Anisotropy signature in extended images

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North Sea data courtesy of Statoil & partners
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wavefield seismic imaging

wavefield reconstruction

\[ \mathcal{L} [W_s (x, t)] = D_s (x_s, +t) \]
\[ \mathcal{L} [W_r (x, t)] = D_r (x_r, -t) \]
wavefield seismic imaging

wavefield reconstruction

\[
\mathcal{L} [W_s (x, t)] = D_s (x_s, +t) \\
\mathcal{L} [W_r (x, t)] = D_r (x_r, -t)
\]

conventional imaging condition

\[
R (x) = \sum_{\text{shots}} \sum_{t} W_s (x, t) W_r (x, t)
\]
North Sea data courtesy of Statoil & partners
wavefield seismic imaging

wavefield reconstruction

\[
\begin{align*}
\mathcal{L} [ W_s (x, t) ] &= D_s (x_s, +t) \\
\mathcal{L} [ W_r (x, t) ] &= D_r (x_r, -t)
\end{align*}
\]

extended imaging condition

\[
R (x, \lambda, \tau) = \sum_{\text{shots}} \sum_t W_s (x - \lambda, t - \tau) W_r (x + \lambda, t + \tau)
\]
extended images

\[ R (x, y, z, \lambda_x, \lambda_y, \lambda_z, \tau) \]

huge & redundant
extended images construction

\[ R \left( x, y, z, \lambda_x, \lambda_y, \lambda_z, \tau \right) \]

assess directional illumination

analyze model accuracy
extended images construction
common-image gathers

\[ R \left( x_c, y_c, z, \lambda_x, \lambda_y, \lambda_z = 0, \tau = 0 \right) \]

biased & arbitrary
extended images construction
common-image-point gathers

\[ R \left( x_c, y_c, z_c, \lambda_x, \lambda_y, \lambda_z = 0, \tau \right) \]

unbiased & efficient
NORTH SEA data courtesy of STATOIL & PARTNERS
automatic picks

NORTH SEA data courtesy of STATOIL & partners
$R(\lambda_x, \lambda_y, \tau)$

**North Sea data courtesy of Statoil & partners**
$R(\lambda_x, \lambda_y, \tau)$

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velocity sensitivity

Yang et al., WEMVA/FWI Theory
anisotropy sensitivity

\eta_L

\eta_C

\eta_H
sensitivity heterogeneity

Model courtesy of the SEAM Consortium
moveout function

\[ \tau \approx \frac{3 \text{sgn} (\eta) \lambda_x^{4/3}}{8v \sqrt[3]{\eta} z^{1/3}} \]
North Sea data courtesy of Statoil & partners
conclusions

efficient extended images

sensitivity to model error

velocity/anisotropy discrimination
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