Sensitivity Analysis of wave-equation tomography

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Abstract

Traditional seismic transmission tomography uses travel times, measured along rays (geodesics), between points on the earth's surface as data. However, in seismic records, travel times are often hard to indentify, and the waveforms are used instead. The "fitness" criterion is then based on cross correlating in time modelled data with observed data at available seismic stations (point receivers) for many events (sources described in terms of initial data). The maximum of this cross correlation, at each station, occurs at what seismologists call the "finite-frequency" differential travel time; hence the term "wave-equation tomography". While making use of the work of Smith (1998), we analyze, and construct, the Fréchet derivative of this "differential time" in media of limited smoothness following a multi-scale approach. (Seismologists refer to this Fréchet derivative as the sensitivity.) Using this framework, we will also comment on the "Banana-Doughnut Kernel" description of such a derivative by Dahlen and Nolet. Finally, we will summarize related results in wave-equation reflection tomography.

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