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Efficacy of Seismic Interferometry in Removing Surface Waves from Active Seismic Records

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While there are seismic techniques which make use of surface waves in imaging the subsurface, there are also those where these types of waves are considered coherent noise. Important examples where the surface waves may significantly degrade the obtained images include different types of reflection seismic surveys (e.g., shallow surveys for engineering, environmental and groundwater investigations, and deep surveys for imaging hydrocarbon reservoirs). In a strongly heterogeneous medium (encountered typically in onshore surveys), the conventional methods for attenuating these waves (such as f-k "velocity" filtering) often do not give satisfactory results.

Seismic interferometry is a data-driven approach that offers a viable alternative for removal of surface waves from active seismic records. In this approach, the reflection data of several sources is considered and for each source, the seismic signals at a pair of receivers are cross-correlated to produce the surface wavefield between the receivers. The cross-correlated waveforms are then summed over all the sources to obtain the "interferometric" signal for the considered receiver pair. During this summation, the reflection and non-physical events cancel out due to the variable differences in the travel times to the considered receiver pair from different sources. The "interferometric" signal consequently contains predominantly the surface waves and this makes it conducive for adaptive subtraction (or filtering) from the original records. This study investigates the efficacy of the commonly used filtering techniques in interferometry to remove the surface waves from active seismic records. For this, the reflection data of a complex 2-D elastic medium is simulated and the filtering techniques are applied to this data. The limitations of these techniques inferred from the quality of the filtered data are discussed and possible remedies to overcome them are suggested.