Optimum aperture length for CMP Cross-Correlation of Surface Waves

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Outline

- Objectives
- CMP Cross-Correlation of Surface Waves (CCSW)
- Optimum aperture length
- Application of the method to the static corrections
- Conclusion

Objectives

The Objective is to develop a method to optimize the estimation of near surface shear wave velocity using *surface waves* applicable to *converted wave statics*.



CMP Cross-Correlation of SurfaceWaves (**CCSW**)

• The method is similar to MASW. But, it improves the estimation of the phase velocity and lateral resolution simultaneously

Hayashi and Suzuki, 2004

First Step of CCSW

Cross-correlation of traces with a reference trace



Second Step of CCSW

The cross-correlated traces from all shots sorted to CMP gathers.



Third Step of CCSW

Estimation of a dispersion curve for the traces in a bin





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Phase Velocity Inversion
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Phase velocity is a function of four parameters.

Schwab and Knopoff (1972)

 $F(f, c_f, v_s, v_p, \rho, h) = 0$





Density and layer thicknesses

- Density: 2000 kg/m³
- Layer thickness: 5m
- P velocity model: tomography



S Velocity Model





(A) A shot record without correction, (B) CCSW static corrected and(C) Non-physical Horizon based trim static corrected.

Static Correction



Priddis Data (2012)

- Priddis data: acquired from a site near Priddis, Alberta
- Geophone interval: 2m
- Shot interval: 4m
- Source : vibroseis
- Sweep frequency: 10Hz to 120Hz
- Listening time:10s
- <u>Bin size: 5m</u>

A CMP gather's phase velocity



Observed Phase Velocity for the Priddis Data



Data Inversion

- Density: 2300 kg/m³
- P velocity: estimated from the S velocity based on a given poison ratio (0.45)

$$\mathbf{V}_{\mathsf{p}} = \mathbf{V}_{\mathsf{s}} \left(\frac{1-\sigma}{0.5-\sigma}\right)^{\frac{1}{2}}$$

• Layer thickness: 2m

S Velocity Model for the Priddis Data



Static Corrections for the Priddis Data



Decimating the Priddis data

- In order to investigate the effect of the geophone interval in CCSW analysis for the static corrections, we decimate the Priddis data to have 8m geophone interval.
- Bin size:15m



Static corrections for the decimated data



Hussar Data (2011)

- Hussar data: acquired by CREWES near Hussar, Alberta, Canada.
- Source: vibroseis
- Sweep: 1Hz to 100Hz
- Listening time: 10s
- Geophone interval: 10m

Phase Velocity for the Hussar Data

Phase Velocity



Data Inversion

- Density: 2200 kg/m³
- P velocity: estimated from the S velocity based on a given poison ratio (0.45)

$$\mathbf{V}_{\mathsf{p}} = \mathbf{V}_{\mathsf{s}} \left(\frac{1-\sigma}{0.5-\sigma}\right)^{\frac{1}{2}}$$

• Layer thickness: 4m



PS Static Corrections for the Hussar Data



PS Static Corrected Data

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Conclusion

• CCSW: a good lateral resolution for the static correction of converted waves

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