

Crosswell Transmission-Reflection Traveltime Tomography Using First Arrivals

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ABSTRACT

We propose a level-set adjoint-state method for crosswell traveltime tomography using both first-arrival transmission and reflection traveltime data. Since our entire formulation is based on solving eikonal and advection equations on finite-difference meshes, our traveltime tomography strategy is carried out without computing rays explicitly. We incorporate reflection traveltime data into the formulation so that possible reflectors (slowness interfaces) in the targeted subsurface model can be recovered as well as the slowness distribution itself. Since a reflector may assume a variety of irregular geometries, we propose to use a level-set function to implicitly parametrize the shape of a reflector. Therefore, a mismatch functional is established to minimize the traveltime data misfit with respect to both the slowness distribution and the level-set function, and the minimization is achieved by using a gradient descent method with gradients computed by solving adjoint state equations. We apply fast-sweeping type methods to solve eikonal, adjoint-state and advection equations arising in our formulation.

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REFERENCES

1. Li, W. and Leung, S., "A fast local level set adjoint state method for first arrival transmission traveltime tomography with discontinuous slowness", *Geophys J. Int.*, (2013) 195, 582-596.
2. Li, W., Leung, S. and Qian, J.L., "A level-set adjoint-state method for crosswell transmission-reflection traveltime tomography", *Geophys. J. Int.*, (2014) 199, 348-367.