

Application of a new type of six-component seismometer for underground anomaly detection

Xinding Fang, Southern University of Science and Technology, Shenzhen, China

Theoretical basis:

$$\text{Rayleigh phase velocity } c(\omega) = \sqrt{\frac{A_z^2(\omega)}{W_x^2(\omega) + W_y^2(\omega)}}$$

where A_z is vertical acceleration, W_x and W_y are horizontal rotational velocities.

MEMS-array 6C-seismometer

- Frequency band: DC-1000 Hz
- Acceleration self-noise: $8\mu g/\sqrt{\text{Hz}}$
- Rotational velocity self-noise: $5\mu\text{rad/s}/\sqrt{\text{Hz}}$
- Instrument response: uniform over 0.5-1000 Hz

Prototype



Field Experiment

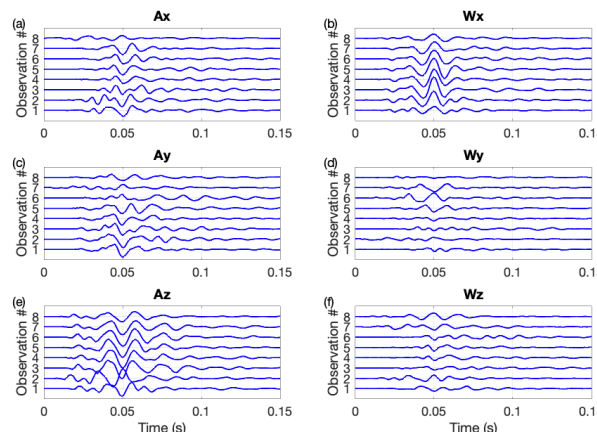
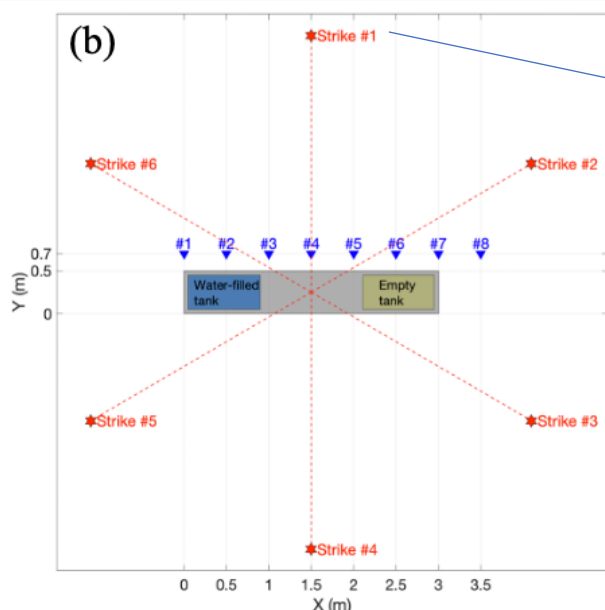
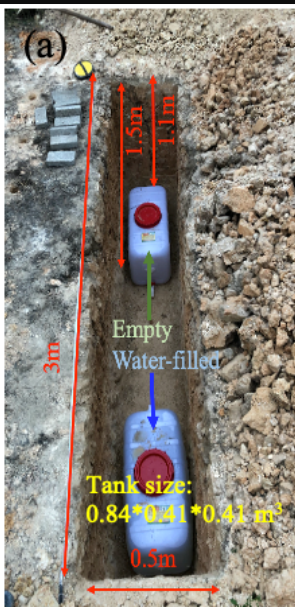


Fig.2. Stacked waveforms for strike #1 (stack of the data produced by 10 repeated strikes at the same position).

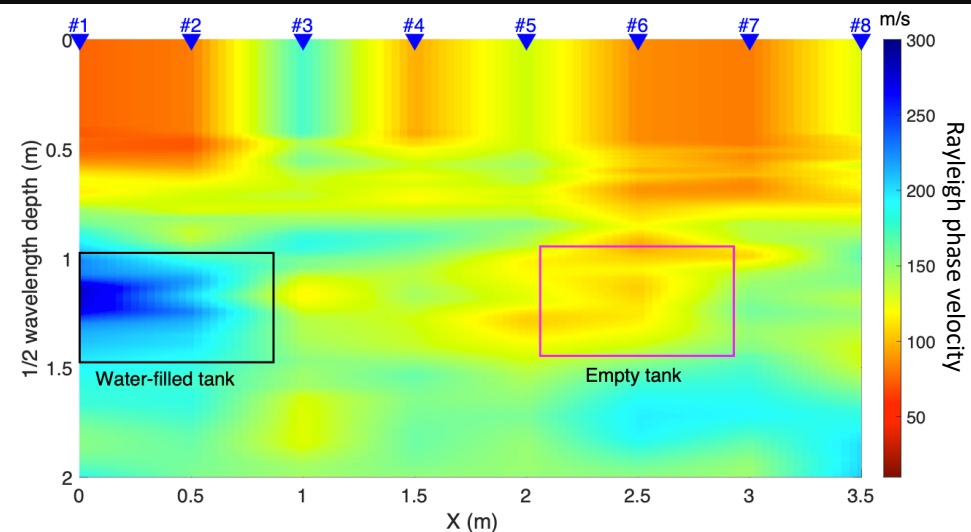


Fig.3. Velocity profile constructed from dispersion data. The vertical axis corresponds to $1/2$ wavelength depth, which is obtained by using a constant shear wave velocity of 200m/s in calculating the wavelength. The blue triangles mark the positions of the eight observation points. The black and magenta boxes respectively indicate the locations of the water-filled tank and the empty tank.

Fig.1. (a) Experiment pit. (b) Acquisition geometry. 6C data are recorded at 8 observation points (blue triangles) that are equally spaced and 0.2 m away from the edge of the pit. A hammer source is struck at 6 positions (red asterisks) that are about 6~10 m away from the pit center.