Ocean-bottom acquisition
Conventional approach

Actual medium

Fluid

Solid

Numerical model

V_s=0

Elastic propagator
Conventional approach

Actual medium

Numerical model
Finite-differences
Finite-differences
Mimetic finite-differences

Fluid

Interface

Solid
Mimetic finite-differences

Fluid

Solid

Interface
Finite-differences: $O(\Delta x^4)$ stencil
Mimetic finite-differences (MFD): Stencil

$O(\Delta x^4)$

$\frac{1}{24}' \quad \frac{-27}{24}' \quad \frac{27}{24}' \quad \frac{-1}{24}$

$O(\Delta x^4)$
MFD: Grid

Fluid

Interface

Solid
MFD for coupled media: Split-node approach
Acoustic/acoustic interface

Distance (km)

Depth (km)

Fluid

Fluid
Acoustic/acoustic interface
Acoustic/acoustic interface

$V_X$

$V_Z$

Coupled

Full-domain

Amplitude

t (s)
Difference for acoustic/acoustic interface

\[ v_x(t) \]

\[ v_z(t) \]

Graphs showing the coupled and difference amplitudes for \( t \) from 0 to 1.0 seconds.
Acoustic/elastic interface

Depth (km)

Solid

Fluid

Distance (km)
Acoustic/elastic interface

$V_X$

$V_Z$

Amplitude vs. time for coupled and full-domain solutions.
Difference for acoustic/elastic interface

$V_X$

$V_Z$
Acoustic/elastic VTI interface
Acoustic/elastic VTI interface

t = 0.4 s

t = 0.75 s
Acoustic/elastic VTI interface

1) Head P-wave
2) Direct P-wave
3) Scholte wave
4) Free-surface reflections
Acoustic/elastic VTI interface

![Diagram of Acoustic/elastic VTI interface]

- **Fluid**
- **VTI**
SV-wave parameter \( \sigma = \left( \frac{V_{P0}}{V_{S0}} \right)^2 (\epsilon - \delta) = 1.6 \)
VTI Marmousi model

\[ \epsilon \]

\[ \delta \]
Wavefield snapshots
Summary

- coupled-domain mimetic FD algorithm
- reduces computational cost
- enforces correct boundary conditions
- uniform accuracy at interface and in model interior
Research plan

- incorporate bathymetry
- imaging/inversion of ocean-bottom data