Geophysical Research Abstracts,
Vol. 11, EGU2009-8693, 2009
EGU General Assembly 2009

Attenuation of harmonic noise in vibroseis data using Simulated Annealing

S. P. Sharma (1), Peter Tildy (1), Kambiz Iranpour (2), and Peter Scholtz (1)
(1) Eötvös Loránd Geophysical Institute, Budapest, Hungary , (2) WesternGeco, Oslo, Norway

Processing of high productivity vibroseis seismic data (such as slip-sweep acquisition records) suffers from the well known disadvantage of harmonic distortion. Harmonic distortions are observed after cross-correlation of the recorded seismic signal with the pilot sweep and affect the signals in negative time (before the actual strong reflection event). Weak reflection events of the earlier sweeps falling in the negative time window of the cross-correlation sequence are being masked by harmonic distortions. Though the amplitude of the harmonic distortion is small (up to 10-20 %) compared to the fundamental amplitude of the reflection events, but it is significant enough to mask weak reflected signals. Elimination of harmonic noise due to source signal distortion from the cross-correlated seismic trace is a challenging task since the application of vibratory sources started and it still needs improvement.

An approach has been worked out that minimizes the level of harmonic distortion by designing the signal similar to the harmonic distortion. An arbitrary length filter is optimized using the Simulated Annealing global optimization approach to design a harmonic signal. The approach deals with the convolution of a ratio trace (ratio of the harmonics with respect to the fundamental sweep) with the correlated “positive time” recorded signal and an arbitrary filter. Synthetic data study has revealed that this procedure of designing a signal similar to the desired harmonics using convolution of a suitable filter with theoretical ratio of harmonics with fundamental sweep helps in reducing the problem of harmonic distortion.

Once we generate a similar signal for a vibroseis source using an optimized filter, then, this filter could be used to generate harmonics, which can be subtracted from the main cross-correlated trace to get the better, undistorted image of the subsurface.

Designing the predicted harmonics to reduce the energy in the trace by considering weak reflection and observed harmonics together yields the desired result (resolution of weak reflected signal from the harmonic distortion). As optimization steps proceeds forward it is possible to observe from the difference plots of desired and predicted harmonics how weak reflections evolved from the harmonic distortion gradually during later iterations of global optimization. The procedure is applied in resolving weak reflections from a number of traces considered together. For a more precise design of harmonics SA procedure needs longer computation time which is impractical to deal with voluminous seismic data. However, the objective of resolving weak reflection signal in the strong harmonic noise can be achieved with fast computation using faster cooling schedule and less number of iterations and number of moves in simulated annealing procedure. This process could help in reducing the harmonics distortion and achieving the objective of resolving the lost weak reflection events in the cross-correlated seismic traces.

Acknowledgements: The research was supported under the European Marie Curie Host Fellowships for Transfer of Knowledge (TOK) Development Host Scheme (contract no. MTKD-CT-2006-042537).