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Green's theorem in seismic imaging across the scales

Kees Wapenaar, Joeri Brackenhoff, Myrna Staring, and Jan Thorbecke
Delft University, Department of Geoscience and Engineering, Delft, Netherlands (c.p.a.wapenaar@tudelft.nl)

Traditionally, methods for seismic imaging evolved independently in the solid earth and exploration communities. This has led to a wealth of imaging methods for passive- and active-source data, based on a variety of principles such as time-reversal acoustics, Green's function retrieval by noise correlation (also known as seismic interferometry), back propagation (also known as seismic holography), imaging by double focusing, and so on. Despite the seemingly different approaches and underlying principles, many of those methods are rooted in some way or another in Green's theorem.
An implicit assumption for all imaging methods based on Green's theorem is that data are available on a closed boundary, a condition that is never met in geophysical practice. As a consequence, although direct and primary scattered waves are handled very well, most methods do not properly account for (long-period) multiply scattered waves. This can be significantly improved by replacing the back-propagating Green's functions in any of the aforementioned imaging approaches by Marchenko-based focusing functions. In the presentation we will illustrate this for several methods. In particular we will show how this improves exploration-like reflection imaging and how it enables the monitoring and forecasting of responses to induced seismic sources.