Application of seismic interferometry by multidimensional deconvolution to ambient seismic noise recorded in Malargüe, Argentina

Weemstra, Kees; Draganov, Deyan; Ruigrok, Elmer; Huniziker, Jürg; Gomez, Martin; Wapenaar, Kees

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Obtaining new seismic responses from existing recordings is generally referred to as seismic interferometry (SI). Conventionally, these seismic interferometric responses are retrieved by simple crosscorrelation of recordings made by separate receivers: a first receiver acts as a 'virtual source' whose response is retrieved at the other receivers. When surface waves are retrieved, the newly retrieved responses can be used to extract receiver-receiver phase velocities. These phase velocities often serve as input parameters for tomographic inverse problems. Another application of SI exploits the temporal stability of the multiply scattered arrivals (the coda). For all applications, however, the accuracy of the retrieved responses is paramount. In practice, this accuracy is often degraded by irregularities in the illumination pattern: correct response retrieval relies on a uniform illumination of the receivers. Reformulating the theory underlying seismic interferometry by crosscorrelation as a multidimensional deconvolution (MDD) process, allows for correction of these non-uniform illumination patterns by means of a so-called point-spread function (PSF). We apply SI by MDD to surface-wave data recorded by the Malargüe seismic array in western Argentina. The aperture of the array is approximately 60 km and it is located on a plateau just east of the Andean mountain range. The array has a T-shape, which makes it very well suited for the application of SI by MDD. We select time windows dominated by surface-wave noise traveling in a favorable direction, that is, traversing the line of virtual sources before arriving at the receivers at which we aim to retrieve the virtual-source responses. These time windows are selected based upon the slownesses along the two receiver lines. From the selected time windows, virtual-source responses are retrieved by computation of ensemble-averaged crosscorrelations. Similarly, ensemble-averaged crosscorrelations between the positions of the virtual sources are computed: the PSF. We use the PSF to deconvolve the effect of illumination irregularities and the source function from the virtual-source responses retrieved by crosscorrelation. The combined effect of time-window selection and MDD results in more accurate and temporally stable surface-wave responses.

Authors

Cornelis Weemstra
Delft University of Technology

Deyan Draganov *
Delft University of Technology

Elmer Ruigrok
Royal Netherlands Meteorological Institute

Jürg Huniziker
University of Lausanne

Martin Gomez
Argentina National Atomic Energy Commission

Cornelis P A Wapenaar
Delft University of Technology

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