



Feasibility of Soft Computing in Civil Engineering- A delusion?

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Abstract

Recently the application of artificial intelligence (AI) in civil engineering problems has drawn considerable attention. However, in practice, its role is not recognized that much. In this paper an extensive review is conducted on the application of AI in civil engineering problems. Based on this study, the role of soft computing in civil engineering is not a delusion if an expert designs an AI-based predictive model with large sets of high quality data as well as proper validations. However, providing large sets of high quality data is a difficult task to be accomplished in civil engineering-related problems.

Keywords: soft computing, ANN, bearing capacity, compressive strength, settlement.

1. INTRODUCTION

The application of soft computing in civil engineering is underlined in numerous papers e.g. [1-4]. In contrary to hard computing, in soft computing techniques the possible error and uncertainty is accepted and the degree of reliability is of importance. Artificial neural network (ANN) is one of the most famous soft computing techniques. ANNs are tools for approximating functions when the nature between inputs and outputs are complex. In other words, as stated by Hsaio et al [5] ANNs map inputs to outputs without prior knowledge of the underlying physical model. Although there are different type of ANNs, for civil engineering problems, multi layer feed forward is considered as the most widely used type of ANNs. This type of ANN comprises three basic layers known as input, hidden and output layers. The layers are connected to each other through connection weights. The input layers consist of sets of data which are necessary for predicting the model output. The hidden layer which forms the essential part of ANN comprises a number of hidden neurons. According to literature their number can be related to the number of inputs and outputs parameters. The desired model output sets to be in the last layer. Before implementation, ANN has to be trained. Back propagation (BP) algorithm is considered the most widely used ANNs training algorithm [6]. BP algorithm works based on gradient descent approach and tries to minimize the error between the predicted output and the target output. However, usually MSE which is the mean square error between two aforementioned outputs are utilized for minimization purpose. The learning process starts with transferring the raw data from input layer to hidden layer through connection weights. After applying a transfer function (usually sigmoid function), the value of each hidden neuron is updated and is passed to the model output. It should be mentioned that the summation of connection weights as well as a threshold value known as bias, B , forms the input of each hidden node, N . Similar procedure is repeated in the output layer. Finally the predicted output is checked against the target output. In the case that the error was not desirable, the network has to back propagate and update its connections weights using relevant equations which are not mentioned here for the purpose of brevity. This procedure is repeated until the error is minimized. Nevertheless, this paper is aimed to shed some lights on various applications of soft computing or artificial intelligence techniques (mainly ANN) in civil engineering problems. Based on an extensive review, the paper also highlights the advantages and limitations of these techniques.

2. SETTLEMENT OF SPREAD FOUNDATIONS

Many researchers underlined the application of artificial neural networks in predicting the settlement of spread foundations. Nazir *et al* [7] recommended an intelligent model for predicting the settlement of spread