristic Parameter Optimization for ANN and Real-Time Applications of ANN

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ABSTRACT

Artificial neural networks (ANN) are often more suitable for classification problems. Even then, training of ANN is a surviving challenge task for large and high dimensional natured search space problems. These hitches are more for applications that involves process of fine tuning of ANN control parameters: weights and bias. There is no single search and optimization method that suits the weights and bias of ANN for all the problems. The traditional heuristic approach fails because of their poorer convergence speed and chances of ending up with local optima. In this connection, the meta-heuristic algorithms prove to provide consistent solution for optimizing ANN training parameters. This chapter will provide critics on both heuristics and meta-heuristic existing literature for training neural networks algorithms, applicability, and reliability on parameter optimization. In addition, the real-time applications of ANN will be presented. Finally, future directions to be explored in the field of ANN are presented which will of potential interest for upcoming researchers.

INTRODUCTION

There are umpteen number of standard machine learning algorithms that are developed during previous decades to cater the day to day activities in various domains which demand pattern recognition, prediction, decision making and many others. But still there is a gap between the domain specific applications and solving algorithms. Furthermore, there is need for parameter optimization of various machine learning

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algorithms, so as to achieve faster convergence with minimum iterations, which in turn increases the efficiency of an algorithm, both in terms of execution time and accuracy. In recent years, many nature-inspired meta-heuristic optimization algorithms (MHOA) were developed, which have been successfully applied for optimization of various machine learning algorithms like artificial neural network (ANN), extreme learning machine, deep learning machine, support vector machine, Radial basis neural network, etc. Few of the MHOAs use memory to keep track of the search process and find the optimal solution based on the previous solutions stored in the memory. Based on the search process, these MHOAs are broadly classified as single solution based and population based algorithms. The search process in the single solution based algorithm starts with one candidate solution (search agent/ object) and progresses over a specific number of iterations. Contrary to single solution, in the population based solution, the search process starts with a set of candidate solutions which gets upgraded in next iterations and finally the best fit candidate is chosen as the optimal solution. This chapter mainly focuses on how MHOAs can be applied to optimize various parameters of ANN in particular connection weights. Furthermore, various applications of ANN in the field of textile, tourism and educations are elaborated. In addition, applications of MHOA optimized ANN are also elucidated.

ANNs has significant advantages over statistical models when both are relatively compared. There is no prerequisite demand of hypothesis for testing as needed for statistical methods. In addition, ANNs are robust enough to handle noisy data, provide desired results, are scalable and suitable for handling nonlinear data. ANN processing is reassuring in numerous areas including medical analysis, (Catalogna, 2012, Raval, 2018), education, agriculture, industry, weather forecasting, tourism, textile, manufacturing industry, defense and many more. Surveys provided on ANN till date is limited to tools survey or ANN with specific application. Comparatively this chapter will provide a deeper insights of design techniques of ANN with respects to parameter optimization of ANN using meta heuristic method and also will discuss applications of ANN and MHOAs optimized ANN for umpteen number of real time applications.

Highlights of the chapter are briefed below:

- An overview of ANN weights optimization using two meta-heuristic algorithms: Genetic algorithm and Particle swarm optimization is provided.
- Brief discussion on ANN for few applications namely education, textile, tourism is provided which is not commonly found in literature. Most of the work published covers common applications of ANN restricted to medical field and agriculture domain.
- GA optimized ANN and PSO optimized ANN is covered in detail for umpteen numbers of applications.
- Summarized information of various meta heuristic methods for optimizing ANN and its applications is also deliberated.
- Recent advances and future applications of NNs are briefed.

OVERVIEW OF ANN

The ANN is a feed forward neural network (FFNN) structure which mostly has three layers namely input layer, hidden layer and output layer (figure 1). The training of ANN is the continuous optimization which is the mapping of input layer to output layer by setting the optimal set of weights and biases so as solve the problem in minimum number of iterations and minimum classification error. The outcome