Points-to-Ponder-II

In this forum we invite authors to submit thought provoking questions which have short answers and which bring out some important issues in the theory or practice of exploration geophysics. The questions should be submitted, preferably, along with their answers; however, that is not mandatory and the editorial board will make efforts to find correct answers. Selected questions will be published with their answers.

1. Following curves show a pair of P-wave and S-wave logs acquired by an Oil & Gas exploration company through a geophysical contractor in an exploratory well. Gas was found in the zone indicated in red color in the P-wave suit. The pair was rejected by an expert doing AVO modeling. What could be the reason?

2. Each point on a primary wavefront at time ‘t’ serves as the source of spherical secondary wavelets such that the primary wavefront at some later time ‘t + Δt’ is the envelope of these wavelets. Moreover, the wavelets advance with a speed and frequency equal to that of the primary wave at each point in space. As per Huygens principle only the forward movement of a wave is explained, but the construction will generate a wave travelling back to the source also. In a homogenous medium that is not observed. How does one explain that?

3. For the simple geometry shown below at [a], S is a source-receiver coincident position, P is a point on the plane reflector directly below at a distance $Z_0$, and Q is another point on the reflector such that the distance $SQ = Z_0 + \lambda/4$. Consider a spherical wave generated from the surface position S and incident on the horizontal reflector at P. The point on the surface S receives reflection energy from an area surrounding the reflection point P. Each element within this area generates a reflected spherical wave which reaches the surface S at a later time corresponding to the extra path it travels. Fresnel zone is defined as that area of the reflector from which reflected waves can reach S with a path difference less than $\lambda/2$. The net amplitude received at the surface location S is due to the interference of the waves reaching from the reflection elements within the Fresnel zone and is roughly twice that from the entire reflector.

Referring to [a] of the above figure, a peak in the wave train starting from S reaches the point P directly below (after traveling a distance $Z_0$ taken as equal to some integral multiple of wavelength in the above case) as peak and after reflection reaches back to S as peak. Now consider the ray to Q on the reflector. Due to the additional path difference of $\lambda/4$ between S and Q, it reaches Q as zero crossing and on return path back to S reaches as trough. The amplitude distribution of the impinging waves and the reflected waves between points P and Q are shown at the bottom and top respectively at [b].
4. “Why 1 second is equal to 1.024 seismic second?”

5. In a marine seismic gun array we use different volumes of guns....It is said that it is used to get the variable frequency...i.e. wide range of frequency band. My question is: if you fire any gun it will give you a spiky signal (which tends to a dirac delta function in ideal case), whatever the volume is...so why is it said that by firing different volumes of gun we get a broad frequency spectrum...because for any spike signal we can assume that it contains all frequencies...?

6. In a 4-D seismic survey, the characteristics of hydrophones / geophones can change over time in a hostile environment. Further, the change ( deterioration (?) in the response of phones over time ( months and years ) may not be uniform for all the receivers. We may ascribe, process and interpret the difference in the earth response after the survey interval as due to the subsurface fluid changes or reservoir characteristics. Do the manufacturing companies analyse such phenomena?

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Observations on “Points to Ponder-I”: Geohorizon July 2006

Item No 1: Predictive deconvolution works better in tau-p domain

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Please look into two other examples.............here primaries and multiples are having same offset but different “p” values.

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Fig.1. The primary ABC & its multiple ADEFC have the same offset value but different ‘p’ values.

Fig.2. Traces ABCDEFG and AHG will appear in same trace in x-t domain but in different traces in t-p domain.

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Editor’s response to the observations on Item No. 1 from Points to Ponder – I

A necessary condition for multiple suppression by 1-D deconvolution in any domain is that the primary and the multiples should not only be in the same trace, but also that the multiples should have a common reverberation period. In the illustration given above at Fig.1 it is true that the multiple ADEFC and the primary have the same offset, but the former cannot be predicted from the latter in any domain. However, Tau-p deconvolution will try to suppress the multiples arriving at C and so on from the primary event ADE.

Similar analysis applies to the Fig. 2. It is true that events for the paths ABCDEFG and AHG will appear in same trace in x-t domain but in different traces in t-p domain. However, they have nothing to do with each other in suppressing the multiples corresponding to path segments – CDE or CDEFG. These can be better suppressed in Tau –p domain than in x-t domain as they have the same p-values as the event for the path ABC and time periods CDE = EFG = ....