S52A-04 - Seismic signals and noises clustering with unsupervised deep representation learning (Invited)

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Swirl Topics

Data & Rising Technologies - SWIRL

Abstract

The acceleration in the collection of seismic data worldwide is outpacing our abilities for analysis, since to date such datasets have been analyzed in a human-expert-intensive, supervised fashion. These analyses can also be strongly biased by the standard models employed by seismologists. In addition, emergent seismic signals can also have complex properties (e.g. background seismic noise, tremors) and may escape our understanding of the underlying physical processes. The background seismic noise is a resourceful signal in seismic interferometry, which quality strongly depends on the nature of the noise. In response to all of these challenges, we develop a new unsupervised machine learning framework for detecting and clustering seismic signals and noises in continuous seismic records. Our approach combines a deep scattering network and a Gaussian mixture model to cluster seismic records segments and detect novel structures. To illustrate the power of the framework, we analyze several seismic datasets. Over very long time scales, we investigate the properties of the background seismic noise and investigate the source effect of the clustering results. We also analyze the seismograms acquired during the June 2017 Nuugaatsiaq, Greenland landslide. We demonstrate the blind detection and recovery of the repeating precursory seismicity that was recorded before the main landslide rupture, which suggests that our approach could lead to more informative forecasting of the seismic activity in seismogenic areas.

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