Seismic wave Propagation and Imaging in Complex media: a European network

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Host Institution: Universität Hamburg Place of Origin: Hanoi, Vietnam Appointment Time: Jan 2005

Project: Modeling of Scholte wave transmissions along corrugated interface.

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Task Groups: Small scale group

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Outline

- Introduction
- Model
- Some main results
- Discussions and conclusions

Introduction

<u>Scholte wave</u> * Interface wave that travels along the fluid-solid interface.

$$\frac{c_{ssk}^{2}\rho_{f}\sqrt{1-c_{ssk}^{2}/\alpha_{s}^{2}}}{\beta^{2}\rho_{s}\sqrt{1-c_{ssk}^{2}/\alpha_{f}^{2}}} + \frac{\beta^{2}}{c_{ssk}^{2}} \left[\left(2-\frac{c_{ssk}^{2}}{\beta^{2}}\right)^{2} - 4\sqrt{1-c_{ssk}^{2}/\alpha_{s}^{2}}\sqrt{1-c_{ssk}^{2}/\beta^{2}}\right] = 0$$
(1)

* Scholte wave , in some cases, considered as Rayleigh wave.

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Corrugated interface

- Seafloor
- Earth surface with topography
- Boreholes, tunnel

Goals

- How the topography influence the Scholte waveform?
- How does the Scholte wave travel in the presence of topography?

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Surface topography



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Implementation

- Horizontal derivatives: Fourier
- Vertical derivative: Chebyshev
- Time integration: 4th order Taylor operator.
- Source time function: Gaussian wavelet
- Source type: (point) explosive source.
- Propagation time: 8 s.

Model without topography



Description of model



Configuration of Corrugated interface. The height of the ripple is 10 m from the middle, the length is varied from 100m-200 m.



Model with regularly corrugated interface. The shot and receivers are both located on the seafloor. The shot location is displayed in the figure.

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Seismogram of reference model



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Seismograms of the model with topography (number of ripples, n=11)



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Seismograms of the model with topography (number of ripples, n=11)

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Comparisons of models with and without topography

Traces No 2

Traces No 21

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Amplitude spectra for models without and with topography

Traces No 14, Results obtained from model without topography

Traces No 14, Results obtained from model with topography

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No topography

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Topography(n=11)

T=0.028 s

T=2.94 s

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Model with more ripples(n=21)

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Model with irregular distribution of ripples(n=11)

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Results from experiment

The experiment models consist of corrugated composite interface with different number of scatterers.

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Discussions

- For the corrugated interface: The main pulses look similar but smaller in amplitude. The ringing tails are more variable. When we increase scatterings on the interface, With more scatterings, we can see more diffraction on the waveform.
- The propagation characteristics of Scholte wave through the corrugated interface depend on some factors such as the height and the wavelength of the scatterers. The distribution of scatterers (regularly or irregularly) also plays a role. It is shown that the irregular distribution of undulations create bigger attenuation.
- Scholte wave velocity is not much dependent on the topography.

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Conclusions

- The simulation work shows the synthetic seismograms are severely attenuated by the diffractions and undulations.
- Confirm the results from experiment: the velocity of propagation is generally not effected much by undulations.

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