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Post Stack Attenuation of Peg-Leg Multiples

Anil Kumar Semwal
(Processing/ Pan India Consultants, Pvt. Ltd., India)

Abstract*: Peg-leg multiples associated with reflectors just below the water bottom are among the concerns, a processing geophysicist is worried about. Peg-legs can be attenuated in both pre & post stack stages. Pre stack attenuation processes are relatively more expensive than those of post stack ones. Multiple attenuation technique based on periodicity of multiples is opted here & exercised on a stack data set pertaining to shallow 2D marine regime.*
Keywords*: Amplitude spectrum, geometrical spreading, Peg-leg multiple, stack, water bottom library*

I. Introduction

Primary reflections are hugely masked by unwanted multiple energy in an offshore scenario. Multiples can be classified in different classes, such as, water-bottom, free-surface, peg-leg, intra-bed & inter-bed multiples.Regardless of the type of multiples, they all have two common properties that can be exploited to attenuate them with varying degree of success — periodicity and move-out that is different from primaries. While these techniques seem to have a good conceptual basis, their performance on field data can be disappointing. There are several possible explanations for this. First, for velocity discrimination techniques to be effective, significant move out differences must exist between primaries and multiples. However, the inability to exploit the large move out differences between primaries and multiples in the mute zone works against the methods based on velocity discrimination. Periodicity of multiples is preserved for the ideal case of zero offset and horizontally layered earth. At nonzero offsets, periodicity often is destroyed even for the horizontally layered case. There is also a problem caused by the application of geometric spreading correction, when it is applied using the primary velocity function. This type of correction usually results in enhancement of the amplitudes of multiple reflections. (Yilmaz, 2011) Just, predictive deconvolution does not suffice attenuating the multiples, so, multiple attenuation is tackled using variety of algorithms & worked out in different domains, such as, *f-x, f-k, τ-p* depending on the type of multiple and cost of process execution.In the current context we chose periodicity property of the peg-leg multiples to attenuate them. Situations arise, when peg-legs are detected in post stack stage and there attenuation is desired then & there. With this as a central idea we opted filtering of peg-legs in post stack stage. Moreover, periodicity of multiples is more or less preserved in this case for the very reasons that we chose to work on stack section i.e. zero offset data obtained from a horizontally stratified shallow offshore regime.

II. Method

Ray path diagram for peg-leg multiples associated with the reflector just below the water bottom is shown below in Fig.1.

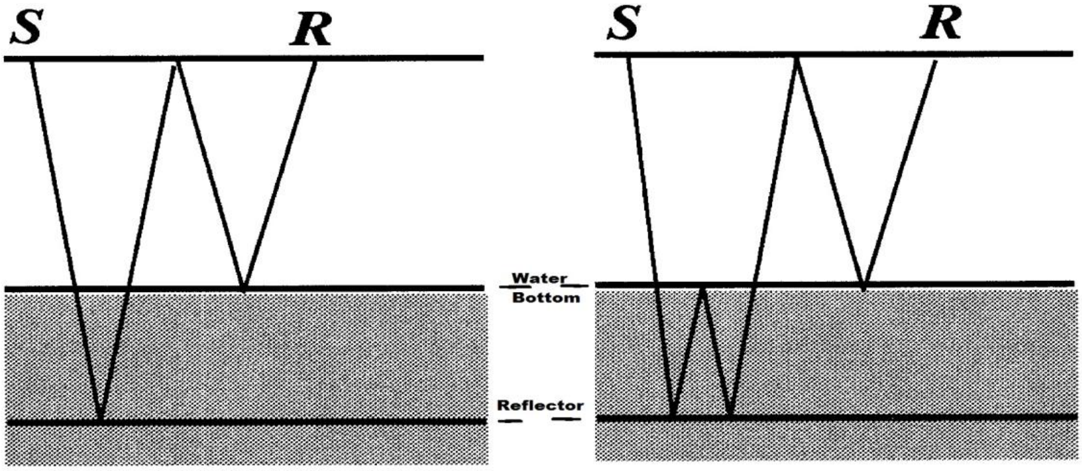

Figure. 1 Raypaths associated with first & second order peg-leg multiples, where S corresponds to air-gun source & R to hydrophone receiver

A shallow marine 2D stack dataset is used here as an input. Processing is carried out in CGG-Veritas's Geocluster platform. It is ensured not to use geometrical spreading correction, as they amplify the unwanted multiple energy. SPLAT (Specified Peg-Legs Attenuation) module from Geocluster's application repository is made use of here. SPLAT performs an attenuation of the peg-legs that belong to a specified primary reflector. The program can be applied before stack (in common offset planes) or after stack. SPLAT works on sections on which the primary (whose multiples are to be attenuated) has already been flattened. If the generator (i.e., the water bottom) is not horizontal, it must be defined by the picked water bottom library before the primary is flattened. The filtering is performed in spatiotemporal gates in the *f-x* domain. SPLAT works under the assumption that the multiples pertaining to the specified reflector exhibit similar spatiotemporal patterns as the primary reflector. It is therefore of utmost importance not to distort these multiples before SPLAT. The attenuation is applied between an initial time and a final time. If some geological reflectors exhibit the same pattern as the specified generator on "n" traces, then they will be removed if spatial gate contains just "n" traces. In that case, SPLAT should run on spatial gates which contain about four times "n" traces, in order not to attenuate the geology. Moreover, number of multiples to attenuate can also be controlled/ enforced and geology immediately below the primary can be ensured by designing a window & a taper after examining the data.

III. Results & Discussions

A 2D line from shallow marine is used here for processing. Fig. 2 illustrates raw stack with swell noise streaks. Swell noise is taken care using SPARN module in gather mode. This module carries out projective filtering in the (f-x) domain.

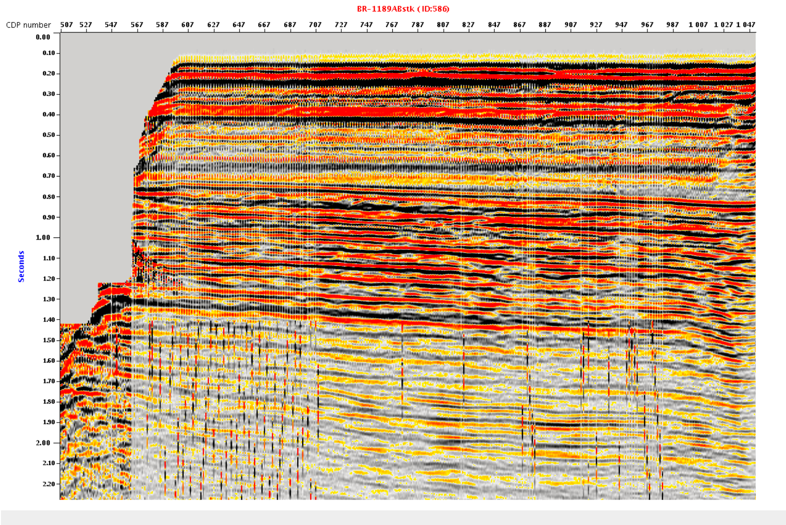

Figure 2. Raw stack without noise attenuation

Application of SPARN brings about swell noise free stack. Vertical to near vertical swell noise borne streaks are completely attenuated and results in a clean section. (Fig. 3)

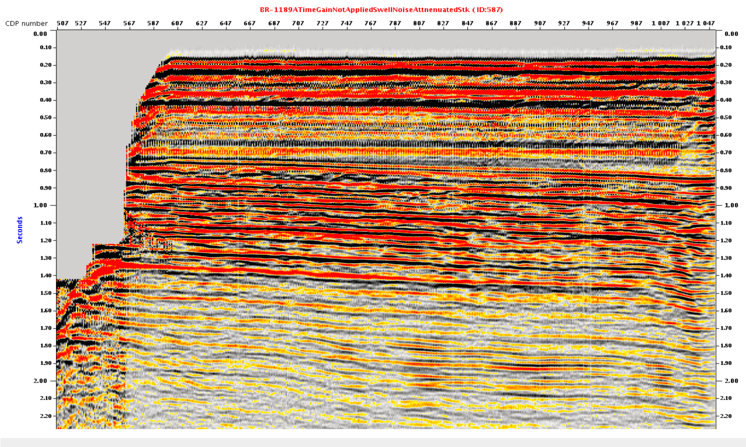

Figure 3. Swell noise attenuated stack

Now, peg-leg attenuation is opted on this noise attenuated stack using SPLAT. It results in generation of peg-leg multiple model and carries out adaptive subtraction of this model from the data simultaneously. Fig. 4 illustrates the peg-leg multiple model.

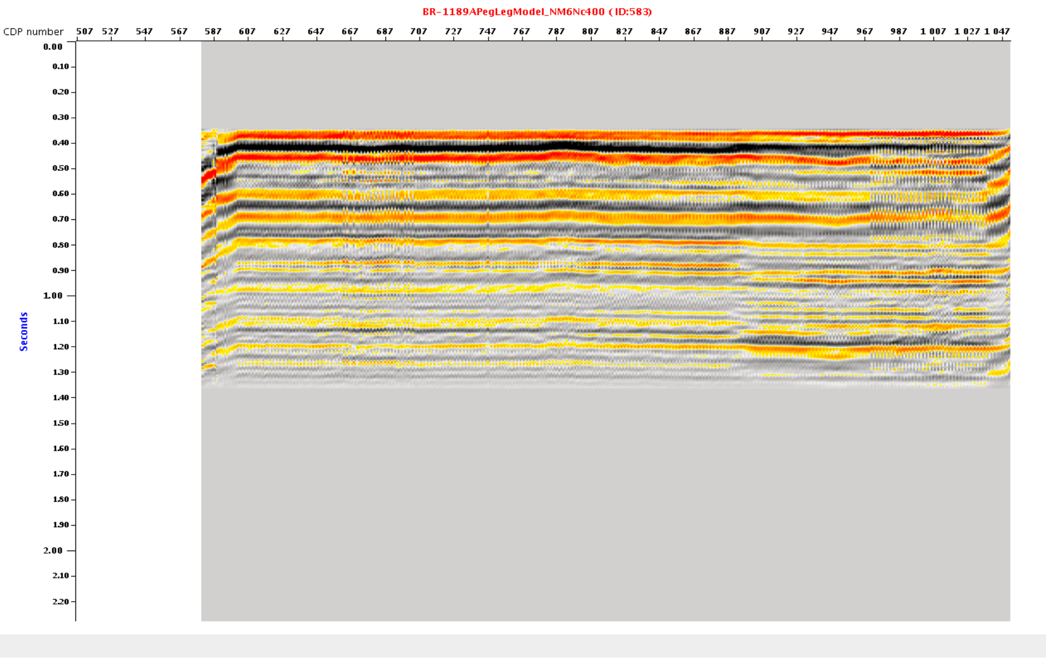

Figure 4. Multiple model

Finally, peg-leg multiple free stack data is achieved and is shown in Fig. 5. Comparison between Fig. 3 & Fig. 5 suggests that peg-legs have been rigorously de-motivated particularly within a time window 400-800 ms and results in standout of true reflectors, which otherwise were multiple masked. Moreover, primary events are crisper & more continuous till 1200 ms in case of peg-legs attenuated section.

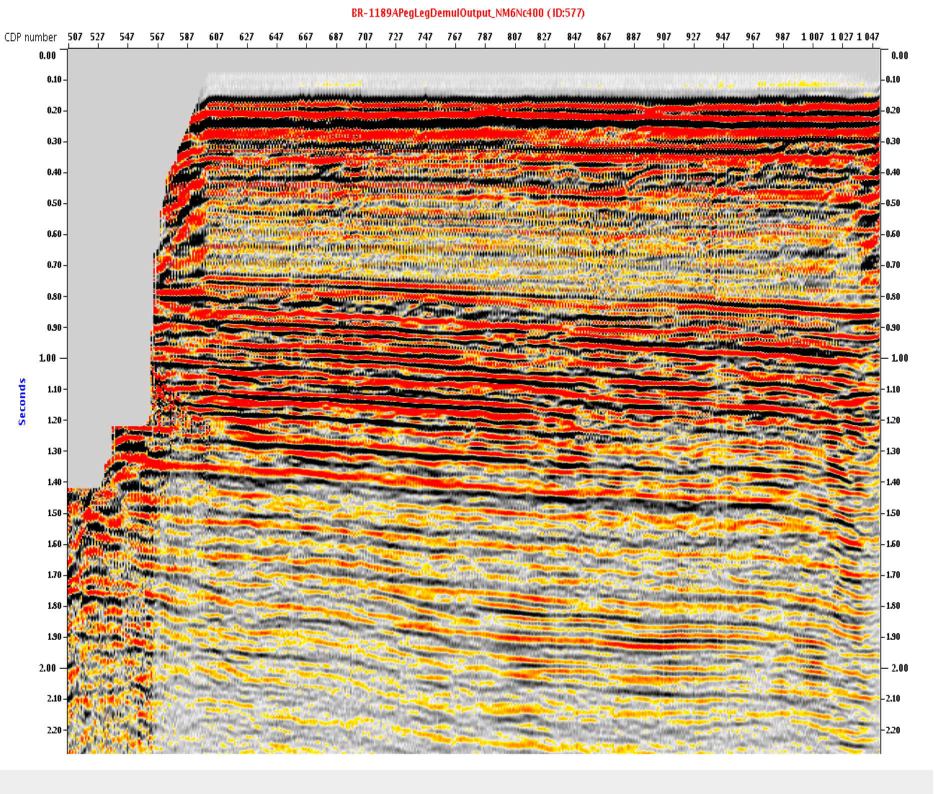

Figure 5. Peg-leg attenuated stack

A comparison amplitude spectra is plotted in Fig. 6, which depicts that frequency components (12-55 Hz.) are most strong for the peg-leg attenuated data set

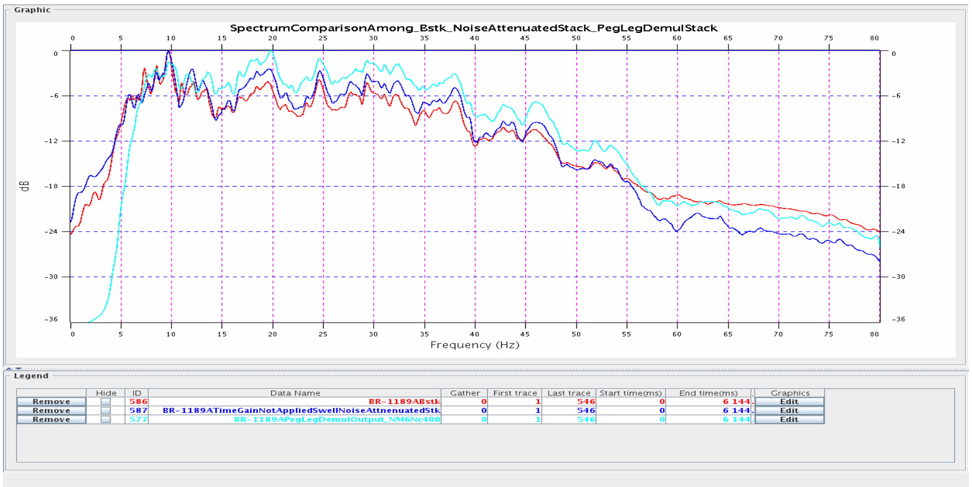

Figure 6. Amplitude spectra for raw (in red), noise attenuated (in violet) & peg-leg removed (in blue) stack

IV. Conclusion

It is exercised to attenuate peg-leg multiples from a stack section of a shallow marine 2D line and processed results show a sufficient degree of success in this endeavor by taking into consideration the relative show up of primary reflections, their continuity and the boosted amplitude spectrum. Moreover, it is relatively far inexpensive in terms of process time for the very reason that input is a stack section rather than being a gather.

Acknowledgments

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References

[1]. Yilmaz Ozdogan, Seismic Data Analysis, (SEG, 2011) 843, 856.