

Fast Location Parameters Determination of Seismic Events from Few Seconds of P Wave Recorded at a Single Seismological Station Using Support Vector Machine Regression

*Luis Hernan Ochoa Gutierrez¹, Carlos Alberto Vargas Jimenez¹, Luis Fernando Niño Vasquez¹

1. Universidad Nacional de Colombia

A Support Vector Machine Regression (SVMR) algorithm was applied to calculate Local Magnitude (ML), epicenter distance, focal depth and back-azimuth of seismic events using only five seconds of signal since P wave onset of one three component of “El Rosal” seismic station located, near to the city of Bogota –Colombia. The algorithm was trained with descriptors of time signals of 863 seismic events acquired between January 1998 and October 2008. During training stages of SVMR several combinations of kernel function exponent and complexity factor were considered for time signals of 5, 10 and 15 seconds along with earthquake local magnitudes of 2.0, 2.5, 3.0 and 3.5. Input parameters were an exponential function of waveform envelope estimated by least squares and maximum value of recorded waveforms for each component of the seismic station as well as a “Polarity Attenuation Factor”, which is proposed as a key for a successful modelling parameter for short time earthquake characterization. We used SVMR algorithm with normalized polynomial kernel and tested with a ten-fold cross validation, obtaining mean absolute error for different exponents and complexity parameters. A grid search method was applied to choose the best model parameters. The mean absolute error obtained in estimation of parameters were: Local Magnitude (ML) with 0.19 units of magnitude, hypocentral distance with 10.3 kilometers, focal depth with 16.5 kilometers and back-azimuth with 45.4 degrees. Proposed algorithm is easy to implement directly in the seismological stations to generate fast decisions at seismic control centers, increasing the possibility of having an effective early warning generation.

Keywords: Earthquake Early Warning, Support Vector Machine Regression, Polarity Attenuation Factor, Earthquake, Bogotá, Colombia, Location Parameters

