A deep neural network approach to seismic event discrimination and phase identification

N.R. Ranasinghe, N. Kulathunga, L. Huang, Y. Wang, D. Vrinceanu and Y. Yang

Seismic event discrimination has been one of the main pillars of academic seismology and discriminating between the origins of smaller magnitude seismic events has been a challenging endeavor. Resurrection of machine learning in last decade has accelerated the rate of new discoveries in number of fields and seismology stands to benefit from machine learning due to its vast quantities of label data freely accessible through data centers all over the world. Here, we attempt to discriminate between local earthquakes and quarry blasts in southern California using seismic data recorded by southern California earthquake data center from 2002 to 2019 implementing a Deep Neural Network (DNN). We explore the DNN architecture developed for image classification to uniquely classify and identify phase arrival times for P and S phases utilizing spectrograms generated from local earthquakes and quarry blasts. The training and testing data sets for the DNN are created by capturing 4 second windows centering around P and S phases for each 3-component seismograms and transforming the captured windows into spectrograms to analyze data simultaneously in both frequency and time domains. Additionally, we are exploring applications of data fitting process using spline approximation for DNN's to further understand the scope of deep networks in geophysics and exploring their theoretical background. We use the max-affine spline approximation to fit the multi-cluster regression data and discuss the possible usages of this method in the context of geophysical data.