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Multiple Removal with Deep Learning

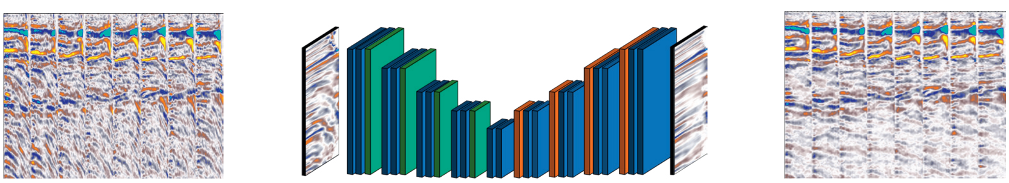
DLSEIS

Parameter-free framework

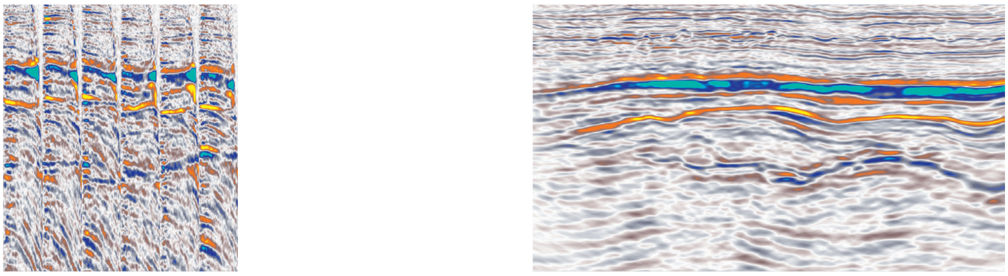
We propose a post-migration demultiple model that can be interpreted as an image-to-image transformation system. Given an input data, our deep-learning based approach identifies the multiples and cancels them out from the output result. The main success of our method is not only the ability to remove multiples, but to do it while preserving the high-frequency components that characterize the data. This approach falls under the multiple separation methods, as it works on NMO corrected gathers, tackling discriminating events with different move-outs. As a result, it can potentially replace Radon-based demultiple in existing workflows and it can deal with data, which were already treated with other demultiple processes (e. g. SRME). Furthermore, our method works in a parameter-free manner, relieving the user from any manual task. To achieve that, we train a convolutional neural network with synthetic pairs of multiple-infested and multiple-free gathers. The generalization capacity of the trained model is assured by employing tailored training data and smart data augmentation techniques.

Versatility

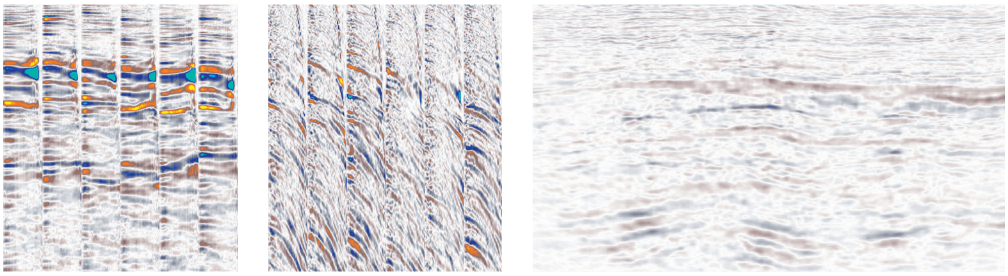
Our approach is designed to tackle angle and offset gathers and is independent of the domain of the vertical axis. Therefore, there is no need for offset-to-angle or time-to-depth conversions prior to application.



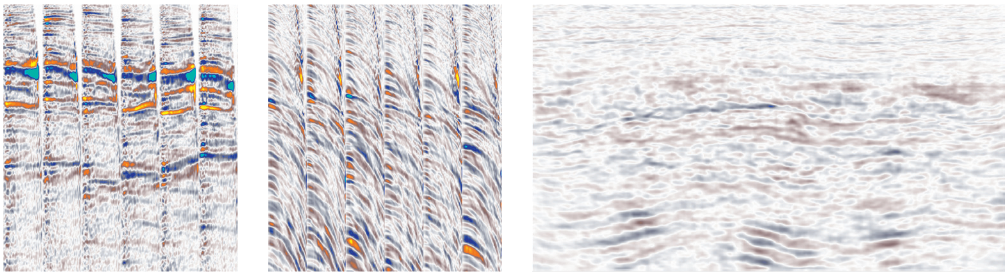
Pipeline of the UNet demultiple approach



Left to right: Input gathers; Input (full-stack)



Left to right: ML-Demultiple result; ML-Demultiple removed multiples; ML-Demultiple removed multiples (full-stack)



Left to right: Radon-Demultiple result; Radon-Demultiple removed multiples; Radon-Demultiple removed multiples (full-stack)

The applicability of our method was tested on numerous real datasets. The case study above presents the results using our ML-Demultiple and Radon-based demultiple approach on real data from the Norwegian sea. As shown, the ML-Demultiple approach successfully attacks similar events as the Radon-based demultiple, without suppressing the primary energy.

The removed events show a parabolic course, however, they are not over-idealized parabolas, as it is the case for the Radon result. The result can also be verified on full-stacks shown on the right side. A big advantage of our method is its parameter-free nature, which drastically reduces the turnaround time.

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For more information visit www.dlseis.org

Contact

Dr. Norman Ettrich
Department "Competence Center High Performance Computing"
Phone +49 1631 31600-4626
norman.ettrich@itwm.fraunhofer.de

Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM
Fraunhofer-Platz 1
67663 Kaiserslautern
Germany

www.itwm.fraunhofer.de/en/hpc