Interferometric imaging condition

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Velocity

\[ v = v_0 + \delta v \]

- \( v \): true velocity
- \( v_0 \): background velocity (knowable)
- \( \delta v \): perturbation velocity (unknown)
Velocity

\[ v = v_0 + \delta v \]

\( v_0 \): background velocity (knowable)

\( \delta v \): perturbation velocity (unknowable)

- \( v_0 \): background velocity
Velocity

\[ \nu = \nu_0 + \delta \nu \]

- \( \nu \): true velocity
- \( \nu_0 \): background velocity
- \( \delta \nu \): perturbation velocity
Velocity

\[ \nu = \nu_0 + \delta \nu \]

- \( \nu \): true velocity
- \( \nu_0 \): background velocity (knowable)
- \( \delta \nu \): perturbation velocity (unknowable)
WE imaging

wavefield reconstruction

imaging condition
WE imaging

wavefield reconstruction
  - non-conventional (tomography/inversion)

imaging condition
  - conventional
WE imaging

wavefield reconstruction

- conventional

imaging condition

- non-conventional (interferometry)
receivers

sources

passive array experiment
source
scatterers
receivers

active array experiment
simulated time position
recorded time position
simulated

recorded

time  position

time  position
$G_0 \left( x_m, y_m, \omega_m \right)$

$P \left( x_m, \omega_m \right)$
Conventional I.C.

\[ R \left( y_m \right) = \int_{\omega_m} d\omega_m \]

\[ \int_{x_m} d\omega_m \left[ P \left( x_m, \omega_m \right) \frac{G_0 \left( x_m, y_m, \omega_m \right)}{x_m} \right] \]

- \( P \): recorded data at coordinates \( x_m \)
- \( R \): reconstructed image at coordinates \( y_m \)
Conventional I.C.

\[ R(y_m) = \int d\omega_m \]

\[ \int d\mathbf{x}_m \ P(\mathbf{x}_m, \omega_m) \ \frac{G_0(\mathbf{x}_m, y_m, \omega_m)}{\omega_m} \]
Conventional I.C. modeling with $\nu$ migration with $\nu_0$
$x_m$

$y_m$
Interferometric I.C.
Interferometric I.C.

\[ R\left(y_m\right) = \int \omega_m \int_{\left|y_h\right| \leq Y/2} dy_h \]

\[ \int_{x_m} dx_m \ P\left(x_m, \omega_m\right) \overline{G_0}\left(x_m, y_m - y_h, \omega_m\right) \]

\[ \int_{x_m} dx_m \ P\left(x_m, \omega_m\right) \overline{G_0}\left(x_m, y_m + y_h, \omega_m\right) \]
Interferometric I.C.

\[ R(y_m) = \int d\omega_m \int_{|y_h| \leq Y/2} dy_h \]

\[
\int d\mathbf{x}_m \left( \int d\mathbf{x}_m \right) P(\mathbf{x}_m, \omega_m) \overline{G_0(\mathbf{x}_m, y_m - y_h, \omega_m)} \frac{1}{\int d\mathbf{x}_m \left( \int d\mathbf{x}_m \right) P(\mathbf{x}_m, \omega_m) \overline{G_0(\mathbf{x}_m, y_m + y_h, \omega_m)}}
\]
Interferometric I.C.

\[ R(y_m) = \int d\omega_m \int_{|y_h| \leq Y/2} dy_h \]
\[ \int_{x_m} dx_m P(x_m, \omega_m) \frac{G_0(x_m, y_m - y_h, \omega_m)}{G_0(x_m, y_m + y_h, \omega_m)} \int_{x_m} dx_m P(x_m, \omega_m) \]
Interferometric I.C.

\[
R(y_m) = \int_{\omega_m} d\omega_m \int_{|y_h| \leq Y/2} dy_h \\
\int_{x_m} dx_m P(x_m, \omega_m) \frac{G_0(x_m, y_m - y_h, \omega_m)}{G_0(x_m, y_m + y_h, \omega_m)}
\]
Interferometric I.C. modeling with $\nu$ migration with $\nu_0$
Interferometric I.C.  

Conventional I.C.
IIC robustness

model realization

anomaly magnitude

anomaly size
robustness to model realization

...images do not change for data generated with different model realizations...
robustness to anomaly magnitude

... images are stable for models with large magnitude variations ...
Summary

WE imaging:

- conventional wavefield reconstruction
- interferometric imaging condition
simulated

recorded

time

position

time

position