



A feasibility study for the application of seismic interferometry by multidimensional deconvolution for lithospheric-scale imaging

Elmer Ruigrok (1), Joost van der Neut (1), Hugues Djikpesse (2), Chin-Wu Chen (3), and Kees Wapenaar (1)

(1) Delft University of Technology, Department of Geotechnology, Delft, Netherlands (e.n.ruigrok@tudelft.nl), (2) Schlumberger-Doll Research, Department of Mathematics and Modeling, Cambridge, USA, (3) Carnegie Institution of Washington, Department of Terrestrial Magnetism, Washington, USA

Active-source surveys are widely used for the delineation of hydrocarbon accumulations. Most source and receiver configurations are designed to illuminate the first 5 km of the earth. For a deep understanding of the evolution of the crust, much larger depths need to be illuminated. The use of large-scale active surveys is feasible, but rather costly. As an alternative, we use passive acquisition configurations, aiming at detecting responses from distant earthquakes, in combination with seismic interferometry (SI). SI refers to the principle of generating new seismic responses by combining seismic observations at different receiver locations. We apply SI to the earthquake responses to obtain responses as if there was a source at each receiver position in the receiver array. These responses are subsequently migrated to obtain an image of the lithosphere.

Conventionally, SI is applied by a crosscorrelation of responses. Recently, an alternative implementation was proposed as SI by multidimensional deconvolution (MDD) (Wapenaar et al. 2008). SI by MDD compensates both for the source-sampling and the source wavelet irregularities. Another advantage is that the MDD relation also holds for media with severe anelastic losses. A severe restriction though for the implementation of MDD was the need to estimate responses without free-surface interaction, from the earthquake responses. To mitigate this restriction, Groenestijn en Verschuur (2009) proposed to introduce the incident wavefield as an additional unknown in the inversion process. As an alternative solution, van der Neut et al. (2010) showed that the required wavefield separation may be implemented after a crosscorrelation step. These last two approaches facilitate the application of MDD for lithospheric-scale imaging.

In this work, we study the feasibility for the implementation of MDD when considering teleseismic wavefields. We address specific problems for teleseismic wavefields, such as long and complicated source wavelets, source-side reverberations and illumination gaps. We exemplify the feasibility of SI by MDD on synthetic data, based on field data from the Laramie and the POLARIS-MIT array.

van Groenestijn, G.J.A. & Verschuur, D.J., 2009. Estimation of primaries by sparse inversion from passive seismic data, Expanded abstracts, 1597-1601, SEG.

van der Neut, J.R, Ruigrok, E.N., Draganov, D.S., & Wapenaar, K., 2010. Retrieving the earth's reflection response by multi-dimensional deconvolution of ambient seismic noise, Extended abstracts, submitted, EAGE.

Wapenaar, K., van der Neut, J., & Ruigrok, E.N., 2008. Passive seismic interferometry by multidimensional deconvolution, *Geophysics*, 75, A51-A56.