Inversion of Phase Velocity Dispersion Curves
Heterogeneity: Source for Dispersion

Homogeneous Half Space

Heterogeneous Half Space
Dispersion Curve and Inversion Concepts

**Theoretical** Dispersion curve

**Known Profile**

<table>
<thead>
<tr>
<th>$\rho_1$</th>
<th>$V_{P,1}$</th>
<th>$V_{S,1}$</th>
<th>$H_1$</th>
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</thead>
<tbody>
<tr>
<td>$\rho_2$</td>
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</tr>
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**Experimental** Dispersion curve

**Unknown Profile**

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Theoretical Forward Method

Inversion
Inversion Methodology

Data Collection

Experimental Dispersion Curve

ReMi Passive Test (Dispersion Resolution Treatment)

Random Velocity Profile

Theoretical Dispersion curve

Theoretical vs. Experimental

Yes

Modify Chromosomes

No

Genetic Algorithm

Iterative Nonlinear Inversion

Final Velocity Profile
Common Methods for Active Data Collection

- **MASW (Multi-channel Analysis of Surface Waves)**
  - Vertical Geophones (4.5 Hz)
  - Uniform Spacing
  - Sledge Hammer/Shotgun

- **SASW (Spectral Analysis of Surface Waves)**
  - Vertical Accelerometers (0.1 Hz)
  - Uniform / Non-uniform Spacing
  - Harmonic Vibrator (swept-frequency source)
T-X Plot in Reality

(from D. Steeples)
Experimental Dispersion Curve

- MASW method
- Frequency decomposition
- Frequency selection, T-X plot
- Frequency-Wavenumber technique
- Power spectrum curve

Last frequency?

- Yes: Presentation as Dispersion Contour
- No

Power spectrum curve
Figure 6.4. (a) Phase velocity spectrum $P(f, V_p)$ is plotted as a function of phase velocity and frequency. (b) Two dimensional representation of the same spectrum in (a). Final phase velocity dispersion curve (white circle) is determined by picking high amplitude points.
Downhole
Questions ?