Seismic interferometry for hydrocarbon exploration: the industry perspective

Arie Verdel[1] and Kees Wapenaar[2]
[1]Shell International Exploration and Production, Rijswijk, The Netherlands
[2]Department of Geotechnology, Delft University of Technology, Delft, The Netherlands

In the search for new hydrocarbon reserves, exploration seismology remains to be the prime exploration tool. Conventional seismic exploration is aimed at obtaining an image of acoustic reflection boundaries, corresponding with geological formation-transitions, in the upper few kilometres of the Earth's subsurface. This is achieved by measuring seismic reflections at the Earth's surface, either on land or marine, from waves activated at the surface by man-made, controlled sources and then transforming these measurements into an image of the geological layer-structures. The construction of a good image requires high-quality reflection recordings from a regular and dense grid of sources. Such data acquisition operations are costly and can be laborious when surface terrain access is difficult such as in mountainous, swampy or densely populated areas or can be highly restricted such as in environmentally sensitive areas.

Seismic interferometry relies on the use of the diffusive nature of the natural background noise in the subsurface. The method allows the exclusive use of receivers in a seismic survey that all act, after simple data processing, as virtual sources as well. It provides a cheap, fast, easy and environmentally friendly alternative for the use of controlled sources and offers therefore large potential for land seismic exploration of, particularly, large new acreage ('frontier exploration'). The spectacular recent gain in insight in interferometric principles, as discussed in an accompanying presentation, in combination with the rapid developments in seismic recording technology that allow the use of high-quality, relatively cheap and dense broadband sensor grids, already caused a change of focus in seismic data processing research and may well change, for a large part, exploration- and maybe even seismic-surveillance practices in the near future. After a successful, but small-scale, background noise recording experiment in a desert area, Shell decided to perform more field tests, but this time on a much larger scale. The data evaluation is carried out jointly with Delft University.