Green's function extraction for general linear systems

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The extraction of the Green's function from field fluctuations has found numerous applications in seismology. We show that the Green's function can be extracted for a wide class of linear systems that are described either by scalar fields or by vector fields. Geophysically relevant examples of such systems include the pore pressure in reservoir or aquifers, or the propagation of low- frequency electromagnetic waves in the conductive subsurface. (The latter technique forms the basis of the now popular CSEM measurements.) We show for systems that are invariant for time-reversal that the sources of the field fluctuations can be confined to a closed surface around the receivers. In contrast, for attenuating or diffusive systems those sources must be distributed throughout the volume. This requirement can be an impediment to practical applications. As an alternative to the, by now, traditional correlation method, we propose multidimensional deconvolution as an alternative that does not require sources throughout the volume.

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