Seismic source identification with machine learning

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Seismic records have been widely used to study different sources, including earthquake, nuclear explosion, volcano and landslide. In practice, the efficient and automatic approach of source identification is necessary to seismologically study the difference sources. Thus, how to quickly and differentially identify the seismic signals caused by different source types is still an important issue. In Taiwan, a complete catalogue of earthquake and landslide and, a well-distributed broadband seismic network provides good seismic data to develop and test the source identification approach. For a purpose of fair comparison, we first collected seismic records of the landslide and earthquake events with considering the similar location and event size. Then, we calculated the signal characteristics of sources, such as signal duration (SD), skewness (SK), kurtosis (KT), spectral amplitude ratio (SR) and the shape of time-frequency map. We also conducted a series of regression analysis and found some regression parameters are also helpful to identify the source type. Based on the specific thresholds of aforementioned parameters, we built the automatic source identification approach, named ASI here. Second, we tested and trained the machine-learning (ML) model by using different model features: time-series record (e.g., envelope function), numeric data (e.g., SD, SK, and KT) and image pattern (e.g., spectrogram). A main goal of this study is to develop optimal system of seismic source identification using a combined approach of ASI and ML.

Keywords: seismic records, automatic source identification, machine learning