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Seismic Array Data Based Machine Learning Approach for Seismic Phase Classification and Back-Azimuth Estimation

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Array processing is routinely used to measure apparent velocity and back-azimuth of seismic arrivals at the International Data Centre and many National Data Centres. Both quantities are measured under the plane wave assumption and are used to classify the phase type and to determine the direction towards the event epicentre. However, structural inhomogeneities can lead to deviations from the plane wave character. We suggest a combined classification and regression neural network to determine the phase type and back-azimuth directly from the arrival time differences between all combinations of stations of a given array, without assuming certain wavefield properties. It is trained using P and S arrivals of over 30 000 seismic events from the reviewed regional bulletins in Scandinavia of the past three decades. Models for the ARCES, FINES and SPITS arrays are trained. Very good performance for seismic phase type classification (up to 99% accuracy) and low source back-azimuth misfits are obtained. The SPITS array in Svalbard exhibits particular issues when it comes to array processing, and we show how our new approach better handles these obstacles. Finally, a systematic test of the performance compared to the results of the existing array processing pipeline at NORSAR was conducted in case of the ARCES array.

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Promotional text

This study is a contribution to ongoing efforts to integrate machine learning as a new technology into the automatic seismic analysis pipeline at the Norwegian NDC. We think that this method is also very relevant for the IDC and other NDCs for improving processing array data.

Oral preference format

in-person

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