Wide-azimuth angle-domain imaging for anisotropic RTM

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wide-azimuth angle gathers
wide-azimuth angle gathers

accurate wavefield imaging
wide-azimuth angle gathers

accurate wavefield imaging

efficient angle decomposition
accurate wavefield imaging

wavefield reconstruction

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

wavefield reconstruction

\[ L \left[ W_s (x, t) \right] = D_s (x_s, + t) \]
\[ L \left[ W_r (x, t) \right] = D_r (x_r, - t) \]

conventional imaging condition

\[ R (x) = \sum_{\text{shots}} \sum_{t} W_s (x, t) W_r (x, t) \]
accurate wavefield imaging

wavefield reconstruction

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

extended imaging condition

\[ R(x, \lambda, \tau) = \sum_{\text{shots}} \sum_{t} W_s(x - \lambda, t - \tau) W_r(x + \lambda, t + \tau) \]
**wavefield-domain decomposition**

loop over shots

1. build $W_s(x, t), W_r(x, t)$
2. decompose $W_s(x, t), W_r(x, t)$
3. select main wave paths
4. apply imaging condition
wavefield-domain decomposition

loop over shots{
    build $W_s(x, t), W_r(x, t)$
    decompose $W_s(x, t), W_r(x, t)$
    select main wave paths
    apply imaging condition
}

image-domain decomposition

loop over shots{
    build $W_s(x, t), W_r(x, t)$
    apply imaging condition
}

decompose $R(x, \lambda, \tau)$
efficient angle decomposition

1. use extended images
2. 
3. 
$R(x, \lambda, \tau)$

common-image gathers: wasteful, biased
$R(c, \lambda, \tau)$

common-image-point gathers: efficient, un-biased
$R(c, \lambda, \tau)$
efficient angle decomposition

1. use extended images
2. use common-image-point gathers
3. 
conventional IC interpretation
extended IC interpretation
extended IC interpretation
ISO: reflection geometry
TTI: reflection geometry

\[ \psi (\theta) \]

\[ n_r \]

\[ n_s \]

\[ 2\theta \]
ISO: $\psi(\theta)$

$v_p = 3 \text{ km/s}$
TTI: $\psi(\theta)$

$v_p = 3\, km/s, \epsilon = +0.45, \delta = -0.29, \theta_a = 35^\circ, \phi_a = 90^\circ$
anisotropic decomposition

\[ R (\lambda, \tau) \xrightarrow{\psi(\theta), v_s(\theta, \psi), v_r(\theta, \psi)} R (\phi, \theta) \]

\[(\hat{q} \cdot \lambda) \sin (2\theta) = [v_s \cos (\theta + \psi) + v_r \cos (\theta - \psi)] \tau\]
anisotropic decomposition

\[ R(\lambda, \tau) \xrightarrow{\psi(\theta), v_s(\theta, \psi), v_r(\theta, \psi)} R(\phi, \theta) \]

\[
(\hat{q} \cdot \lambda) \sin (2\theta) = [v_s \cos (\theta + \psi) + v_r \cos (\theta - \psi)] \tau
\]

\[
(\hat{n} \cdot \lambda) = 0
\]
efficient angle decomposition

1. use extended images
2. use common-image-point gathers
3. use reflector geometry
\( v_p = 3\text{km/s} \)
\[ v_p = 3 \text{km/s}, \epsilon = +0.45, \delta = -0.29, \theta_a = 35^\circ, \phi_a = 90^\circ \]
wide-azimuth angle gathers

- accurate wavefield imaging
- anisotropic RTM
- efficient angle decomposition
- extended CIPs
Center for Wave Phenomena