A tale of two tomographies: traveltime and waveform

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Abstract

Traveltime tomography, in its reflection variant, is widely used to create velocity models for industrial seismic imaging. This process requires that seismic events be identified and their arrival times measured. While modern practice largely automates event picking, the possibility remains that some important events are missed, or that unimportant events (associated perhaps to irrelevant propagation velocities) are picked, or that signal components carrying important velocity information are not identified as events, hence missed altogether. Alternative methods of velocity estimation based directly on the ("waveform") data have also been developed, though many of these are primarily interactive and subjective. In this talk, I will show how various forms of objective waveform tomography can be related directly to traveltime tomography, at the level of algorithmic components. In particular, waveform tomography formulated via explicit use of high-frequency asymptotics uses the same traveltime computations as does traveltime tomography. I will review progress in designing a waveform tomography algorithm using the Qian-Leung traveltime tomography package. If time permits, I will illustrate some important numerical issues, and their implications, using a simpler algorithm based on a layered medium approximation. The principal implication is that reduction in numerical artifacts demands explicit computation of pseudodifferential operator actions.