Reflection coefficient measurement using a finite-difference injection technique (1pUWc12)

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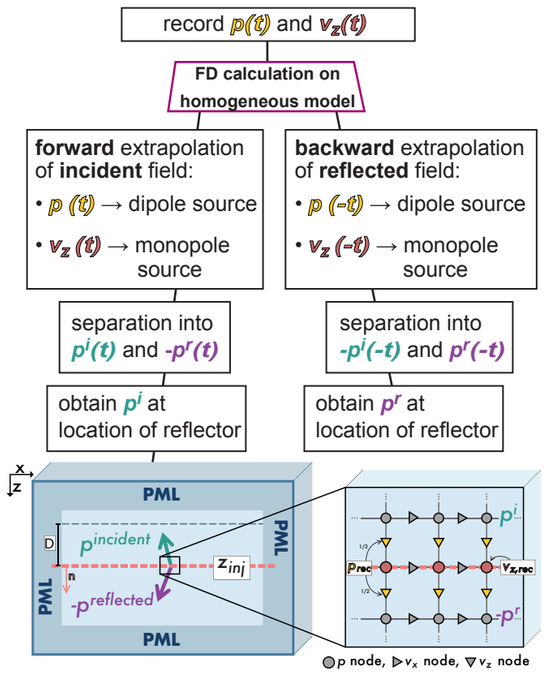
1 Introduction

GOAL: method to experimentally characterize angle- and frequency-dependent reflection coefficients of medium interfaces (here: water-air interface)

HOW TO REACH: 3D finite-difference (FD) injection technique in the space-time domain to separate the recorded wave field and extrapolate the separated constituents to the reflecting interface[1,2]

2 FD injection method



3 Wavefield separation and extrapolation

Experimental setup

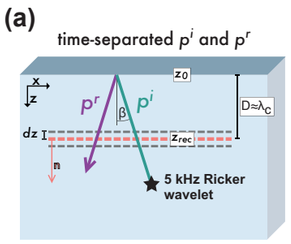
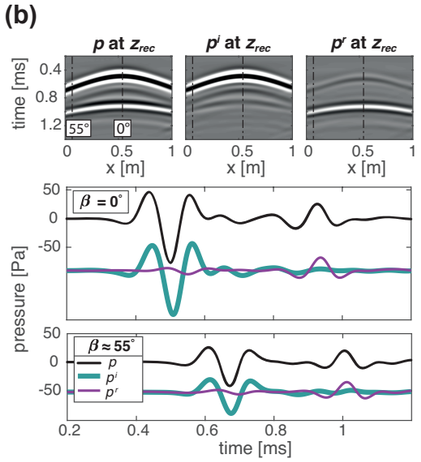


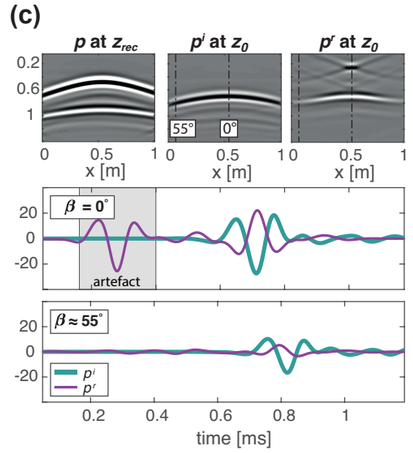
Fig. 1. Time-separated incident and reflected wave field
(a) Experimental setup. The pressure is recorded at different depth levels to calculate the vertical particle velocity.
(b) Separation into incident and reflected wave field at the recording surface.
(c) Forward and backward extrapolation to reflecting interface.

→ **artefact** in backward extrapolation due to limited aperture

Wave field separation



Wave field extrapolation



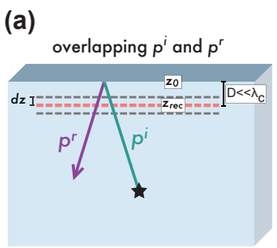
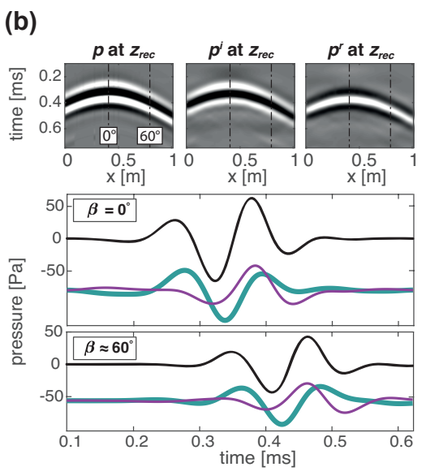
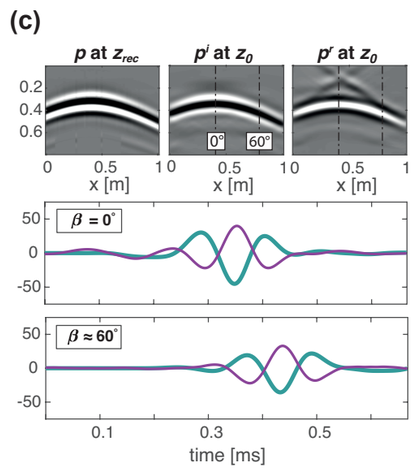


Fig. 2. Overlapping of incident and reflected wave field
(a) Experimental setup.
(b) Separation into incident and reflected wave field at the recording surface.
(c) Forward and backward extrapolation to reflecting interface.

→ **artefact is reduced** in backward extrapolation





5 Reflection coefficient

calculation of R in the space-frequency domain:

$$R(\beta,\omega) = \frac{\tilde{P}^r(\beta,\omega)}{\tilde{P}^i(\beta,\omega)}$$

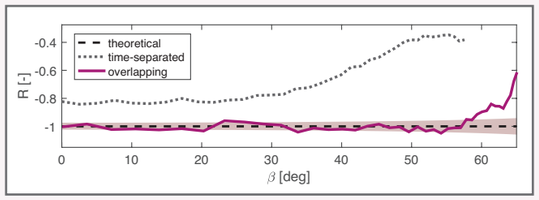


Fig. 3. Experimentally determined reflection coefficients for a frequency of 5kHz, calculated along a line. The pink area indicates the FD spatial resolution error.

6 Conclusion

- separation and extrapolation in space-time domain
- robust for incidence angles up to 60° for broadband wave fields
- crucial requirement to reduce limited aperture effects: recording surface close to reflector
- future studies: frequency-dependent problems including fluid-fluid and fluid-solid interfaces

6 References

1. **Robertsson, J.O.A. & Chapman, C.H., 2000.** An efficient method for calculating finite-difference seismograms after model alterations. *Geophysics*, 65, 907-918.
2. **Amundsen, L. & Robertsson, J.O.A., 2014.** Wave equation processing using finite-difference propagators, Part 1: Wavefield dissection and imaging of marine multicomponent seismic data. *Geophysics*, 79, T287-T300.
3. **Vasmel, M. & Robertsson, J.O.A., 2016.** Exact wavefield reconstruction on finite-difference grids with minimal memory requirements. *Geophysics*, 81, T303-T309.

Acknowledgements

We would like to thank Marlies Vasmel for providing the numerical implementation of the FD injection algorithm.
This work was funded by the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 641943.