Wave field autofocusing and imaging with multidimensional deconvolution

Numerical examples in complex media

Filippo Broggini* and Roel Snieder
Center for Wave Phenomena

Kees Wapenaar
Delft University of Technology
Wapenaar et al. – GJI (2012) and PRL (2013)
Broggini et al. – SEG expanded abstract (2012)
$G(x_I, x_S, t)$
$G^+ (x_I, x_S, t)$

$G^- (x_I, x_S, t)$

$z \text{ (km)}$

$x_1 \text{ (km)}$

$\frac{\text{km/s}}{}$
Reference
$G(x_I, x_S, t)$
$G^-(x_I, x_S, t)$
Reflection response
Background velocity

![Graph showing background velocity with x and z axes in kilometers and a color scale for km/s.](image-url)
One-way migration
One-way migration
Autofocusing + correlation
1. retrieve $G^+$ and $G^-$ at each image point
2. crosscorrelate $G^+$ and $G^-$
3. evaluate at $t = 0$
Autofoocusing + correlation
Solve $R$ by MDD

$$G^-(x_R, x_S, t) = \int_{-\infty}^{\infty} \left[ R(x_R, x, t) \ast G^+(x, x_S, t) \right]_{z_I} \, dx$$

Wapenaar et al. – GJI (2011)
van der Neut et al. – Geophysics (2011)
Auto-focusing + MDD
Autofocusing + MDD
Comparison

MDD

One-way
Background velocity +10% error
One-way migration
Autofocusing + MDD

![Diagram with labeled axes: x (km) and z (km)]

- Red arrow pointing at a specific region
- Yellow arrow pointing at another specific region
Conclusions

• accurate wave field retrieval
• autofocusing + MDD (or correlation) yields an image free of ghost reflectors
  – Forward and back propagation are NOT needed
• robust with respect to errors in the background velocity model
Future work

• reflection data with free-surface multiples
• attenuation
• application to real data
• elastic waves
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Questions

I never worry about the future.
It comes soon enough.

- Albert Einstein