

Marchenko Imaging

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Abstract: The Marchenko equation has since long been used by mathematical physicists as a basis for 1-D inverse scattering theory. Recently, Brogгинi and Snieder (2012) discussed an interesting link between the Marchenko equation and seismic interferometry. They showed that, by using the Marchenko equation, the Green's function between an arbitrary virtual-source position inside the medium and a receiver at the surface can be retrieved from the reflection response measured at the surface of that medium. This constitutes an important step beyond seismic interferometry, because no longer a receiver is needed at the position of the virtual source.

We have recently extended this 1-D approach to three dimensions (Wapenaar et al., 2013). With this method we can retrieve the 3-D Green's function between a virtual source inside the medium and receivers at the surface from the reflection response at the surface. The thus recovered Green's function properly contains the internal multiples of the 3-D inhomogeneous medium. As in the 1-D case, no physical receiver is required at the position of the virtual source. Apart from the reflection response at the surface, the method requires an estimate of the direct arrivals (including triplications in case of multipathing) between the virtual-source position and the receivers at the surface.

In the presentation we discuss this method in detail and show how it can be used for improved seismic imaging, properly accounting for internal multiple reflections (Figure 1).

References

Broggini, F., and Snieder, R., [2012] Connection of scattering principles: a visual and mathematical tour: *European Journal of Physics*, **33** (3), 593-613.

Wapenaar, K., Brogгинi, F., Slob, E., and Snieder, R., [2013] Three-dimensional single-sided Marchenko inverse scattering, data-driven focusing, Green's function retrieval, and their mutual relations: *Physical Review Letters*, **110**, 084301.

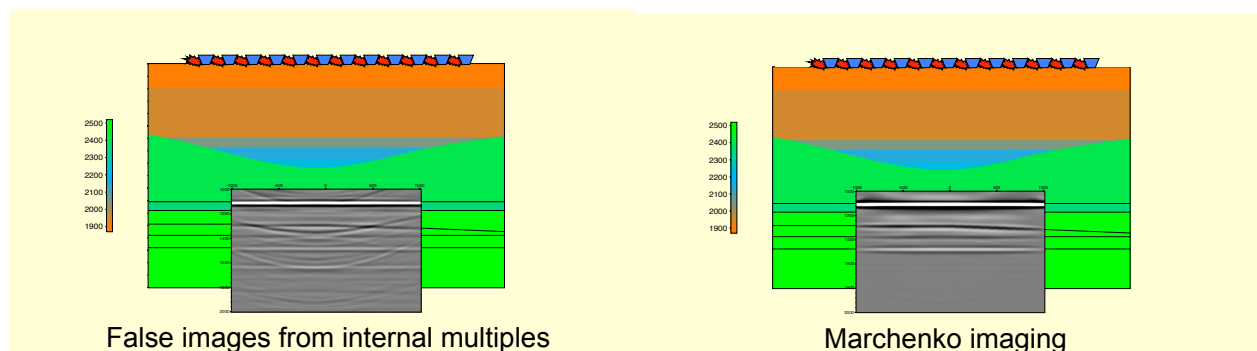


Figure 1. Example of imaging of a target zone in a simple 2D configuration. Standard imaging does not account for internal multiples, which leads to false images. Marchenko imaging employs the internal multiples in a correct way, without the need to resolve the multiple generating interfaces in the overburden.