Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 2, No. 1, January, 2016

Predicting the Earthquake Magnitude Using the Multilayer Perceptron Neural Network with Two Hidden Layers

Jamal Mahmoudi[a*], Mohammad Ali Arjomand[b], Masoud Rezaei[c], Mohammad Hossein Mohammadi[d]

[a]*PhD Candidate, Structural Engineering Research Center, International Institute of Earthquake Engineering and Seismology, Tehran, Iran*

[b]*Assistant Professor, Faculty of Civil Engineering, Shahid Rajaee Teacher Training University, Tehran, Iran*

[c]*Faculty of Earthquake Engineering, Road-Building and Housing Research Center, Tehran, Iran*

[d]*Faculty of Civil Engineering, Kharazmi University, Tehran, Iran*

Received 23 October 2015; Accepted 30 January 2016

Abstract

Because of the major disadvantages of previous methods for calculating the magnitude of the earthquakes, the neural network as a new method is examined. In this paper a kind of neural network named Multilayer Perceptron (MLP) is used to predict magnitude of earthquakes. MLP neural network consist of three main layers; input layer, hidden layer and output layer. Since the best network configurations such as the best number of hidden nodes and the most appropriate training method cannot be determined in advance, and also, overtraining is possible, 128 models of network are evaluated to determine the best prediction model. By comparing the results of the current method with the real data, it can be concluded that MLP neural network has high ability in predicting the magnitude of earthquakes and it's a very good choice for this purpose.

Keywords: Earthquake Magnitude, Prediction, Multilayer Perceptron, Neural Network, Two Hidden Layers.

1. Introduction

Since ancient times, in the wake of natural events and disasters, man has always been looking for ways to prevent or control these events. The earthquake is one of these natural disasters which cause heavy losses of life and property, when it occurs. Time, location and magnitude of the earthquake are three parameters that must be a good estimate of their amounts in order to control and minimize its losses. Hence, scientists and researchers have done attempts, including many successful and unsuccessful ones, to find a relationship between these three parameters, or make a good estimation of them.

These efforts have resulted in developing a number of theoretical and empirical equations. However, applicability of equations developed for calculating the magnitude of earthquakes is affected by a lot of parameters. Most of these parameters need to be measured and entered in the equations accurately, while, in many areas, due to the lack of required equipment, these parameters mostly are measured approximately and with low precision or even sometimes assumed. Also, some parameters of the equations such as physical and functional characteristics of faults are difficult to measure. For example, geodetic strain rate of reverse faults with no apparent sign of fault strike on the earth surface is not measurable. Moreover, these equations usually are exclusive of a specific region or state, so they are not reliable enough for other new regions.

On the other hand, neural networks have been proven to be one of the most practical effects in modelling and forecasting [1]. There are three major advantages of neural networks. First, neural networks are able to learn any

[*] Corresponding author: jamal.mahmoudi@iiees.ac.ir