INVERTING EVERY TYPE OF ARRIVAL FOR NEAR-SURFACE IMAGING

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In the past, imaging of the near surface by seismic surveys usually was restricted to inverting just one type of arrival, e.g. refraction traveltimes for 2D P-velocity tomograms or dispersion curves for 1D S-velocity models. The advent of multigigaflop laptop computers, cheaper channel counts, and dense recording arrays now allow for the inversion of almost every type of arrival in the seismic records.

In this presentation, I will show how the modern methods of seismic interferometry, waveform inversion, and multidimensional surfacewave inversion can be used to effectively invert almost every type of arrival for shallow seismic imaging. I will present examples that show how (a) “super virtual interferometry” can double more than the offset of useable first-arrivals in refraction inversion by enhancing the SNR of far-offset traces, (b) “full waveform inversion” inverts the diving waves and refractions to give high-resolution P-velocity images, (c) “parsimonious seismic interferometry” decreases the acquisition time of refraction and surface-wave surveys by at least one order-of-magnitude, and (d) multidimensional inversion of surface-wave dispersion curves provides high-resolution estimates of the 2D shear-velocity tomogram to a depth of about the longest shear wavelength. I will present field data examples for hydrology applications, fault detection and earthquake hazards, and estimation of statics. All of these inversion methods can now be used for a single seismic survey with a sufficiently dense recording geometry.