Surface-wave dispersion spectrum inversion method applied to Love and Rayleigh waves recorded by DAS

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Recently, a new seismic acquisition technique, Distributed Acoustic Sensing (DAS), has been applied to shallow seismic structure imaging, providing dense spatial sampling at a relatively low cost. DAS on a standard fiber-optic cable mostly records axial dynamic strain, which makes it difficult to separate Rayleigh and Love wavefields via particle motion as in the case of a three-component geophone record. As a result, the mixed Rayleigh and Love wave signals cannot be used in the surface-wave dispersion inversion method. Therefore, it is often ensured that the source and the cable are in-line and only Rayleigh wave dispersion is used, which limits constraints on structure and model resolution.
We propose to invert surface-wave dispersion spectra instead of dispersion curves. This inversion method can use mixed Rayleigh and Love waves recorded by DAS, even when the source and receiver array are not aligned. The new method not only improves the flexibility of the acquisition system design, but the Love wave data also provide additional constraints on the inversion. Our method is applied to active source and ambient noise datasets acquired at a geothermal site, providing consistent results for different datasets and acquisition geometries. The sensitivity of the data to layer thickness, density, and Vp are also discussed. Our method extends the usefulness of DAS datasets and improves data constraints that help to construct higher resolution models in practice.

