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IMAGING

Abakumov et al. introduce a new non-hyperbolic multiparameter stacking operator based on a double square root expression and a pragmatic search strategy for converted waves. The key step of their method is the simulation of a zero-offset section by the stack of γ-CMP gathers, which may be considered an approximation of common conversion point gathers. Numerical experiments confirm that the new expression is superior to the corresponding hyperbolic operator.

Amaro et al. compare a number of imaging conditions based on stabilized least-squares solutions. The conclude that imaging conditions that sum over all sources before deconvolution do not fully preserve amplitudes. As demonstrated on synthetic data of different complexity, the best imaging conditions, both in a true-amplitude sense and regarding migration artifacts are based on total least squares.

Behzadi and Gajewski present a new passive seismic imaging method based on move out correction and cross-correlation stacking. The point source and microtremor events related to a known hydrocarbon reservoir in a complex medium are localized. The maximum of image function obtained by this method provides the source location. Both first and most energetic arrivals are considered and the results of most energetic arrivals provided better source location.

Coimbra et al. present an approach to seismic diffraction imaging and velocity model improvement. This method that uses an approximate velocity as input requirement, provides a average velocity model and diffraction locations in depth domain as result. Our algorithm is based on focus of remigration trajectories over diffraction curves and velocity continuation. This method has been shown as low computational cost numerical method. Beyond that, the automatic location of diffraction points is achieved after image picking.

Costa et al. implement a 3D downward continuation FD migration without splitting in the space coordinates using a complex Padé approximation and implicit finite differences, eliminating numerical anisotropy at the expense of a computationally more intensive solution. They show that the use of the complex Padé approximation not only stabilizes the solution, but also acts as an effective preconditioner for the BICGSTAB algorithm, reducing the number of iterations as compared to implementation using the real Padé expansion.

Dell and Gajewski extended their approach for CRS-attributes based diffraction imaging to 3D geometry. The approach is based on a simultaneous application of the CRS-based diffraction operator and a diffraction filter to separate diffracted events. Also they introduced a technique to build migration velocities in both the depth and time domain. The migration velocities are determined using isolated diffracted events in the poststack domain.

de Figueiredo et al. further develop a method for the detection of diffractor points in a common-offset-gather domain. The method is based on pattern recognition using amplitude distribution along the diffraction operator. While the method, in principle, requires knowledge of the migration velocity field, i.e., RMS or interval velocities, it is very robust with respect to an erroneous model. A real GPR data example demonstrates the feasibility of the method.

Mondini et al. compare the performance of splitting techniques for 3D complex Padé Finite-Difference (FD) migration techniques in terms of image quality and computational cost. The compared splitting techniques are two and alternating four-way splitting. They also extend the Li correction for use with the complex Padé expansion and diagonal directions. From numerical examples in inhomogeneous media, they conclude that alternate four-way splitting is the most cost-effective strategy to reduce numerical anisotropy in complex Padé 3D FD migration.

Rueda et al. employ a smoothing procedure on Common-Reflection-Surface (CRS) parameters to eliminate fluctuations and outliers of stack sections. Application of the scheme attenuates random noise in the stacked sections, leading to an increase in signal-to-noise ratio and better continuity of the reflections. Application to a synthetic and real marine data sets provided encouraging results.

Sakamori and Biloti present a study on a numerical approach to describe the residual moveout observed in image gathers as a function of the migration-velocity correction factor and the dip of the reflector. The new description allows the incorporation of neighbouring image gather to stabilize and improve the the parameter estimates.

Schwarz et al. introduce two conceptually different parameterizations of the isotropic recursive stacking operator (RSO) in terms of the three well-known CRS parameters. While the first parameterization is based on the application of a time shift, the second one results from a Taylor series expansion of the squared RSO traveltime. Accuracy studies reveal that the time-shift-based parameterization behaves essentially the same as the planar multifocusing expression. The parameterization based on a Taylor series expansion turns out to provide higher accuracy than CRS and planar multifocusing over the full investigated range of reflector curvatures for constant vertical velocity gradient media of differing gradient strength.

Schwarz et al. apply two different parameterizations of the recursive stacking operator (RSO) in terms of the CRS attributes to different synthetic datasets. For the simple case of a spherical reflector in a constant vertical velocity gradient medium, application of RSO leads to higher semblance values and more reliable attribute estimates than CRS and planar multifocusing over the full range of reflector curvatures. This also results in an improved approximate attribute-based poststack time migration. Comparison of the stacking and migration results from application of RSO to those from CRS for the Sigsbee 2a model confirms the overall superior performance of RSO for a more complex subsurface setting.

Vanelle et al. suggest a new stacking operator, the recursive stacking operator (RSO), for curved subsurface structures in the presence of anisotropy. It is derived from evaluating Snell's law at a locally spherical interface. Examples show that the new operator performs well for a wide range of reflector curvatures from nearly planar reflectors to the diffraction limit.

Vanelle et al. suggest a new CRS-type hyperbolic stacking operator for converted waves. Although their operator was derived under the assumption of a constant v_p/v_s ratio, it has the advantage that CRS attributes from a monotypic stack can be used as intial values for the converted wave stack, even when v_p/v_s is varying, leading to a significant increase in computational efficiency of the optimisation procedure. Furthermore, monotypic and converted wave attributes can be evaluated for shear model building.

MODELING

Bloot et al. present a general elastic wave equation in weakly anisotropic VTI media by linearizing the stiffness tensor. Using zero-order ray theory, they derive the associated eikonal and transport equations for q-P, q-SV and q-SH waves in general and pseudo-acoustic VTI media.

de Figueiredo et al. use ultrasonic surveys to investigate the influence of source frequency on elastic parameters (the Thomsen parameter γ and shear-wave attenuation) of fractured anisotropic media. Under controlled conditions, they prepared anisotropic models containing penny-shaped rubber inclusions in a solid epoxy resin matrix with 10 to 17 layers, crack density ranging from 0 to 6.2%, and number of uniform rubber inclusions per layer ranging from 0 to 100. S-wave splitting measurements have shown that scattering effects are more prominent in models where the crack aperture to seismic wavelength ratio ranges from 1.6 to 13.3 than other models where the ratio was varied from 2.3 to 23.

FULL WAVEFORM INVERSION

Dunkl gives an overview about 3D elastic full waveform inversion. She shows the performance of the inversion code for the example of a random medium model in transmission geometry.

Kurzmann investigates the influence of attenuation on acoustic 2D full waveform tomography. Acoustic tomography – with or without involvement of attenuation – is applied to viscoacoustic data. The resulting error in velocity reconstruction is quantified.

Macedo decomposes the Fréchet-derivative sensitivity kernels for the full wavefield using a scattering-based approach and assuming acoustic-only data. Those results provide for the decomposition of current FWI kernels into different sub-kernels which have explicitly different levels of nonlinearity with respect to data. This capability to discern levels of nonlinearity within FWI kernels is key to understanding model convergence in gradient-based, iterative FWI.

Przebindowska et al. analyse the role of the density information in the reconstruction of subsurface model by means of full waveform inversion.

Schäfer et al. discuss the effects of geometrical spreading corrections for a 2D full waveform inversion of shallow seismic surface waves. They show synthetic inversion results with line source wavefields and amplitude corrected point source wavefields as observations. They conclude that not only an amplitude correction but also a phase-transformation must be applied to the point source seismograms. Therefore they introduce possible transformations known from literature for body waves and test them for surface waves.

OTHER TOPICS

Asgedom et al. Introduces a new way of diffraction separation in a common-offset section. They utilized a special version of the CRS moveout equation employing a constant-offset central ray and demonstrated the possibility of diffraction separation using both synthetic and real data.

Barros et al. propose an iteratively implementation of MUltiple Signal Classification (MUSIC) algorithm, used for obtainment of high resolution velocity spectra. They also propose a new MUSIC algorithm, based on the spatial covariance matrix of seismic data.

Biloti introduces GêBR, a graphical user interface for seismics processing packages, describing its most appealling features.

Das and Gajewski make an attempt to understand the dependence of coherency measure for velocity analysis. A comparative study of normalized cross-correlation sum and semblance; which are two different measures of coherency is undertaken. The two coherency measures are applied on a large number of synthetic datasets involving different situations. The results of these applications show that the normalized cross-correlation sum measure is better than semblance method in most of the cases, in terms of resolution and identification of events in complex situations.

Minarto and Gajewski discuss the conjugate direction method for the minimization of an objective function. Numerical tests on an analytical example demonstrate the ability of this method to find the global minimum in situations were the Nelder-Mead optimization method gets stuck in a local minimum. The application of the conjugate direction procedure to CRS using the SIGSBEE data revealed that the determination of CRS attributes has a computational advantage of about 4-5 compared to the Nelder-Mead method.

Perroud et al. investigate a recently proposed moveout, of non-hyperbolic character but depending on the conventional common-reflection-surface (CRS) parameters. Such moveout, valid for 2D and 3D models, is referred to as non-hyperbolic CRS traveltime. The few synthetic experiments, available only for 2D models, show that the new moveout exhibits impressive accuracy in long offsets, which encourages its use in the CRS method. In this ongoing research, still restricted to 2D, the sensitivity of the non-hyperbolic CRS moveout to its parameters is evaluated with the aim of the design of parameter estimation strategies. By means of a controlled parameter perturbation in selected configurations, which extend those used in conventional CRS, the study confirms the high potential of the new moveout as an optimal choice for CRS.