An Adjoint State Method For Three-dimensional Transmission Traveltime Tomography Using First-Arrivals

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Abstract

Traditional transmission travel-time tomography hinges on ray tracing techniques. We propose a PDE-based Eulerian approach to travel-time tomography so that we can avoid the cumbersome ray-tracing. We start from the eikonal equation, define a mismatching functional and derive the gradient of the nonlinear functional by an adjoint state method. The resulting forward and adjoint problems can be efficiently solved by using the fast sweeping method; a limited memory BFGS method is used to drive the mismatching functional to zero with quadratic convergence. 2-D, 3-D numerical results and Marmousi synthetic velocity model demonstrate the robustness and the accuracy of the method.

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