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A new algorithm to detect earthquakes outside the seismic network: preliminary results

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In this text we are going to present a new technique for detecting earthquakes outside the seismic network, which are often the cause of fault of automatic analysis system. Our goal is to develop a robust method that provides the discrimination result as quickly as possible. We discriminate local earthquakes from regional earthquakes, both recorded at SGG station, equipped with short period sensors, operated by Osservatorio Vesuviano (INGV) in the Southern Apennines (Italy). The technique uses a Multi Layer Perceptron (MLP) neural network with an architecture composed by an input layer, a hidden layer and a single node output layer. We pre-processed the data using the Linear Predictive Coding (LPC) technique to extract the spectral features of the signals in a compact form. We performed several experiments by shortening the signal window length. In particular, we used windows of 4, 2 and 1 seconds containing the onset of the local and the regional earthquakes. We used a dataset of 103 local earthquakes and 79 regional earthquakes, most of which occurred in Greece, Albania and Crete. We split the dataset into a training set, for the network training, and a testing set to evaluate the network's capacity of discrimination. In order to assess the network stability, we repeated this procedure six times, randomly changing the data composition of the training and testing set and the initial weights of the net. We estimated the performance of this method by calculating the average of correct detection percentages obtained for each of the six permutations. The average performances are 99.02%, 98.04% and 98.53%, which concern respectively the experiments carried out on 4, 2 and 1 seconds signal windows. The results show that our method is able to recognize the earthquakes outside the seismic network using only the first second of the seismic records, with a suitable percentage of correct detection. Therefore, this algorithm can be profitably used to make earthquake automatic analyses more robust and reliable. Finally, with appropriate tuning, it can be integrated in multi-parametric systems for monitoring high natural risk areas.