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# Enhance the reconstruction of near-surface targets by integrating surface waves analysis with elastic full-waveform inversion

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Accurate reconstruction of shallow targets is not a straightforward process due to the complex interaction between the seismic wavefield, free surface and local heterogeneous anomalies. Seismic data recorded in such environments are often dominated by high amplitude Surface Waves (SW). Relative Dispersion Curves (DC) analysis can be used to retrieve the near-surface physical proprieties from SW, together with classical Tomography or Full-Waveform Inversion (FWI) approaches.

The purpose of this study is to improve the imaging resolution of heterogeneous shallow targets by integrating recent DC analysis techniques (functional for sharp lateral variations) with elastic FWI. The developed workflow involves two main steps: The first one relies on the DC extraction using a spatially variable Gaussian window (Bergamo et al., 2012) and the DC conversion into 2D S-and P-waves velocity models (Vs and Vp) through clustering (Khosro Anjom et al., 2019) and data transform procedures (Socco et al., 2017; Socco and Comina, 2017). In the second step, the obtained models are used as input for a spectral-element-based elastic FWI workflow, implemented inside SEM46 code (Trinh et al., 2019).

The benchmark models, used to compute the elastic reference data for this work, are based on the geological properties of a real case-study: A low-density sand-body is buried among a compact sediment background.

The first step with DC analysis provides good initial models for FWI, in which the calculated data is not cycle-skipped at low frequencies compared with the reference data. In the second step, we perform multi-parameter elastic FWI tests starting from these initial models, with gradient smoothing through a Bessel filter (Trinh et al., 2017) and depth-variable boundary constraints for Vp and Vs parameters. The FWI step further improves the model resolution, but mainly at shallow depth due to the limited penetration of SW.

Subsequently, we are going to incorporate model-oriented and data-oriented strategies into the current FWI workflow. The former strategy aims at enhancing the Vs resolution at higher depths through a preliminary mono-parameter (Vs) reconstruction. The latter is expected to reduce the non-linearity introduced by the cycle-skipped far-offset traces while exploiting the body waves content for deeper model update.

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