Virtual seismology: from hydrocarbon reservoir imaging to induced earthquake monitoring

Wapenaar, Kees; Brackenhoff, Joeri; Staring, Myrna; Thorbecke, Jan Willem; Slob, Evert

Publication date
2018

Document Version
Final published version

Published in
Proceedings of the American Geophysical Union (AGU) Fall Meeting 2018

Citation (APA)

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.
Recent developments in exploration seismology have enabled the creation of virtual sources and/or virtual receivers in the subsurface from reflection measurements at the earth's surface. Unlike in seismic interferometry, no physical instrument (receiver or source) is needed at the position of the virtual source or receiver. Moreover, no detailed knowledge of the subsurface parameters and structures is required: a smooth velocity model suffices. Yet, the responses to the virtual sources, observed by the virtual receivers, fully account for multiple scattering. This new methodology, which we call virtual seismology, has led to a breakthrough in hydrocarbon reservoir imaging, as is demonstrated in a companion paper (Staring et al., Marchenko redatuming for multiple prediction and removal in situations with a complex overburden). The aim of the present paper is to discuss applications of virtual seismology beyond exploration seismology, in particular induced earthquake monitoring, and to highlight the connections between these applications. The ability to retrieve the entire wave field between (virtual or real) sources and receivers anywhere in the subsurface, without needing a detailed subsurface model, has large potential for monitoring induced seismicity, characterizing the source properties (such as the moment tensor of extended sources along a fault plane), and forecasting the response to potential future induced earthquakes. This will be demonstrated with numerical models and preliminary real-data results.

Authors

**Cornelis P A Wapenaar**  
*Delft University of Technology*

**Joeri Brackenhoff**  
*Delft University of Technology*

**Myrna Staring**  
*Delft University of Technology*

**Jan Thorbecke**  
*Delft University of Technology*

**Evert C Slob**  
*Delft University of Technology*

View Related Events

**Day:** Friday, 14 December 2018