首都圏地震観測網における地震自動検知：複数観測点連続波形への畳み込みニューラルネットの適用

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1. Background

Over the last decade, continuous seismic data have been enormously acquired on seismic networks consisting of multiple sensors at distributed locations. Analyzing these data efficiently and thoroughly offers substantial benefits to seismology. The primary step in the analysis is earthquake detection, that is, looking for earthquakes recorded in continuous massive datasets.

2. Proposed mehod

In this talk, we present a convolutional-neural-network-based scheme for earthquake detection from continuous records in a seismic network. We work with a convolutional neural network (CNN), which is one of the most powerful supervised learning techniques, to capture features discriminating between earthquakes and noises. CNN has recently gathered much attention in seismology (e.g., Perol, Gharbi, and Denolle, 2018; Ross, Meier, and Hauksson, 2018). To accomodate the spatial structure of seismic networks, we also employ the graph partitioning technique to train the CNN efficiently. Our scheme has an advantage of leveraging multiple stations in a seismic network to discriminate between earthquakes and noises. The task here is simply classification, which is of benefit to identity characteristic features of seismic waves.

3. Result

We apply our scheme to continuous data recorded by Metropolitan Seismic Observation network (MeSO-net) from September 4, 2011 to September 16, 2011. MeSO-net has consisted of approximately 3,00 seismic stations distributed around Tokyo, Japan. In addition to earthquake signals, various kinds of noises originated from near-surface environment has been recorded in the waveforms. Full waveform information at multiple stations has a potential advantage of improving on the ability of earthquake detection. We show our scheme improves on CNNs based on single stations especially in preventing mis-detection. In addition, the trained network in the last fully connected layer has quasi-sparsity, by which we identify features important for CNN to recognize earthquakes.