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Abstract title: Multi-component deblending of marine data using a pattern-based approach

Introduction

We present the theory and initial results for deblending multi-component (MC) simultaneous source data using a pattern-based approach based on multidimensional prediction-error filters (PEFs) (Guitton, 2005). In using this pattern-based approach, we provide a method for PEF estimation that makes use of the directional information recorded on the horizontal geophone components in order to improve the source separation on the hydrophone. We tested our method on synthetic numerical examples and an example from a FreeCable^{TM} data set to demonstrate that using PEFs estimated on all data components results in better separation than using only the hydrophone component.

Theory

To extend the pattern-based approach in order to handle MC data and capture directional patterns, we make the assumption that the data components can be treated as linear combinations of each other. For an acoustic medium, this assumption is valid as the pressure and particle velocity wavefields are linearly related. To capture the directional patterns, we design a multichannel filter with the hydrophone and geophone components as multiple inputs and the prediction-error on the hydrophone as the output.

Examples

We first applied our method to synthetic examples. We showed that for 100% frequency overlap between sources, it is not possible to separate the two sources using only the hydrophone data while the MC approach allows for nearly perfect separation. When the sources do not have 100% overlap in frequency content, using the MC data speeds up the convergence of the inversion. We then applied our method to a FreeCable^{TM} data set acquired in the Mediterranean Sea (Haumonté, et al., 2016). We found that the MC approach achieved an SNR of 16.17dB whereas the single component approach gave an SNR of 11.65dB.

Conclusion

We extended the pattern-based approach for signal and noise separation to incorporate MC data and applied it to the simultaneous source deblending problem. We showed that using the geophone components allowed for better separation of the hydrophone data for both synthetic and field data.

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References

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