Seismic Modeling, Migration and Velocity Inversion Migration Review

Bee Bednar

Panorama Technologies, Inc. 14811 St Marys Lane, Suite 150 Houston TX 77079

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Bee Bednar (Panorama Technologies) Seismic Modeling, Migration and Velocity Inversion

Outline



Review

- The Hierarchy
- Economics and Practicalities



Review

Outline



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- The Hierarchy
- Economics and Practicalities



Non Ray Based Methods

Two-Way propagation

- Finite Difference in Space-Time
- Pseudo Spectral
 - Derivatives via Fourier Transform
- No time domain version
- One-Way propagation
 - Finite Difference in Space-Time
 - Implicit method accurate but difficult to implement
 - PSPI
 - Phase-shift plus interpolation method
 - Wavefield interpolation is the issue
 - Phase Screen
 - No interpolation
 - More mathematical approach
 - Full 3D V(x,y,z) throughout



Alias Suppression

RTM and XT one-way methods

- Aliasing handled in XT
 - Choice of Δx , Δy , Δz
- Proper choice of source frequency
- Frequency domain methods
 - Aliasing handled in FK or FX
 - Transformation of the basic equations
 - Aliasing handled in XT
 - Choice of Δx , Δy , Δz





Ray Based Methods

Three Ray Based Methods

- Classic Beam
- Gaussian Beam
- Kirchhoff
- All easily handle TTI

All have similar issues relative to traveltimes

- Very sensitive to lateral velocity changes
- Model must be smooth
- High ray density for Kirchhoff and Beam
- Rays below very fast structure in slow surroundings
 - Salt, Basalt, Granite, ···



Alias Suppression

- Ray methods handle aliasing on the fly
- They filter as a function of dip
- There are two popular methods
 - Direct application of a low pass filter
 - So called triangular filters
 - Both accomplish the same result





Prestack Migration/deMigration Algorithms



Accuracy (Amplitudes and Wavefront) increases from bottom to top Sensitivity to velocity errors tends to decrease from bottom to top Computational costs tends to increase from bottom to top Everything below the horizontal line is a one-way mothod

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Prestack Migration/deMigration Algorithms



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Beam

Fabulous for velocity estimation

- When coupled with automatic picking algorithms
- Multiple migrations with different Earth models
- Can bring out events not visible in other methods
- Poor amplitude response in some implementations
- Excellent for initial interpretations
- Excellent for hypothesis testing
 - Restricted dip imaging
 - Flat water bottom multiple suppression
- Best in areas with weak lateral velocity variation
- Economic



Kirchhoff

- Velocity workhorse
- Understood by everyone
- Excellent implementations
- Improved resolution
- Reasonable amplitude response
- Less Economic then Beam
- Better in areas with weak lateral velocity variation



One-way methods

- Much higher resolution
- Improved amplitude response
- Some loss of dip
- Much less economic then Beam and Kirchhoff
- Excellent imaging in areas with strong lateral velocity variation

RTM and Gaussian Beam

- Much higher resolution
- Most expensive approaches
- Least velocity sensitivity
- Best amplitude response
- All dips maintained
- Excellent imaging in areas with strong lateral velocity variation



Questions?

