Global scale seismic interferometry

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Seismic reflection imaging has shown its virtues on exploration scales, but has little been applied on a global scale due to a sparse source distribution; the earthquake hypocenters are mainly along the active lithosperic plate boundaries. This problem can be remedied with the help of seismic interferometry.

In recent years there has been considerable progress in the development of seismic interferometric techniques. A source can be simulated at any receiver position by the application of a correlation integral. By measuring the responses of a medium at a receiver due to a number of sources and correlating it with the responses due to the same sources measured at other receivers and subsequently stacking the contribution of the different sources, a reflection response of the medium is created due to a virtual source at one of the receiver positions.

The application of seismic interferometric techniques on a global scale would simulate shot locations at places where naturally no earthquakes occur. In this way we would be able to create a dense enough sampling of shot gathers, enabling the application of reflection imaging on a global scale.

We derived a new correlation integral for global scale interferometry and verified it with numerical modeling. When the sampling of real source locations is dense enough, then the correlation integral synthesizes well the Earth's reflection response from a virtual source. Also when none off the near-offset sources are being used in the integration process, still the reflections from deeper medium contrasts can be reconstructed properly. When one is only interested in reflections from a certain epicentral distance and depth range, only a dense source sampling at a specific epicentral distance range will reconstruct the reflection response.