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

Ivan Pšenčík\(^1\) and Véronique Farra\(^2\)

1) Institute of Geophysics, Acad. Sci. Praha, Czech Republic
2) Institut de Physique du Globe, Paris, France

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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 $45^0 \to 0^0$
  vertical variation of WA parameters

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

![Graphs showing relative error in travel time and spreading as a function of depth for reflected and transmitted waves.](image-url)
Numerical examples   HTI/HTI model

ray-theory seismograms
Numerical examples  HTI/HTI model

ray-theory seismograms

FORT seismograms
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 → tangent. inc.): $\sim 22\% → 39\%$
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
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