Wavefield tomography based on local image correlations

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Shot 3
Migration Velocity Analysis

Velocity error from migrated images
Velocity analysis criteria

Semblance

Focusing
Velocity analysis criteria

Semblance (common-image gathers)

Focusing
Velocity analysis criteria

Semblance (common-image gathers)

Focusing (common-image point gathers)
Velocity analysis criteria

Semblance (common-image gathers)

Focusing (common-image point gathers)

Warping
Velocity analysis criteria

Semblance (common-image gathers)

Focusing (common-image point gathers)

Warping (few images)
Incorrect model
Incorrect model
Incorrect model
Incorrect model
Correct model
Correct model
Correct model
Correct model
Dip and Warping
Dip and Warping
Dip and Warping
Warping

\[ c_j(x, \lambda) = \int_{w(x)} R_{j+1} \left( \xi - \frac{\lambda}{2} \right) R_j \left( \xi + \frac{\lambda}{2} \right) d\xi \]

\[ w(x) : \text{Gaussian window} \]
Warping

\[ c_j(x, \lambda) = \int_{w(x)} R_{j+1} \left( \xi - \frac{\lambda}{2} \right) R_j \left( \xi + \frac{\lambda}{2} \right) d\xi \]

\( w(x) \) : Gaussian window

\[ u(x) = \arg \max_\lambda c_j(x, \lambda) \]
Warping

\[ c_j(x, \lambda) = \int_{w(x)} R_{j+1}(\xi - \frac{\lambda}{2}) R_j(\xi + \frac{\lambda}{2}) \, d\xi \]

\( w(x) \): Gaussian window

\[ u(x) = \arg \max_{\lambda} c_j(x, \lambda) \]
\[ P(x, \lambda) = \lambda \cdot \nu(x) \]
$P(x, \lambda) = \lambda \cdot \nu(x)$
$P(x, \lambda) = \lambda \cdot \nu(x)$
$P(x, \lambda)$
$P(x, \lambda) c(x, \lambda)$
High velocity

\[ P(x, \lambda) c(x, \lambda) \]
Correct velocity

\[
P(x, \lambda)c(x, \lambda)
\]
Low velocity
Objective function

\[ J = \frac{1}{2} \sum_{j} \left\| r_{j}(x) \right\|_{x}^{2} \]

\[ = \frac{1}{2} \sum_{j} \left\| \sum_{\lambda} P(x, \lambda) c_{j}(x, \lambda) \right\|_{x}^{2} \]
Gradient computation

adjoint-state method

slowly varying dip field
Inversion test
Correct model
Initial model
12th iteration
Image: 12th iteration

The diagram shows a cross-sectional view with the x-axis labeled as "x (km)" and the z-axis labeled as "z (km)". The horizontal scale ranges from 0 to 9 km, and the vertical scale ranges from 0 to 4 km. The lines in the diagram represent geological features or measurements at various depths and positions along the x-axis.
Shot-domain CIGs: initial model
Shot-domain CIGs: 12th iteration
Real Data
200 shots

99 receivers per shot

marine streamer

max offset 1.225 km
Conclusions

model information in structural features

model building while imaging
Insights

stereotomography

dynamic-image warping

integration with data-domain FWI
Acknowledgments

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