Acquisition highlights SEG 2012

Special Session 2

SS2.2 Meunier and Bianchi, "How long should the sweep be?" Derives the required sweep rate as a function of frequency for a new survey on basis of comparison with a reference survey. The sweep design formula includes effects of shot density and number of receivers listening to each shot. Comes very close to a prediction what is needed to achieve adequate signal-to-ambient noise ratio for any frequency. In the presentation Meunier mentioned there is an error in formula (14) of the abstract. It should be $Sr_{new} = A_{tot}^2 * Sr_{ref}$, where Sr_{new} is the sweep rate of the new survey, Sr_{ref} the sweep rate of the reference survey, and A_{tot} is the product of all acquisition effects. To get lower and higher frequencies than in the reference survey it will often be necessary to reduce the sweep rate for those frequencies.

SS2.6 At the London 2007 EAGE Conference, Girard et al. presented the acquisition of an *array-based* truly 3D symmetrically sampled survey with parameters shot and receiver interval = 25 m, shot- and receiver-line interval = 200 m, and maximum inline and crossline offset = 3000 m (see also Girard et al., 2008, First Break). The fold-of-coverage of this survey was 225. The developments in the field of acquisition have been stunningly fast over the last few years as demonstrated in Las Vegas by Pecholcs (Aramco) et al. who described the acquisition of a *single-source, single-sensor* truly 3D symmetrically sampled survey with shot and receiver interval = 12.5 m, shot- and receiver line interval = 125 m, and maximum inline and crossline offset = 6000 m. The fold-of-coverage is 2304 in 6.25 x 6.25 m bins. If you have this many traces in each bin, each bin can also be considered and treated as a 3D-cube with inline offset and crossline offset as the spatial axes of the data set. Excellent low-frequency data were obtained with the "maximum displacement" sweep. On the other hand, the high frequencies of the sweep (up to 90 Hz) were (as yet) not recovered, the maximum useful frequency in the final data being only 60 Hz. This loss of high frequencies might have been caused by near-surface problems that are notorious in the area. In his presentation, Pecholcs also described some asymmetrically sampled single-source, single-sensor surveys.

The interest in *low frequencies* has increased considerably over the past few years. This has led to new tests comparing various geophones (2, 4, and 10 Hz + Vectorseis) and comparisons of dynamite against vibrators. SS 2.1 Chiu et al. compared 2 and 10 Hz geophones, whereas SS 2.4, Margrave et al. not only compared 4 types of geophones but also dynamite with vibrators using three different sweeps. The 2 Hz geophones seem to be best below 4 Hz, whereas the only (tentative) conclusion of Margrave et al. was that Vectorseis may experience internal noise at low frequencies. The data set is there, but most analyses still have to come. Baeten et al. (SS 2.8) concluded from a test with "excessive effort" that current vibrator technology does not allow the reliable generation of 1 Hz signal.

Session Acq 4

Acq 4.1 "Full-wavefield, towed-marine acquisition and applications" (Halliday et al) discusses the potential of using multi-component sources in addition to their multi-component streamer. Potential solutions for generating multi-component sources are also reviewed. The main application would be to interpolate inline sources allowing to tow faster. I do not see how it would solve the major problem in marine data acquisition of the crossline distance between sources.

In Acq 4.6 and 4.7 Goujon et al. and Teigen et al. discuss the research Schlumberger had to carry out to make the multicomponent streamer a reality. Goujon et al. discuss the efforts to achieve vector fidelity of the measurements and Teigen et al. demonstrated the predictability of various noise modes in a stiff streamer. Results of data acquired with the multicomponent streamer (Isometrix™) were shown in paper SPIR 1.4, Vassallo et al. Their claim is that crossline data can be faithfully reconstructed into 6.25 x 6.25 m bins from an input sampling of 75-m streamer interval. The results are stunning as compared to the 75-m sampled data, but there is also some "breathing" in the reconstructed data, suggesting that interpolation is pushed beyond its limitations.

Ghost removal. A most interesting and rather unexpected development is the ability to remove source and receiver ghosts of conventional towed-streamer acquisition using some processing tools. Nowadays streamer noise is limited (especially when towed deep) and ghost notches are never very sharp due to wave action. These developments are described for instance in Zhou et al. (First Break, Oct 2012, WiBand technique of GXT), in Williams and Pollatos (First Break, Nov 2012) and in ads on TGS′ Clari-Fi. With these techniques contractors with conventional streamers are also able to produce broadband data. At Session Acq 4, Hegna and Parkes (PGS) and Wang and Peng (CGGVeritas) acknowledged as much in their papers. An important observation was made by Hegna who mentioned that the towing depth of sources and streamers should be different so that their first notches (and more notches if towing deep) should not coincide; the depth difference restricts the severity of the ghost notches.

Really autonomous nodes

Last year Shell announced their "Flying nodes project" (Duey, E&P Magazine, "Flying nodes shift marine seismic paradigm"), a project intended to develop self-propelled robots that navigate to preset underwater locations, record sound waves, then return to the surface for reassignment. At the SEG Conference CGGVeritas and Saudi Aramco jointly announced a similar project called SpiceRack to develop a robotized solution for seabed seismic acquisition.

Relax spatial sampling requirements by 5D interpolation?

The answer to this question might be given by application of the approach by Cary and Perz (SPIR 1.2, "5D leakage: measuring what 5D interpolation misses"). They present a useful method to determine an idea about the error in 5D interpolation. Only if the measured error consists of just random noise, may we be confident to have done a good job.

StagSeis

At the CGGVeritas booth presentations on StagSeis were given. This is a patented wide-azimuth towed-streamer (WATS) technique in which 5 sources are distributed over 2 streamer vessels and 3 source vessels. The sources are arranged along a line making an angle of 45° with the sailing direction and the streamer vessels are located on the outside of the setup. This provides maximum inline offsets in the order of 20 km, whereas the maximum crossline offset may be in the order of 4500 m. The survey area is traversed in orthogonal directions. Apart from the long offsets being acquired in one go, the main limitations of WATS acquisition remain: coarse crossline sampling and large ranges of azimuths not covered by long offsets.