First-order P-wave ray synthetic seismograms in inhomogeneous, weakly anisotropic, layered media

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Outline

- Introduction
- Numerical examples
  - HTI/HTI model
  - ORT/ORT model
- Conclusions

Introduction

FORT and FODRT for P waves in smooth media:

Replacement of the exact eigenvalue of the Christoffel matrix

by its first-order counterparts

Use of second-order traveltime correction

FORT and FODRT in layered media:

Transformation of FORT and FODRT at an interface

Transformation of amplitudes at an interface

Introduction

Transformation of FORT at an interface

Iterative determination of the slowness vector of a generated wave

Transformation of FODRT at an interface

Exact formulae with exact quantities

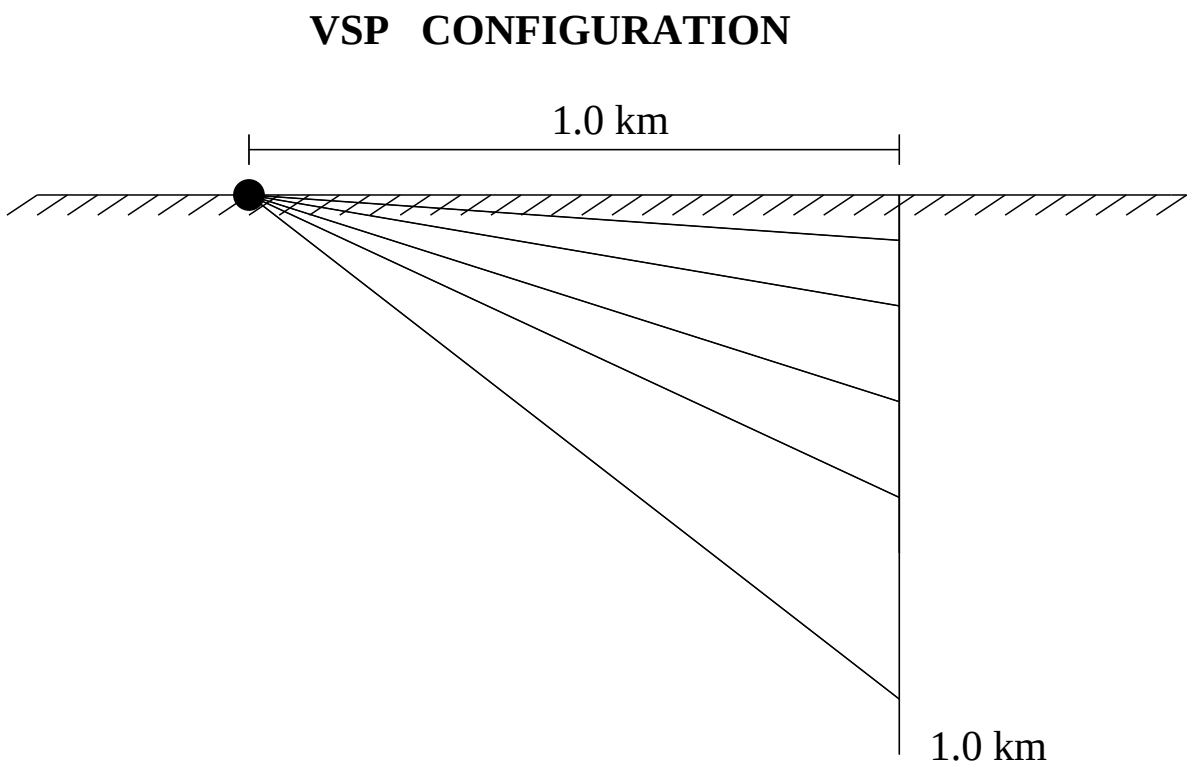
replaced by their first-order counterparts

Transformation of amplitudes at an interface

Exact formulae with exact slowness and polarization vectors

replaced by their first-order counterparts

Numerical examples



Numerical examples HTI/HTI model

Two-layer HTI model: HTI/HTI model

Layer 1: 0-1 km; symmetry axis rotates $45^0 \rightarrow 0^0$

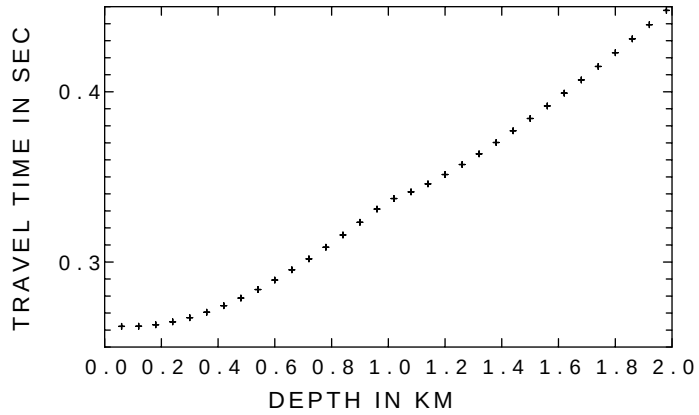
vertical variation of WA parameters

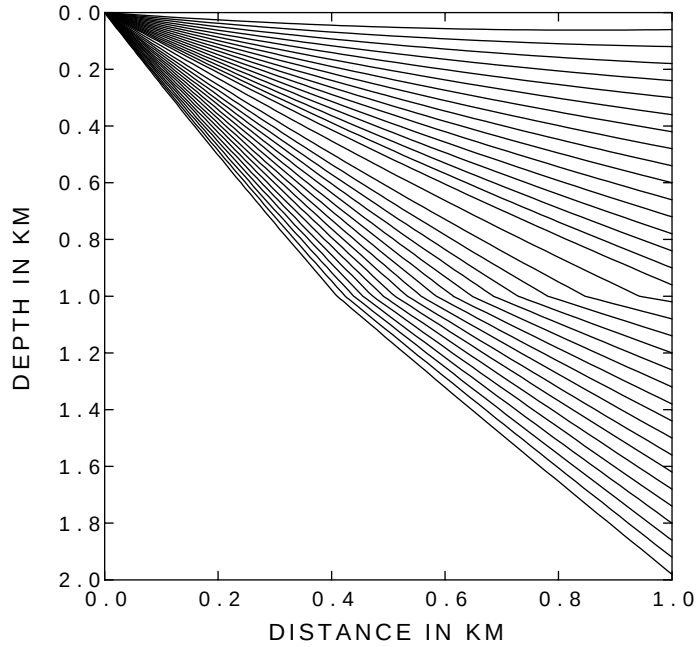
Layer 2: 1-3 km; symmetry axis rotates $0^0 \rightarrow 45^0$

no variation of WA parameters

Anisotropy: $\sim$ 8%; contrast: $\sim$ 23%

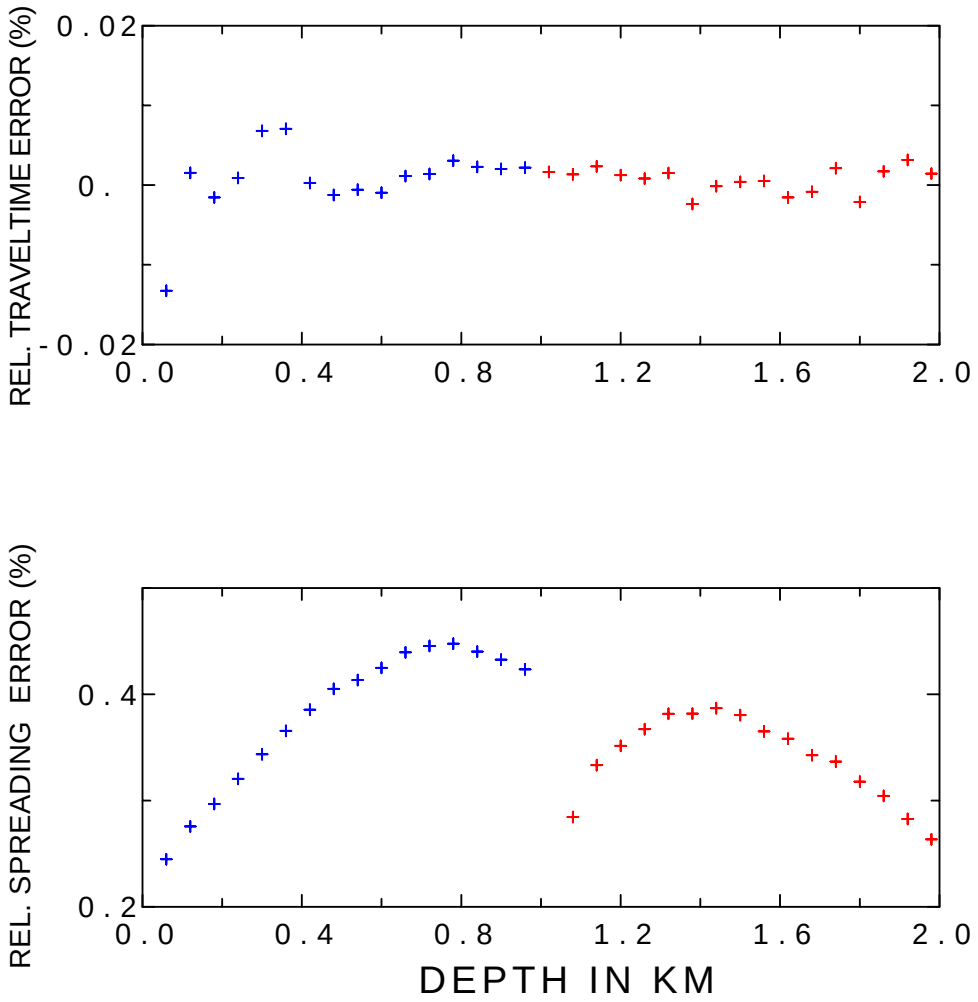
Numerical examples HTI/HTI model





direct and transmitted waves

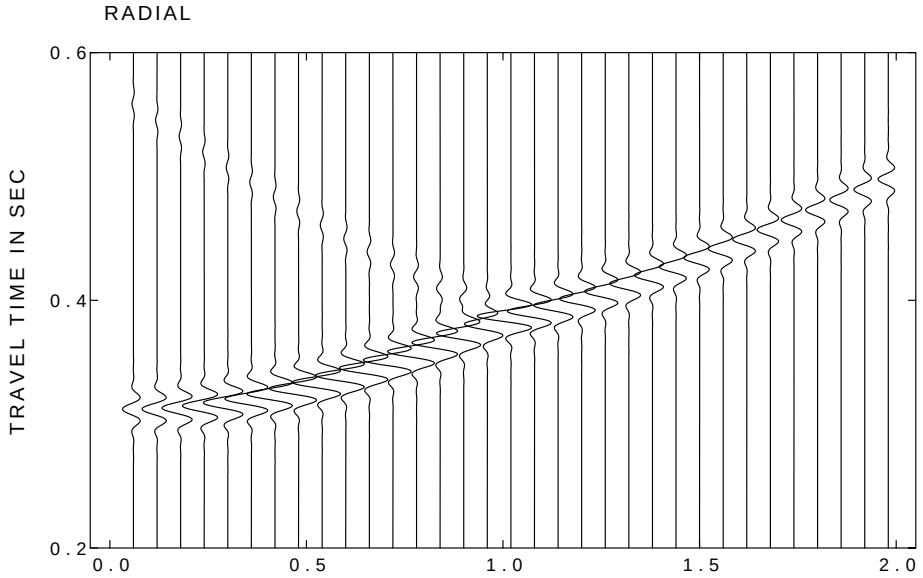
Numerical examples HTI/HTI model



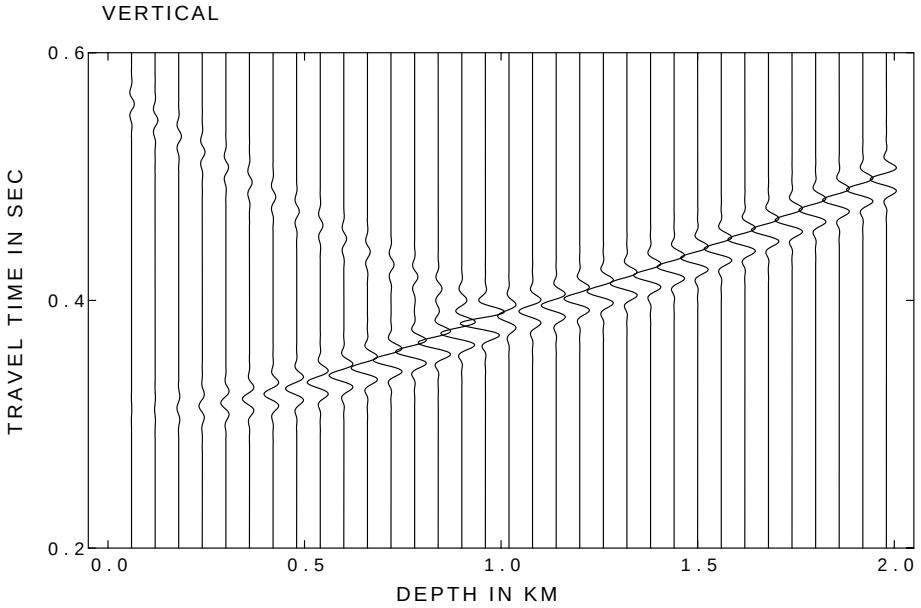
reflected wave

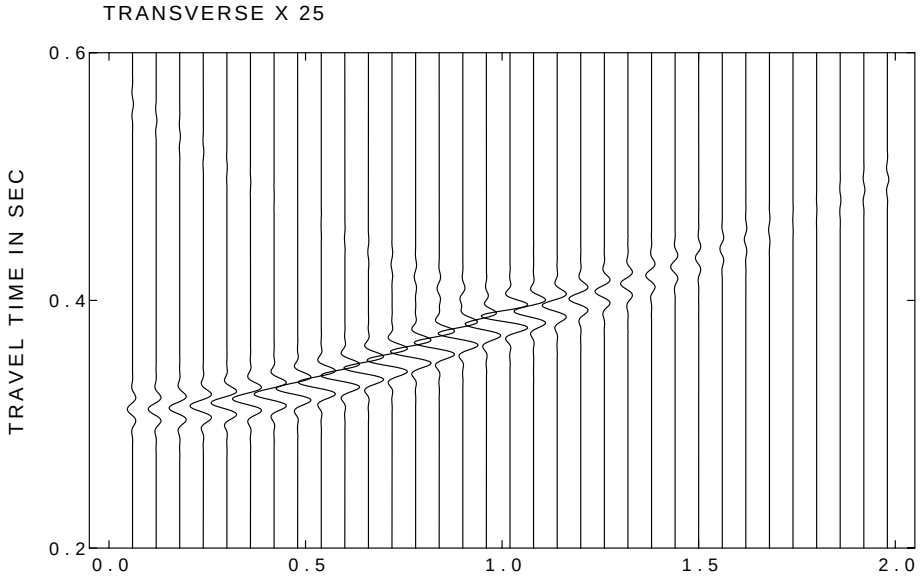
transmitted wave

Numerical examples HTI/HTI model

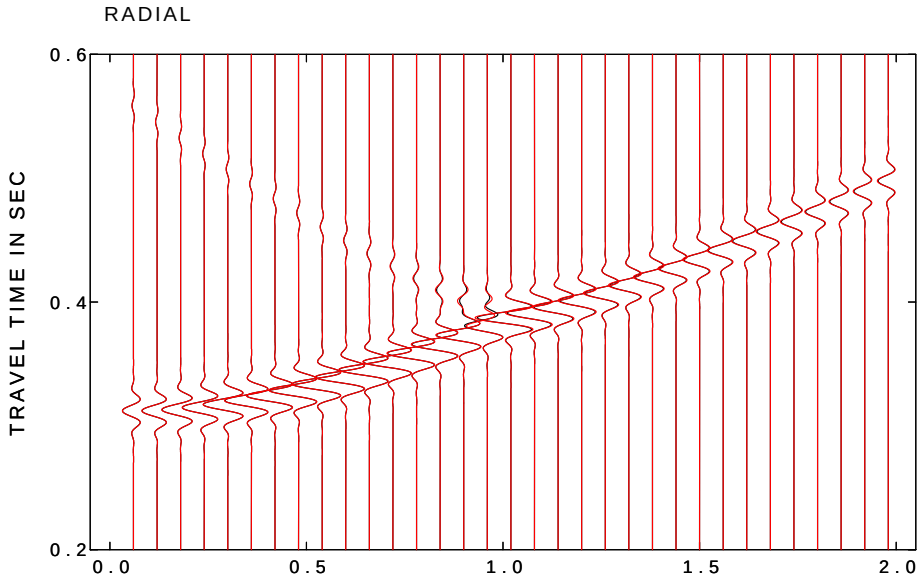


ray-theory seismograms



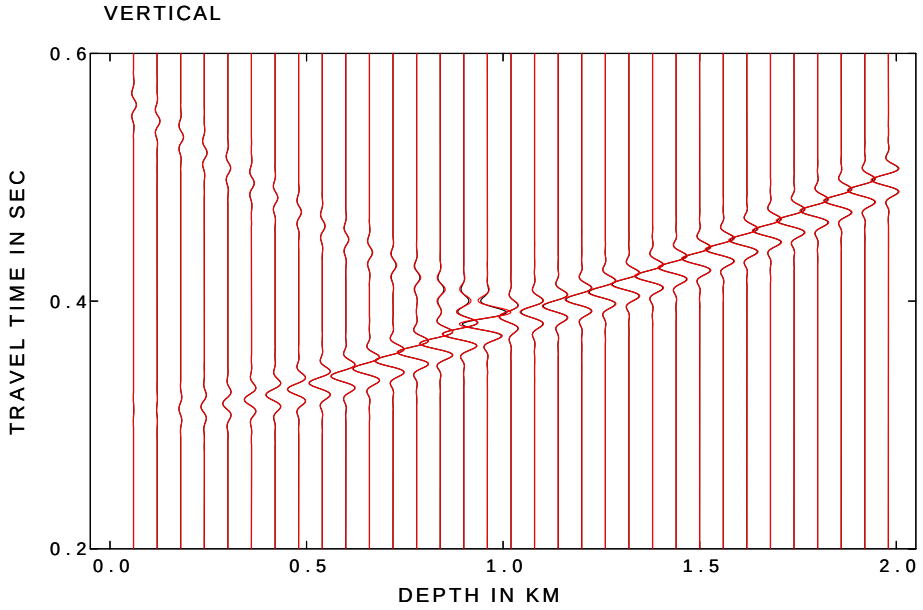


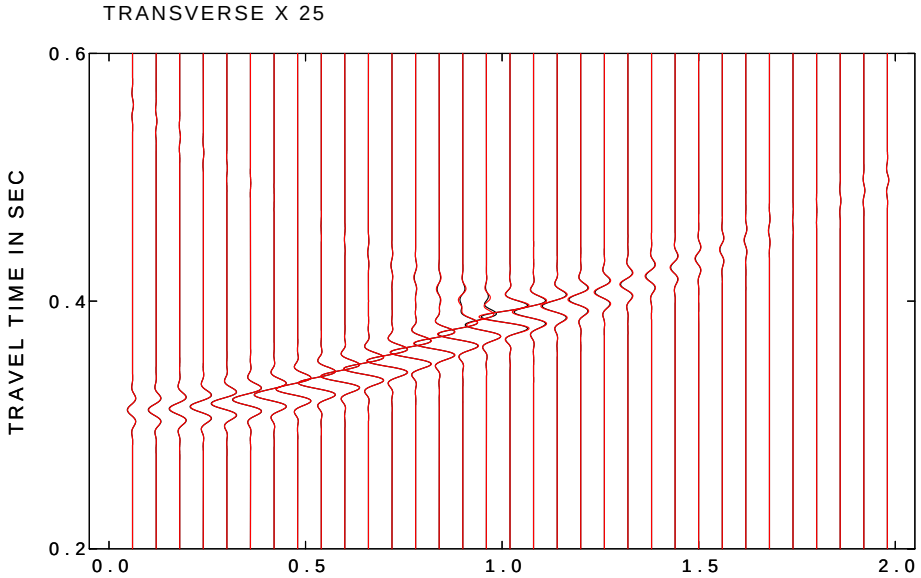
Numerical examples HTI/HTI model



ray-theory seismograms

FORT seismograms





Numerical examples ORT/ORT model

Two-layer ORT model: ORT/ORT model

Layer 1: 0-1 km; rotation of crystal symmetry with depth

vertical variation of WA parameters

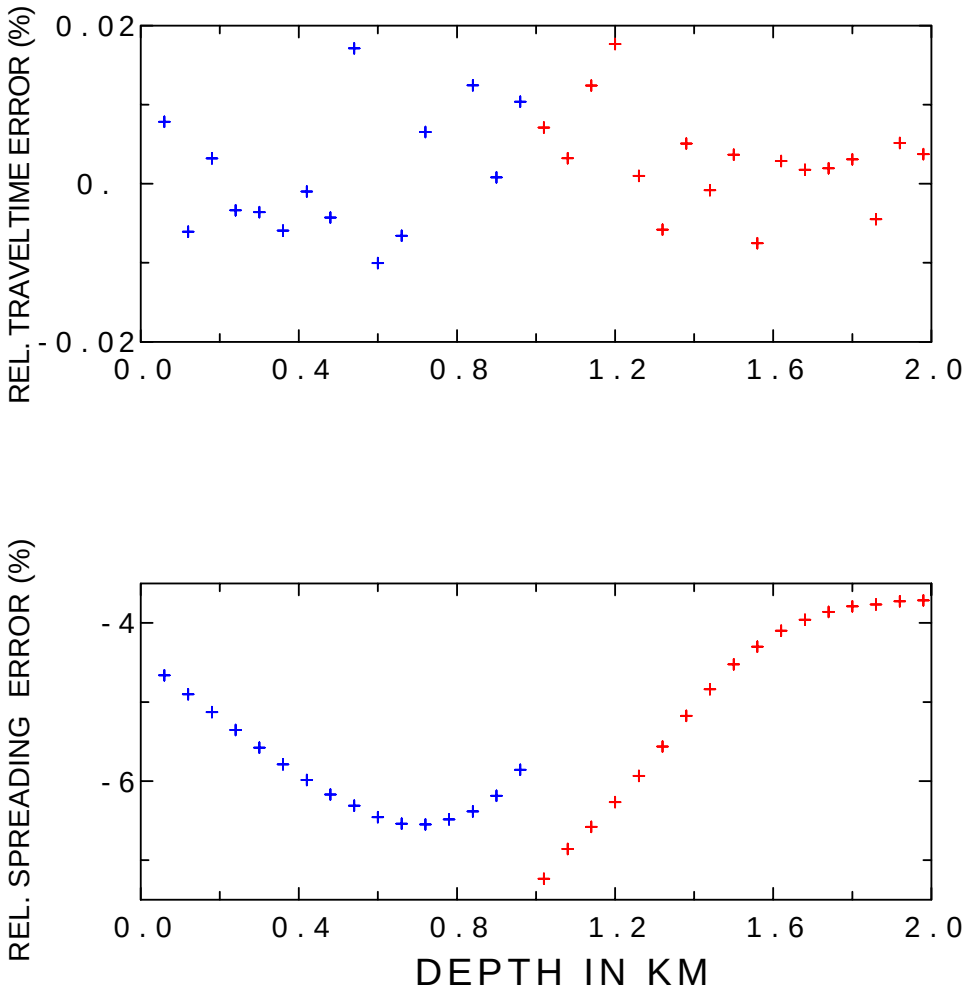
Layer 2: 1-3 km; rotation of crystal symmetry with depth

no variation of WA parameters

Anisotropy: $\sim$ 20%;

contrast: (normal $\rightarrow$ tangent. inc.): $\sim$ 22% $\rightarrow$ 39%

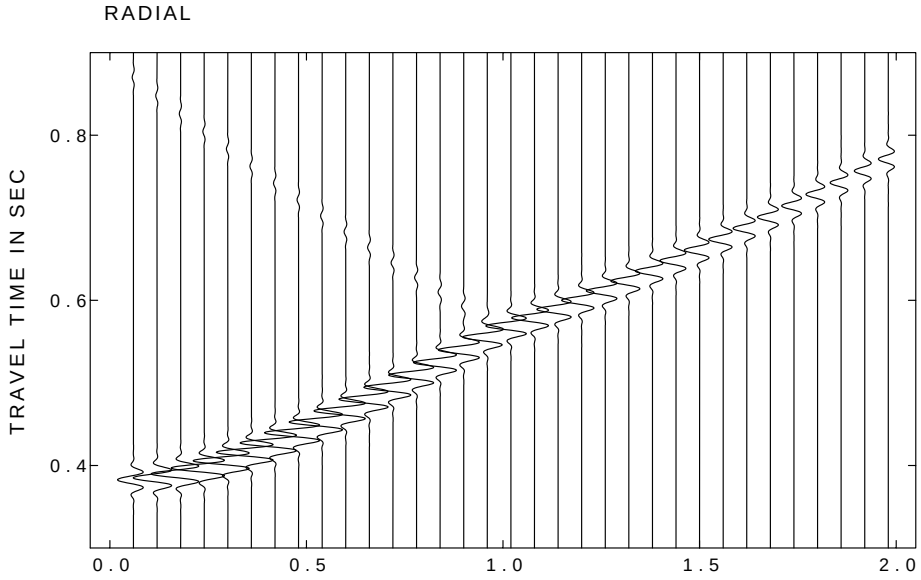
Numerical examples ORT/ORT model



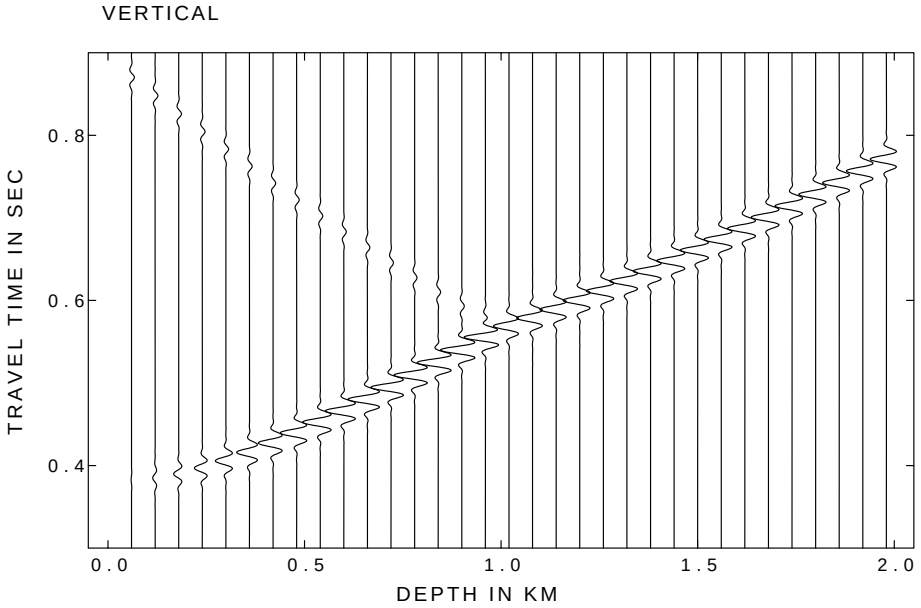
reflected wave

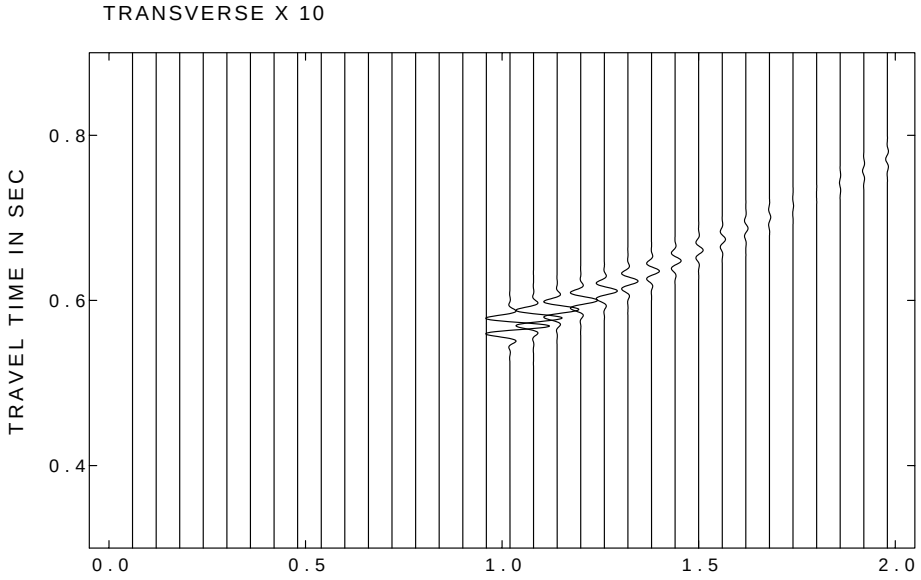
transmitted wave

Numerical examples ORT/ORT model

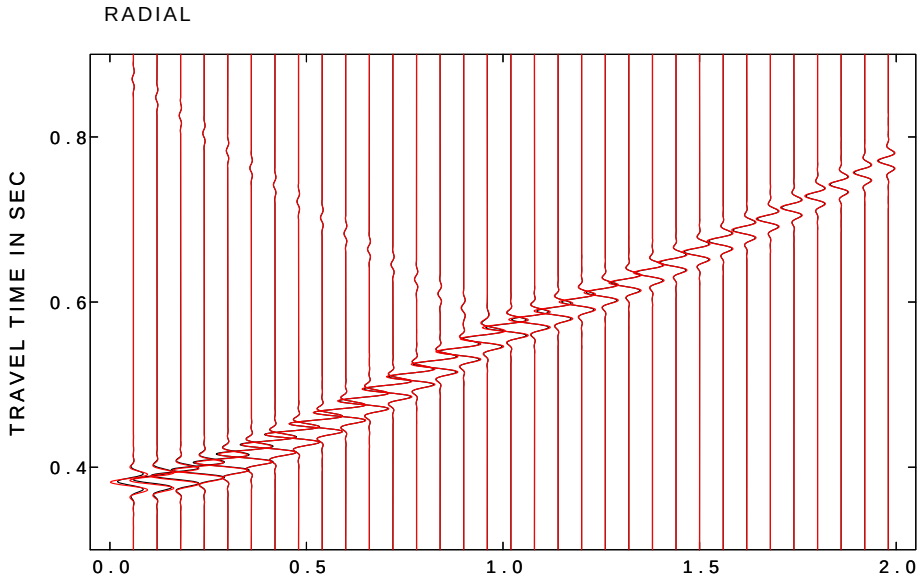


ray-theory seismograms



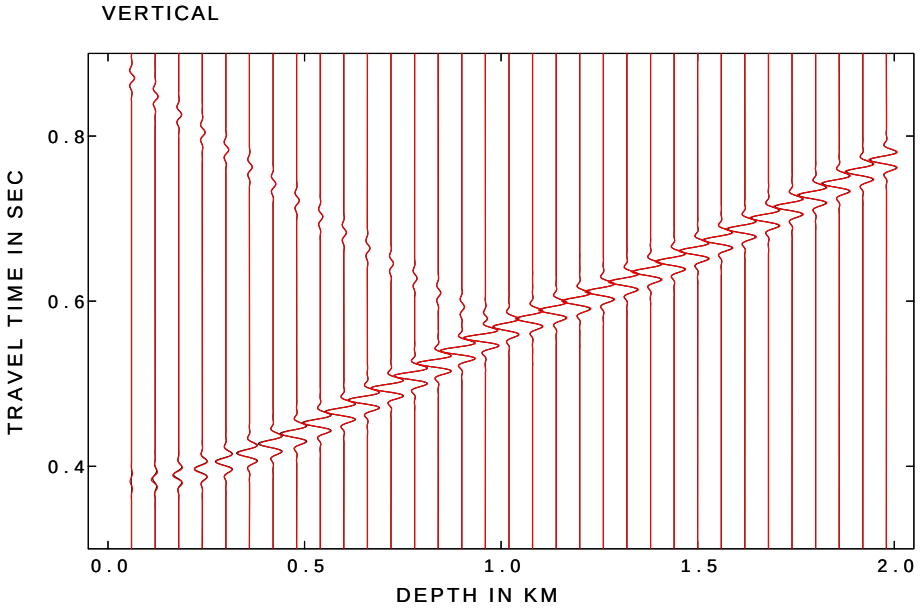


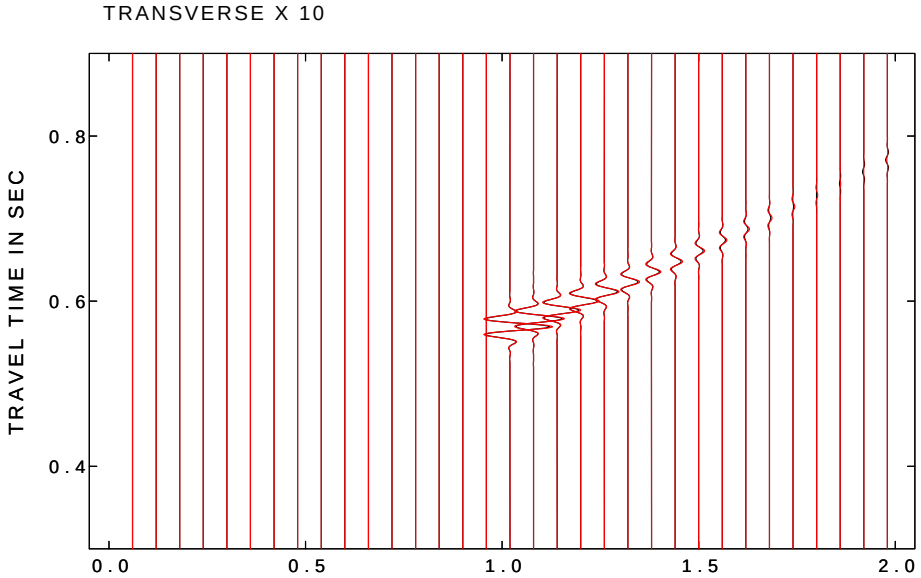
Numerical examples ORT/ORT model



ray-theory seismograms

FORT seismograms





Conclusions

P-wave separated from S wave

Second-order traveltime, first-order spreading

Accuracy of approximate seismograms in layered media

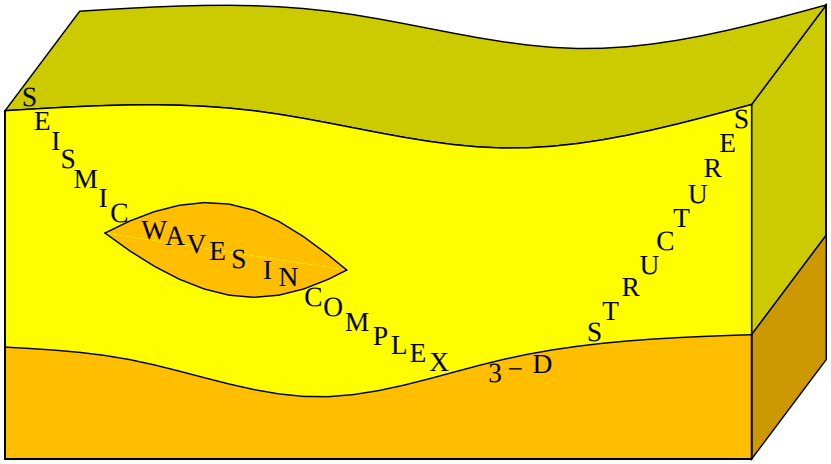
comparable with accuracy in smooth media

Future plans

Extension to the critical and overcritical region

Incorporation of converted waves generated by P-wave incidence

Acknowledgements



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