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# Deep Learning-based Deghosting in Marine Seismic Data Processing

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**Objectives/Scope:** We demonstrate the potential of using Deep-Learning (DL) based de-ghosting methods in marine seismic data processing. A field-informed synthetic modelling strategy is used to create a diversified training data set, that accounts for acquisition uncertainties such as variable depth streamer profiles, wave height and variable surface reflectivity. An Ultra-High Resolution (UHR) application and a conventional streamer (3D) example are presented.

**Methods, Procedures, Process:** Ghost reverberations deteriorate the marine seismic image, as ghosts constructively and destructively interfere with the primary wavefields. Conventional deghosting methods often lead to a compute- and user-intensive process to estimate the optimal parameters to obtain satisfactory results. Supervised Deep learning (DL) based methods provide an alternative, where pairs of input data and desired outcome (labelled data) are used to train a network to apply an operator to previously unseen data. An important consideration in supervised DL-based processing is how to train the network, using field data, synthetic data, or a combination of both. Using synthetic modelling methods such as analytical methods, high-density finite-difference modelling or spectral element modelling, high-quality pairs of input-labelled data can be generated that provide high-fidelity examples to be learned by the network. We propose a field-informed modelling strategy by creating data that mirrors the field data as closely as possible. This can be achieved by using multiple geology-models to describe the field data conditions as much as possible, by using modelling wavelets that are extracted from acquisition data, by using temporal & spatial sampling templates that match those of the field data, and by modelling a variety of receiver depth profiles to accommodate variable depth cables and wave-height variations.

**Results, Observations, Conclusions:** In UHR deghosting applications, the problem of variable depth cables and wave-height variations cause a severe challenge for conventional methods as the variability of the effective source- and receiver depth is large compared to the nominal depths. Applications of the DL-based method leads to excellent results, where the source- and receiver notches are fully recovered in the spectra. In a second application to an inner- and outer streamer from a conventional streamer acquisition, source- and receiver notches are completely recovered after 3D DL-based deghosting. Once again, realistic, field-informed synthetic data were used to train the network to obtain the results.

**Novel/Additive Information:** Using a field-informed strategy to create a diversified training data set that resembles the inference field data applications as much as possible, acquisition uncertainties such as variable depth streamers, wave action and variable surface reflectivity can be accounted for in 2D and 3D applications. Satisfactory results are obtained efficiently with minimal user-interaction. This is particularly useful in fast-track processing, aimed at delivering a data volume for early interpretational work and/or velocity model building.