LIÈGE université

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Academic year 2024-2025

Numerical investigation of a multi-step one-shot method for frequency domain acoustic full waveform inversion

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Illustrative summary

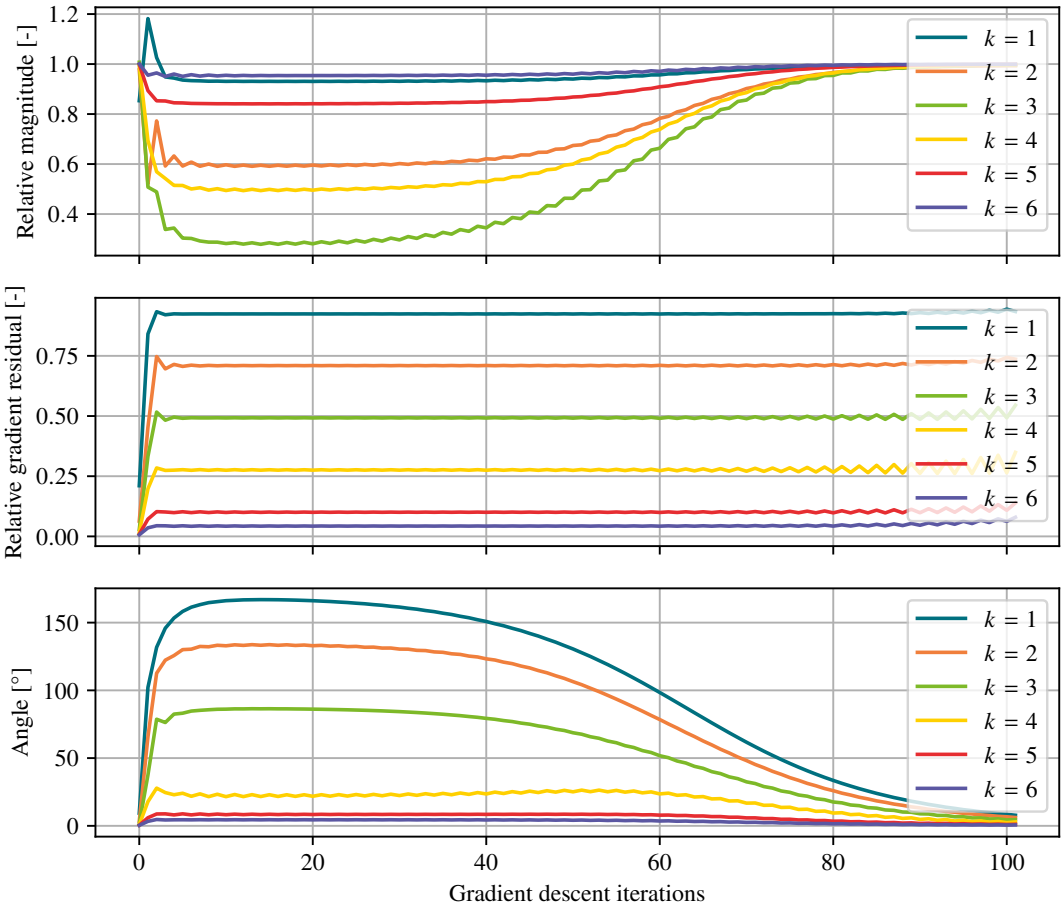

Figure 1: Evolution of the relative magnitude, relative gradient residual and angle of the tentative estimated one-shot gradient with respect to the gradient calculated using LU decomposition, during inversion with the reference gradient, for the linearized inverse problem at 1 Hz in the Marmousi case with a subdomain layout of $(4, 2)$. Richardson is used as the iterative linear system solver in one-shot, and the optimization algorithm is the gradient descent with step size 9. The graphs respectively indicate the histories for $k = 1$ to 6.

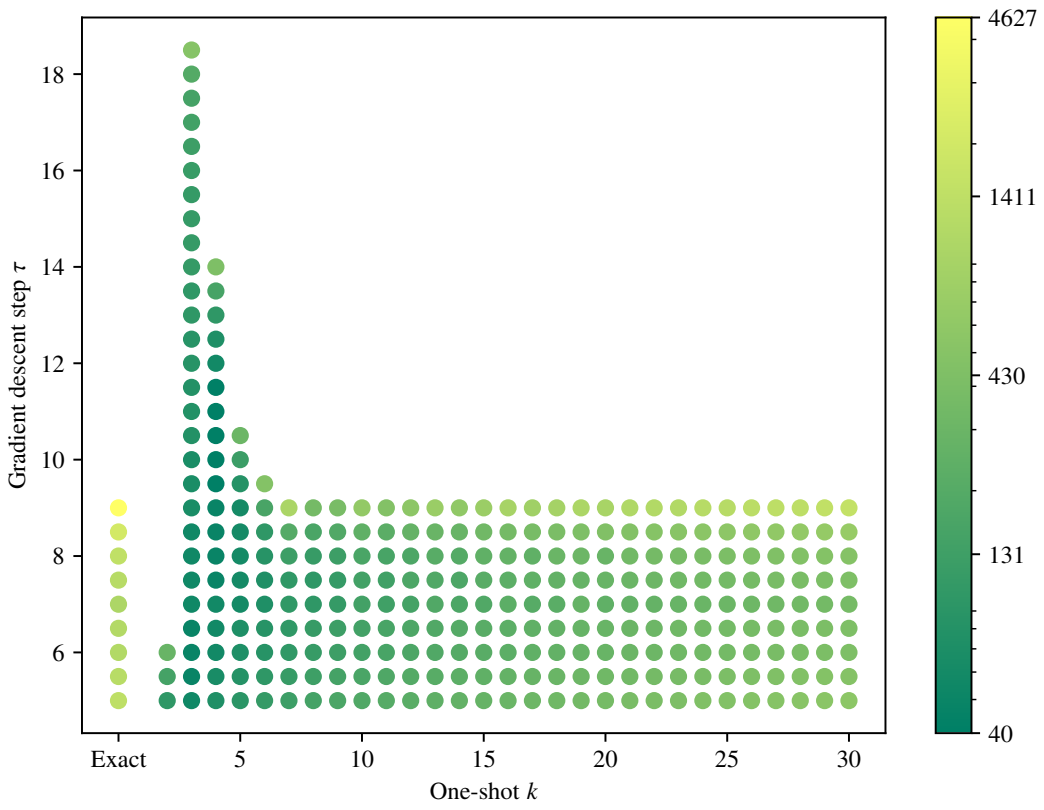

Figure 2: Cost to reach convergence as a function of the multi-step one-shot parameter k and the gradient descent step size τ, using Richardson iterations as the linear system solver, for the linearized inverse problem at 1 Hz in the Marmousi case. Absence of data indicates a divergence in the inversion for the given configuration.

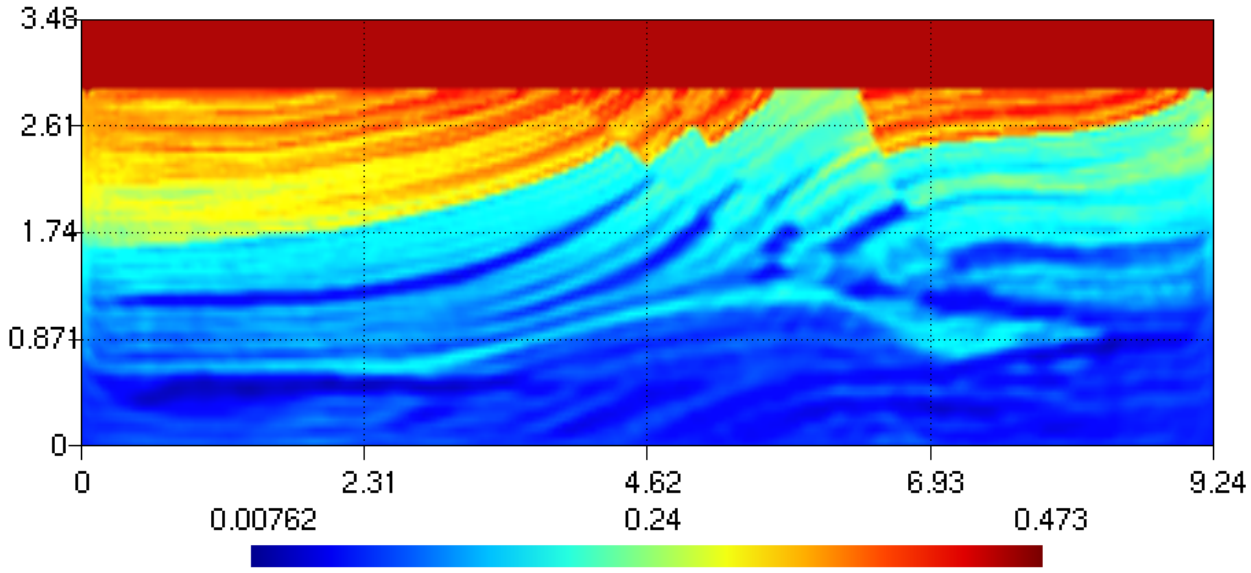

Figure 3: Squared wave slowness model that results from the inversion sweep at frequencies $\{1, 1.6, 2.5, 4, 6.5, 10.4\}$ Hz using Gauss-Newton one-shot for the Marmousi case. The domain is partitioned into 8 subdomains with METIS. This result is obtained after 2702 preconditioner applications. The distances are in kilometers, and the squared wave slowness field is expressed in $\mathrm{s}^2\,\mathrm{km}^{-2}$.