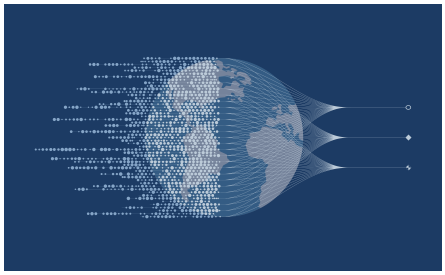

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deep learning for seismic array processing pipelines

Deep learning (DL) has shown to be a powerful method for seismic phase detection for single three-component station. Here, we explore the application of DL to enhance automatic array processing pipelines for seismic event detection. Our work focuses on three key tasks where DL could complement or potentially replace traditional methods: (1) seismic phase detection, (2) seismic phase classification and back-azimuth estimation, and (3) seismic event classification. Phase picking models based on the widely used PhaseNet model, incorporating modifications such as Transformers, are used in Task (1). We investigate various approaches for this task, including phase detection using array beams, aggregating individual single-station detections from array elements, and detecting on all array stations at the same time. In Task (2), we apply a DL model to process detected seismic phase arrivals on arrays. This offers a faster alternative to traditional Frequency-Wavenumber (F-K) analysis and is resilient to local and large-scale medium inhomogeneities. For Task (3), we use DL for event discrimination, specifically focusing on differentiating between earthquakes and mining-induced events. We evaluate all methods on unseen data and compare results with the classic STA/LTA based array detectors and F-K analysis. We observed clear improvements for regional events in Northern Europe.

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