Earthquake Detection Using Deep Learning

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ABSTRACT: Earthquakes are detected and located primarily by use of patterns in seismic waves, or specifically seismic wave phases, seismic signals they generate. Machine learning methods have been successful in various science and engineering domains to identify signatures and patterns. Among various machine learning methods, deep learning is one state-of-the-art technique. In this research, we develop a novel deep-learning-based detection method to locate earthquakes, which is based on locating specific patterns in time series signals. Because of the range of durations of the earthquakes events and their related signals, traditional machine-learning methods for object detection yield low accuracy. To tackle this problem, we develop a hierarchical, end-to-end detection model, which allows an efficient identification of earthquakes with different durations. To verify the performance of our detection method, we employ data from a bi-axial 'earthquake machine' located at Penn State University. We apply acoustic data sets acquired from the experiments as the testing data. The lab-quake data sets are used to mimic real earthquakes albeit for a single fault patch. Through our numerical tests, we show that our technique yields accurate detection; therefore, our deep-learning-based earthquake detection method could potentially be a powerful tool for locating real earthquake events.