Summary: WIT report 2007

IMAGING

Anikiev et al. apply a modified diffraction stack for the localisation of seismic events. Examples for data with a high noise level and near-surface complexities show that the technique yields reliable results for these situations. Furthermore, an additional example demonstrates that the method also leads to a good localisation accuracy even if the velocity model is not known.

Baykulov et al. applied CRS stack method to reflection data from the North German Basin which were recently released by the industry. The reprocessing of the data clearly demonstrates the capabilities of the CRS technique for low fold data. The images display a considerably improved SN ratio and show much more details than the CMP processing of the 1980s. Moreover, a velocity model consistent with the data was build and used to perform pre- and post-stack depth migrations which were so far not available for these data. The new depth images allowed an updated look on the petroleum system of the Glueckstadt Graben, which indicates new possible exploration targets.

Baykulov and Gajewski performed partial stacking of prestack seismic reflection data based on the kinematic wavefield attributes computed during the automatic CRS stack. The resulting CRS supergathers are more regularized and have better signal to noise ratio compared to original CMP gathers. The improved data can be used in any conventional processing tool instead of the original data, providing enhanced images of better quality. The CRS supergather method is especially suited for low fold seismic reflection data. Application of the new method to synthetic and real low fold data shows a clear improvement of seismograms as well as time and depth-migrated sections.

Bohlen et al. discuss a relatively new wave equation based imaging method that utilizes the full information content of the multi-component elastic wave field. The elastic parameters of the sub-surface are derived by an iterative tomographic inversion method. The resolution of the derived velocity models is in the order of the seismic wavelength. Applications to synthetic data sets demonstrate the outstanding imaging potential of the method.

Costa et al. propose a new, reflection-angle-based kind of smoothness constraint as regularization in slope tomography and compare its effects to three other, more conventional constraints. They find the smoothness constraints to have a distinct effect on the velocity model but a weaker effect on the migrated data. The new constraint leads to geologically more consistent models.

Dümmong and Gajewski are presenting two approaches for identification of surface related multiples within the CRS workflow. One approach focusses on the multiple identification with CRS attributes (i.e. the angle of incidence). The second one is based on the multiple prediction by autoconvolving each stacked trace with itself (hybrid SRME-CRS approach). Both approaches are tested on two synthetic data sets.

Gamboa et al. study the effect of enhancement of signal high frequencies on CMP and CRS stacked volumes. It is shown that high frequencies can be successfully recovered by means of the application of spectral whitening. Recovery is seen to be significantly better in CRS than in CMP stacked volumes.

Iversen and Tygel revisit the problem of time-to-depth conversion of a given time-migrated section and a time-migration velocity field. The study, which extends the previous work described in WIT Report 2006, is now fully 3D with an accompanying 3D synthetic example.

Lima et al. propose the use of a fourth-order "semblance" function as an alternative for the classical (second-order) semblance as a coherence measure to obtain CRS parameters from multicoverage data. Their first test show that this higher-order statistics measure better discriminates signal and noise, having, thus, the potential of producing cleaner sections and more reliable parameter estimates.

Meier et al. give a comparison between two tomographic inversion schemes, namely prestack stereotomography and NIP-wave tomography. The results are compared for two examples from a real marine dataset from the Eastern Mediterranean. One example focusses on the vertical resolution of the velocity model and the other one on the lateral resolution of the obtained velocity distribution. The differences are discussed with respect to the different inversion problem formulations.

Pila et al. derive a 2.5D true-amplitude diffraction-stack-type redatuming operator and present its specific form for zero-offset data. The operator consists of performing a single weighted stack along adequately chosen stacking lines. For simple types of media, they derive analytic expressions for the stacking lines and weight functions and demonstrate its functionality with numerical examples.

Schleicher et al. compare the effects of different imaging conditions for common-shot wave equation migration on the final migrated images after stack using the Marmousi data set. They confirm the conclusion from the single-shot experiments that the most robust imaging condition with illumination correction is the one that divides the crosscorrelation of the up- and downgoing wavefields by the autocorrelation of the downgoing wavefield.

Silva Neto et al. propose a new imaging condition with obliquity correction for reverse time migration. Its implementation requires the determination of the Poynting vector of the source and receiver wavefields at the image point. Numerical examples show that the obliquity correction reduces backscattering artifacts and improves the illumination compensation.

Tessmer and Gajewski investigate the influence of a scattering surface layer on the accuracy of reverse modelling event localization.

Ursin and Tygel discuss tuning and stretch effects that appear on AVO and AVA in the presence of a thin layer.

von Steht and Mann present a simple and efficient approach to calibrate the velocities at downhole receivers by means of walkover VSP data. This allows an accurate determination of emergence angles, as verified for wavefield decomposition.

MODELING

Freitas et al. describe a fast method for seismic ray tracing in a cellular model, in which cells can have general polynomial shapes with non-planar bounding faces. Numerical examples are shown using Mod2B, an interactive prototype editor.

Kashtan and Tessmer show that under certain conditions there is a Rayleigh wave which has a horizontal component of polarization perpendicular to its propagation direction. Numerical experiments using the pseudo-spectral Chebyshev method confirm this result. The amplitude of this wave is about 100 times smaller than that of the classical Rayleigh wave.

OTHER TOPICS

Gomes et al. describe the development of CRS Office, a friendly Java graphical user interface for the CRS stack processing code of Dr. Jürgen Mann released in Karlsruhe, Germany, and an example of application to synthetic and real marine data from offshore Brazil.

Feskova et al. present a hybrid modeling procedure involving 2D FD and ray tracing techniques. The approach assumes that the travel path can be determined in the geometrical optic limit. The applicability is demonstrated by numerical experiments of elastic wave propagation for models of different complexity.

Schleicher et al. discuss several different ways of extracting the desired slope information from the data. Based on the observation that the inverse of the local slope can also easily be extracted from the data, they propose a simple, straightforward correction to linear plane-wave destructors and study the extraction numerically.

Schleicher and Aleixo compare a number of traveltime approximations in VTI media that have been discussed in the literature and introduce a few new approximations. Some of the new traveltime formulas have rather simple analytic expressions and provide the same quality of approximation as the better of the established approximations.