Back-projection of physically-modelled seismic data

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ABSTRACT

FWI of measured wavefields yields high resolution images of velocity/density structures but can be very slow if the starting model is far from the true model. We recorded physically-modelled seismograms across a 2D region containing isolated targets, and demonstrate that simply by back-projecting travel-time and amplitude anomalies we are able to quickly create starting models close to the actual model in location, size, and shape.

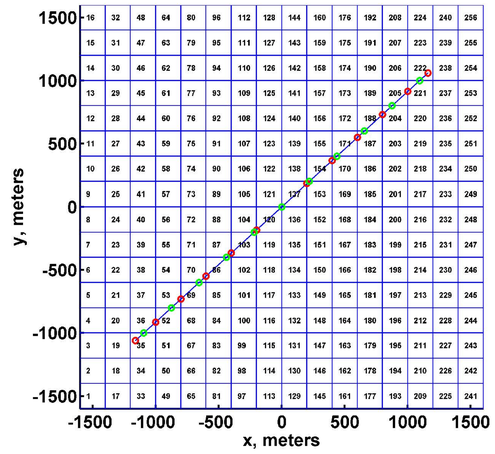

Fig. A1: Top: An example of 2D array of cells on which slowness values will be projected. One ray is shown with its intersections will cell boundaries

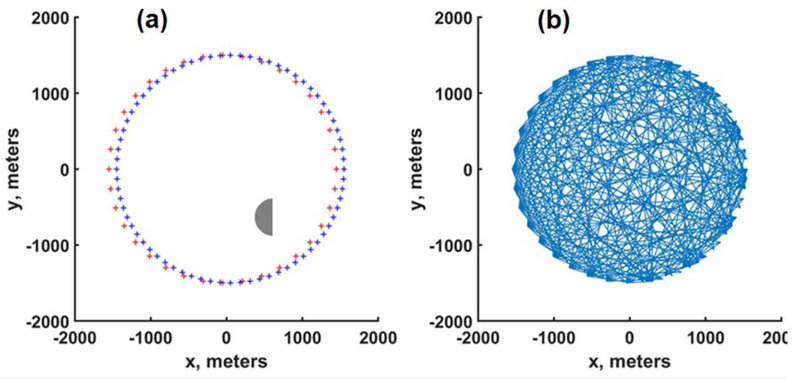

Fig. A2: (a) Source and receiver positions and a single isolated target located within the scanned area. (b) Scanning pattern. Every 5th ray (out of a total of 1333) is displayed.

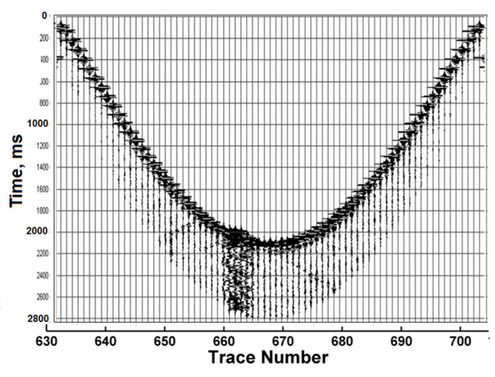

Fig. A3: An example CSG of piezopin-acquired seismograms taken from the survey. Note the arrival-time anomaly.

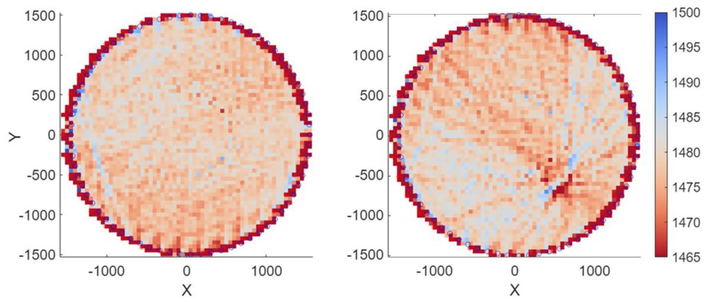

Fig. A4: Velocity images after **10 iterations**, for survey over area with no targets (left) and with one target (right).

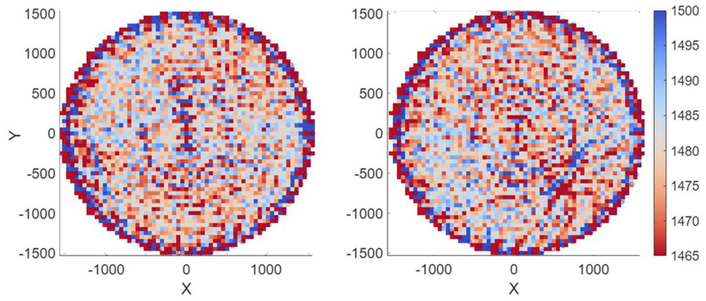

Fig. A5. Velocity images after **50 iterations**, for survey over area with no targets (left) and with one target (right).

Multiple iterations of updating cell slowness residuals in principle should increase the accuracy of the image. But the noise on Figure A5 means too many iterations are over-fitting the input data. The reason are likely due to the following factors: (a) The picked arrival-times are inaccurate; (b) the recorded source-receiver coordinates are deviated from the actual positions; (c) the iterative back-projection algorithm has not been programmed properly.

B. Back-projection of High-Amplitude Rays

We conduct a time-lapse experiment using buzzers. Baseline and monitor surveys survey were recorded scanning across a 2D plane in water without and with targets. Figure C1 shows the physical model setup.

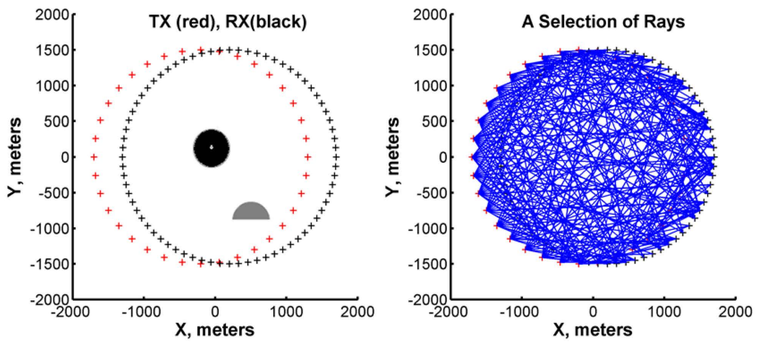

Fig. B1. Right: Buzzer sources (TX) and receivers (RX) are located on an area with two isolated targets. Left: Scanning pattern over the surveyed area. Every 10th ray (out of a total of 2665) is drawn.

Acknowledgements

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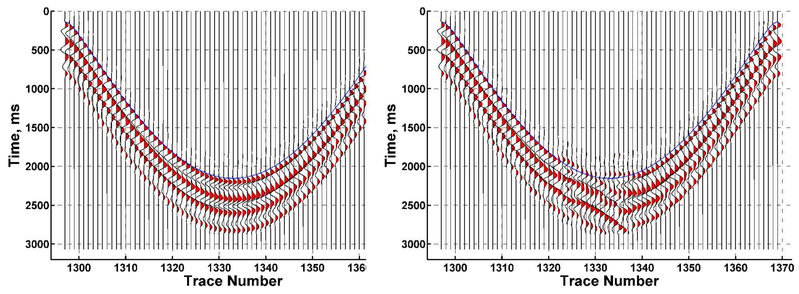

Fig. B2: Left: A CSG from the baseline survey. Right: A CSG from the monitor survey. The effect of the targets is clearly seen.

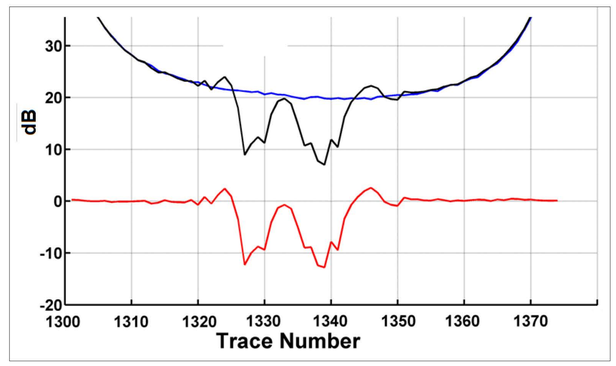

Fig. B4: Blue and black lines are maximum peak-to-peak amplitudes for the CSGs above. Red line is the ration of monitor survey amplitudes to baseline survey amplitudes.

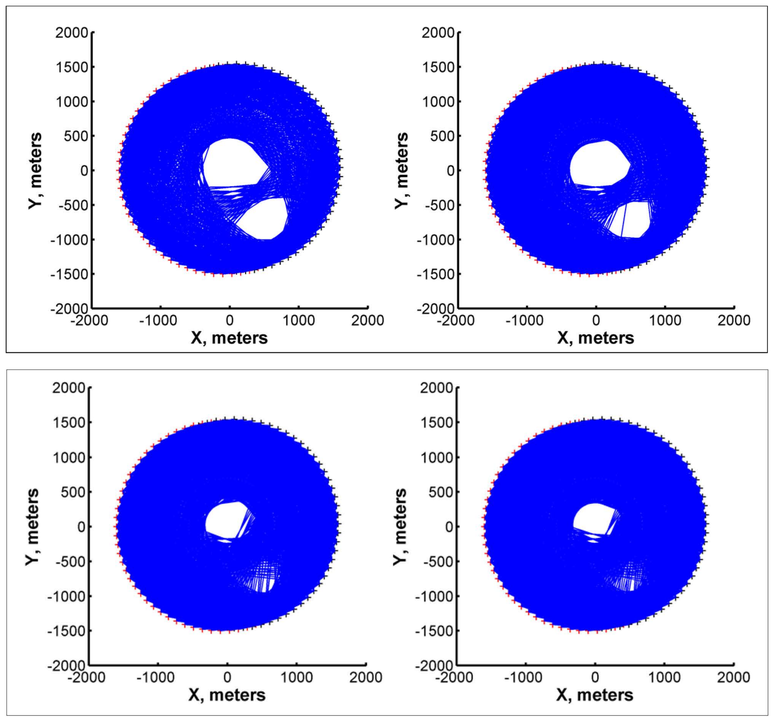

Fig. B5: A ray is drawn if the peak-to-peak amplitude ratio associated with it exceeds a cutoff threshold. Cutoff values for the top two images are -0dB and -1dB. Cutoff values for the bottom two images are -4dB and -5dB.

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