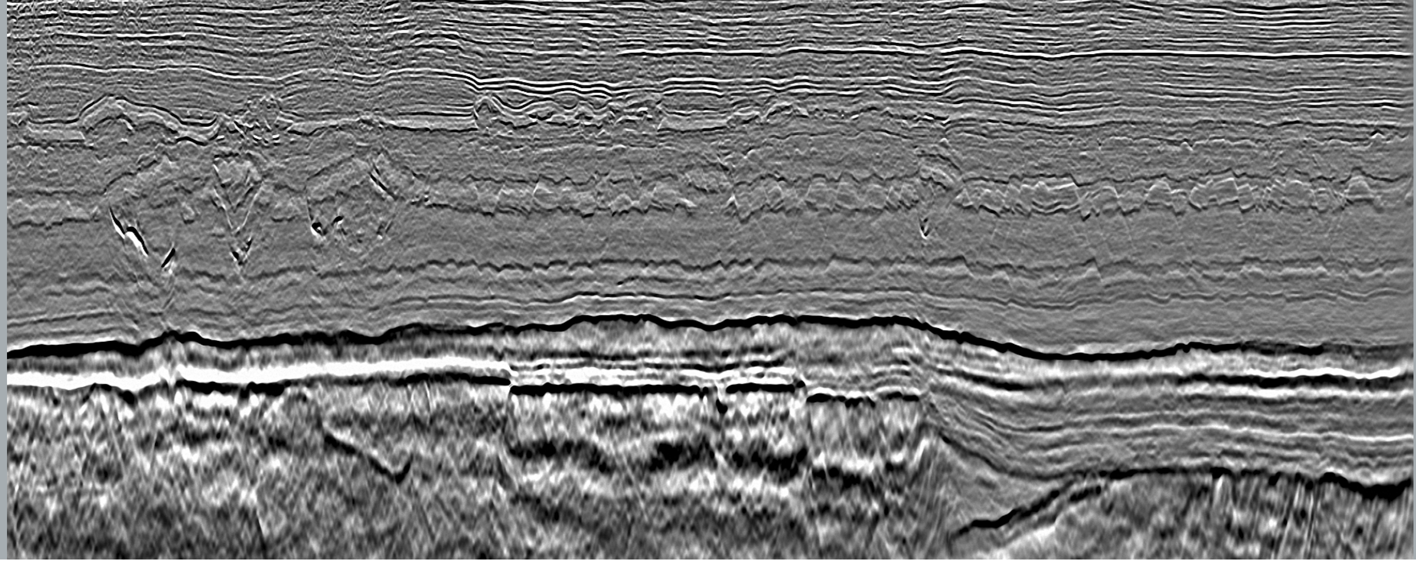
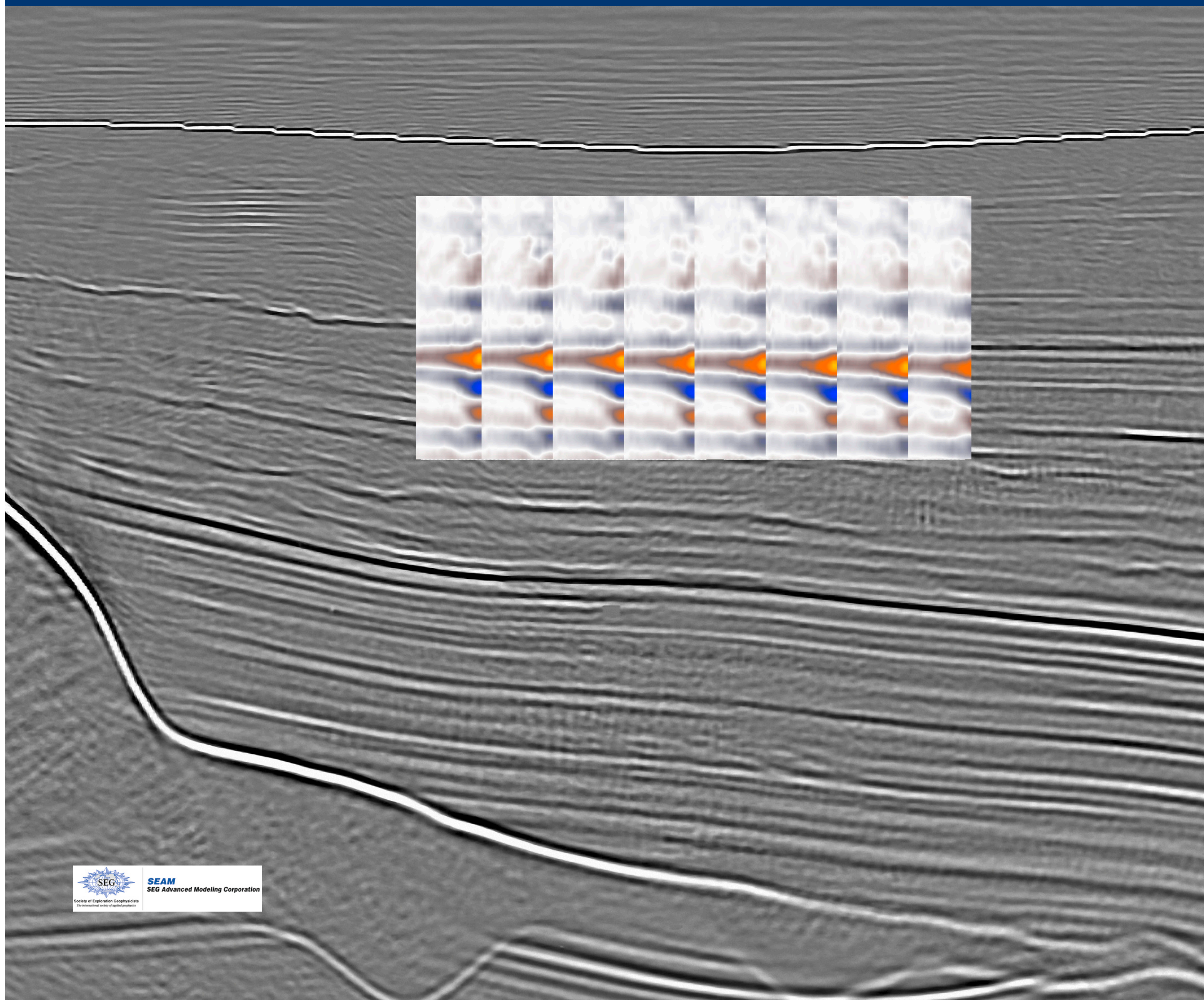


Fraunhofer
ITWM

FRAUNHOFER INSTITUTE FOR INDUSTRIAL MATHEMATICS

SF-GRT ANGLE DOMAIN MIGRATION

TRUE-AMPLITUDE DEPTH MIGRATED IMAGE GATHERS FOR AVA INTERPRETATION



Projects and licenses

ITWM offers services with SF-GRT. Projects are executed on ITWM's computers.

Client provides arbitrarily sorted/unsorted 3D data without any correction of geometrical spreading. Traces must have source/receiver coordinates set. Client gets migrated true-amplitude angle gathers, stack of the gathers, and a processing report. For optional post-processing (alignment, noise suppression, demultiple, depth-to-time conversion, ...) PSPRO's gather conditioning toolkit is used.

ITWM offers introductory projects to new clients that aim at demonstrating SF-GRT's benefit to the clients' data. In these projects, target-oriented migration to few lines will be executed using 3D data input.

In case of ordering a subsequent full-volume migration, the price for the target-oriented migration will be credited.

Pricing

- Full volume migration: charge per km² input data
  - Surcharge for TTI velocity models
  - Surcharge for migration depth larger 8 km
- Special offer for 3D migration to 2D output

The SF-GRT-software can be licensed and used on clients' clusters or in the Cloud. Although the usage of the software is straightforward, it is recommended to ask for training courses to learn how to exploit SF-GRT's several additional options. Prices are available upon request.

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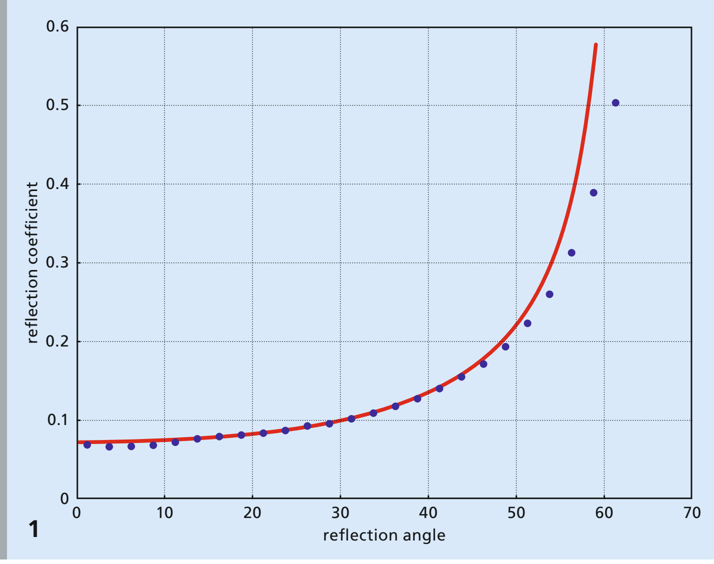
hpc_flyer_SF-GRTAngleDomainPrestackDepthMigration-EN-2016



1 *Reflection coefficients from GRT angle gathers (blue), compared to the exact curve (red)*

Introduction

Fraunhofer ITWM and Statoil have developed a 3D angle domain migration based on the theory of generalized Radon transform (GRT) for massively parallel commodity clusters (Ettrich, N., Merten, D. and Foss, S.-K., 2008. True-amplitude Angle Migration in Complex Media, EAGE, Expanded Abstracts). The underlying technology of ITWM's GPI allows to efficiently handle big data sets in memory as needed for GRT migration jobs with fast turn-around time. ITWM's SF-GRT is worldwide among the very few implementations of this method that run in production-mode on big data sets.

Ray-based migration schemes, carried out in the angle domain, offer several advantages over conventional Kirchhoff migration methods:

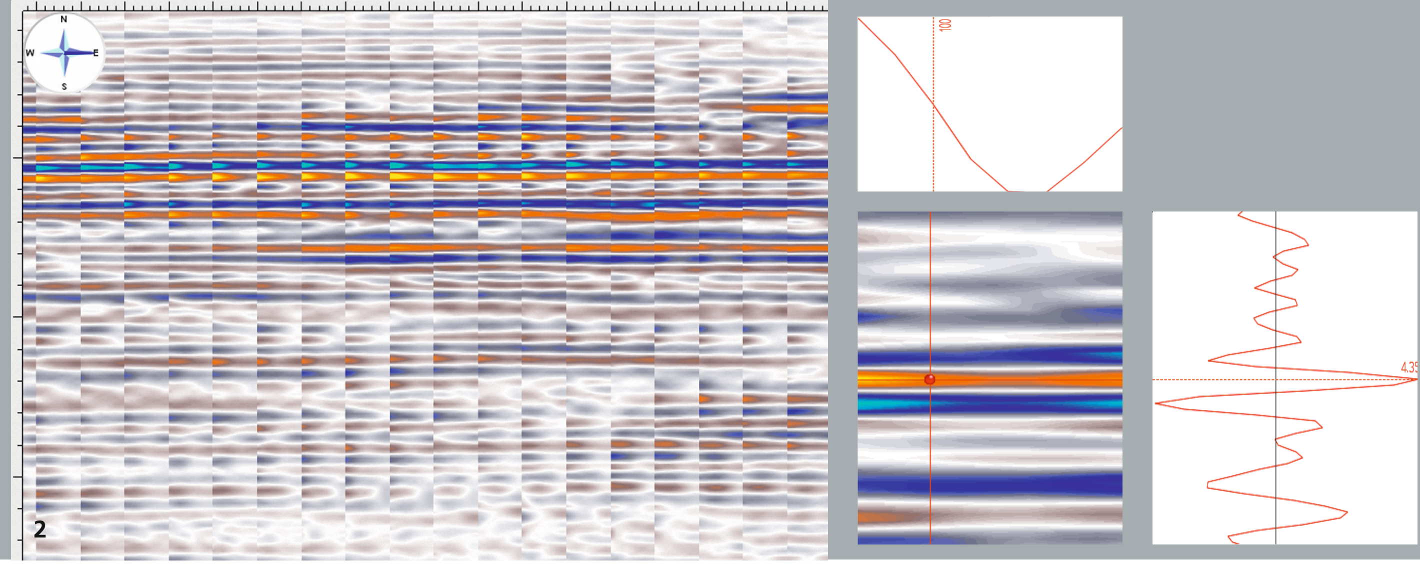
- The migration result is generated in dependence on incidence angle. No explicit knowledge of local dip or post-migration mapping between offset and angle is required.
- There is no need for regularizing the input data.
- True-amplitude weighting is applied to the seismic traces. Migration amplitudes are, thus, proportional to the local angle- and azimuth-dependent reflection coefficient.
- Identifying rays in the angular domain solves problems of multi-pathing in a natural way, while Kirchhoff migration has severe problems in storing and accessing multiple ray events. GRT is, thus, essentially an all-arrival migration.

Technical

SF-GRT is a true-amplitude migration based on ray tracing that computes the reflection response in dependence on sub-surface angle of incidence:

$$R(\theta,\psi,\mathbf{x}) = \int_{E_{v^m}} W\,\tilde{u}_{,t}\left[\mathbf{x}^r, T(\mathbf{x}^r,\mathbf{x},\mathbf{x}^s), \mathbf{x}^s; \mathbf{x}\right] d\nu^m \quad \text{with} \quad W = \frac{\left|\mathbf{p}^m(\mathbf{x})\right|^2}{2\sqrt{V^r(\mathbf{x})\cos\alpha^r\, V^s(\mathbf{x})\cos\alpha^s}}$$

where θ is the inclination angle of the incident ray, measured with respect to the vertical direction, and Ψ is the azimuthal angle. For narrow azimuth data, the azimuthal component is sparsely covered and the migration result $R(\theta,\mathbf{x})$ is computed solely in dependence on the inclination angle at sub-surface points $\mathbf{x}$.



2 *Angle gathers with AVA curve and trace-wiggle plot*

Seismic input traces u should not have any amplitude scaling applied prior to GRT migration. GRT internally converts the input traces to versions $\tilde{u}$ from which the amplitudes are picked according to computed traveltime $T(\mathbf{x}^r,\mathbf{x},\mathbf{x}^s)$ between source/receiver and output point $\mathbf{x}^r,\mathbf{x},\mathbf{x}^s$. The weighting factor W and integration weights according to the dip-vector increment $d\nu$ make the output R proportional to the reflection coefficient.

The list of features of SF-GRT comprises

- Output of spatially densely sampled true-amplitude reflection angle gathers
- Isotropic, VTI, TTI, and orthorhombic velocity models
- Marine surface, marine OBC, and PP land data
- PS converted wave mode
- Ray-perturbation workflow to enable migration with weakly smoothed velocity models
- Identification of subsurface azimuth, WAZ migration
- Output of dip angle gathers for event analysis
- Diffraction imaging
- Output of directional dependent subsurface illumination
- Dip-focusing and aperture-optimization
- Signal-to-noise enhancement
- Implementation for distributed memory clusters of O(100) compute nodes
- GRT in the Cloud