THE EPICENTER FORECASTING OF DARB-E-ASTANEH EARTHQUAKE (2006) AND BANDAR ABBAS EARTHQUAKE (2009) USING FORESHOCKS AND ARTIFICIAL NEURAL NETWORK

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Precise detection of epicenter of the main earthquake after occurrence of foreshocks can significantly contribute to reduction of damages and casualties. The objective of the present study is to forecast the geological location of epicenters of Darb-e-Astaneh Earthquake (2006) and Bandar Abbas Earthquake (2009) through their previous foreshocks by application of artificial neural network.

Artificial neural networks were developed based on human brain. They are composed of a number of artificial neurons connected to each other by weight vectors. The artificial neural networks can categorize a large amount of input data in a simultaneous and parallel manner. They are also able to detect seismic patterns. In the present study, Perceptron Neural Network with three latent layers, mean square error function and training function are used. For this purpose, the seismic catalogue of International Institute of Earthquake Engineering and Seismology (IIEES) was evaluated. For two destructive earthquakes, the latitude and longitude of foreshocks and main earthquakes on main regional faults were added to Perceptron Neural Network and it generated the forecasted input and output, training function and location of main earthquakes.

The analysis of more than 900 global earthquakes with magnitude of higher than 2.2 showed that the foreshocks generally occur at the distance of 10 km away from the epicenter of the main shock. Of course, analysis of a definite region might exclude a number of foreshocks, especially when the main rupture occurs in a large earthquake within different distances from the epicenter. To reduce such an error, one can search for foreshocks in a framework, of which the epicenter of the main shock and its length is equal to the length of the fault (Felzer et al., 2004).

In regard to the interval between occurrence of the foreshock and main shock, there are different theories. The analysis of foreshocks in China showed an interval of 30 days between occurrence of foreshocks and main earthquakes (Mobin and Mokhtari, 2008). It is noteworthy that most of the observed foreshocks observed in China occur in an interval of less than 10 days from the main shock (Wang et al., 2004).

In the present study, maximum geographic difference of foreshocks from main earthquakes is 1.55 which is much less than the length of main faults generating the earthquake. In addition, maximum interval of foreshocks from the main earthquake is 6 days.

The forecasted results by the neural network and the original results of Darb-e-Astaneh and Bandar Abbas earthquakes were compared (Figure 1). This figure shows that the artificial neural network could estimate the longitude and latitude of epicenter of Darb-e-Astaneh Earthquake with respective differences of 0.097 and 0.071. As to the longitude and latitude of epicenter of Bandar Abbas Earthquake, the neural network was able to estimate them with respective differences of 0.095 and 0.026.

Due to the fact that the estimating the location of earthquakes is difficult, one could use gradient algorithm of Perceptron M.L.P and seismic catalogues of earthquakes to identify the underlying seismic system and estimate the relative epicenter location with the help of foreshocks. In the present study, the locations of epicenters of Darb-e-Astaneh and Bandar Abbas earthquakes were estimated with 14.7 and 10.8 km error respectively. It should be mentioned that all associated simulations of present study were done in Matlab Software.

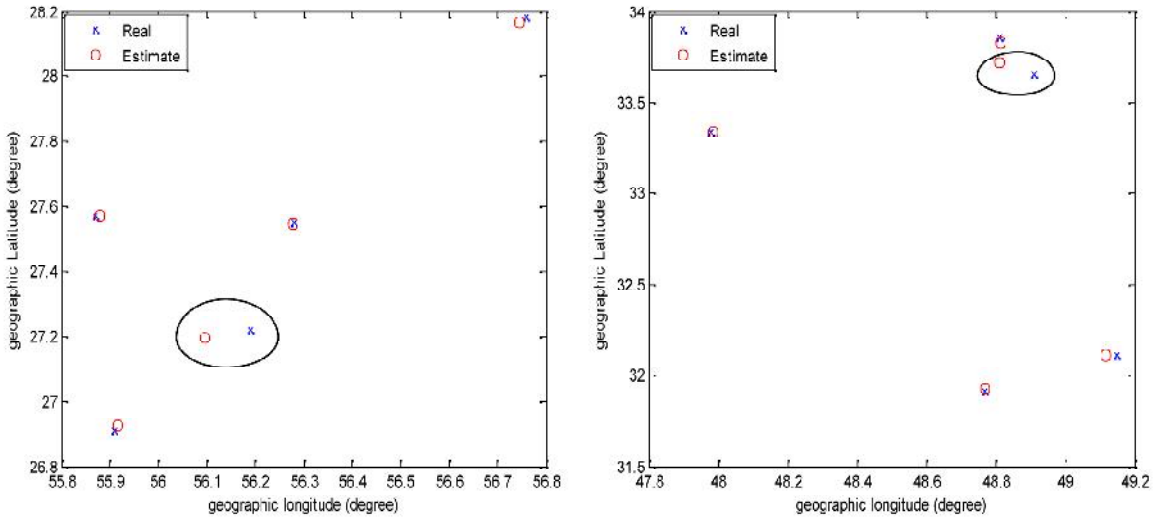

Figure 1. Original and Forecasted Earthquake Epicenters; a) Bandar Abbas and b) Darb-e-Astaneh

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