NMO and CRS stack in seismic marine data

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Abstract

This work is focused on processing, and imaging of the selected data of the Marmousi Basin, based on the NMO and CRS stacking methodologies, where the of post-stacking Kirchhoff migration in time is in depth, and common to all techniques. Beyond in addition, the partial-CRS stack was applied to densification of CMPs. Several tests were performed to optimize parameters, operator openings of the model, and as a result the flowchart of generated better visual quality of the sections, the main results compared in the course of the work for both methodologies.

INTRODUCION

The exploitation of marine energy resources requires more and more high technology for success and optimization of costs. In this direction, the academy and projects with economic resources directed to develop research and contribute to the formation of human resources for oil and gas. Being thus, the area of geophysical exploration, particularly the seismic, has fundamental importance in obtaining images of terrestrial subsurface in basin areas sedimentary potential and risk reduction exploratory.

The use of the three methodologies used has the purpose of complementing and increasing the information on the characteristics of the subsurface, and give more options for geological interpretations of the results obtained. The main results are stacked and migrated sections discussed in more detail detailed in the sequence of the work.

For the processing and imaging the applications were used **CWP/Un*x ?**, **crsstack ?**, **crsstack_supergathers** and **?**.

METHODOLOGY / RESEARCH PROBLEM

The NMO stacking methodology is based on the model of flat-horizontal layers, whose time of transition to primary reflections is given by a hyperbolic approximation given by Yilmaz (1988) :

$$t^2(x) = t^2(0) + \frac{x^2}{v_{NMO}^2}, \tag{1}$$

where x is the source-receiver spacing, $t(x)$ the time transit, $t(0)$ the double-time simple vertical and v_{NMO} the normal overtemperature speed. It is necessary to A model of velocity distribution obtained through of paired marking (v_{NMO}, t_0) on the coherence map Semblance, and that serves the correction, stacking and migration.

The CRS stack, initially described by MÃ$\frac{1}{4}$ller (1999) and Mann (2002), is based on the layers bounded by curved interfaces, and considered independent of the speed model, where the transit for primary reflections is given by the approximation hyperbolic:

$$t_{CRS}^2(x_m,h) = \left[t(0) + 2\frac{sin\beta_0}{v_0}(x_m - x_0)\right]^2 \tag{2}$$

$$+2t(0)\frac{cos^2\beta_0}{v_0}\left[\frac{(x_m-x_0)^2}{R_N} + \frac{h^2}{R_{NIP}}\right]^2,$$

being x_m the common-mid-point, v_0 the next speed to the point of emergency and h the source-receiver half-distance. In this method we retrieve the trio of attributes of the two hypothetical waves N and NIP through the solution of a non-linear triparet optimization problem, and Which are: the emergency angle β_0, the radius of curvature R_N and the radius of curvature R_{NIP}. These attributes carry Information on slope, depth and shape of the reflecting interfaces. In order to improve These results we opted for using the process Of CRS-partial stacking described by Baykulov & Gajewski (2008), and that produced sections of better reason signal/noise ratio. This process consists of the interpolation of CMP families to the data cube with the objective of Densify the mesh prior to stacking CRS under The condition of super-families.

RESULTS

The parameters and operator openings chosen for the processing of this line, as well as the order of the in the flowcharts were obtained by means of Of exhaustive tests, and the most satisfactory results in the sense of higher signal-to-noise ratio has its main results presented in the sequence.

The preprocessing stage, performed by Silva (2016) , was common to both methodologies, and included processes shown in Figure 1.

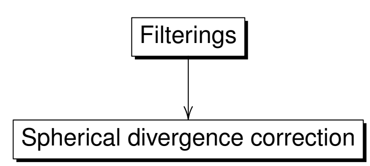

Figure 1: NMO stacking flowchart.

For the insertion of the Geometry analysis of the field report, and the Information can be found in Table 1.

Aquisition Geometry	
Bowl	Marmousi
Year of acquisition	1988
Source depth	9 m
Shots number	240
receivers number	96
shots interval	25 m
receivers interval	25 m
minimum offset	200 m
maximum offset	2575 m
Record time	3.0s
Sampling interval	4 ms

Table 1: Acquisition Geometry Information.

The exit data from this first stage, organized in the CMP family, served as input for the NMO and CRS. Thus, the NMO processing was and the steps are shown in Figure 2.

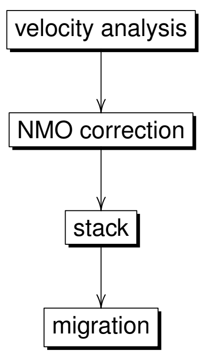

Figure 2: NMO stacking flowchart.

The speed models smoothed over time and in the depth, are shown in Figures 3 and 4, and were obtained, respectively, by markings in the semblance map and the conversion of average-quadratic velocities for intervals.

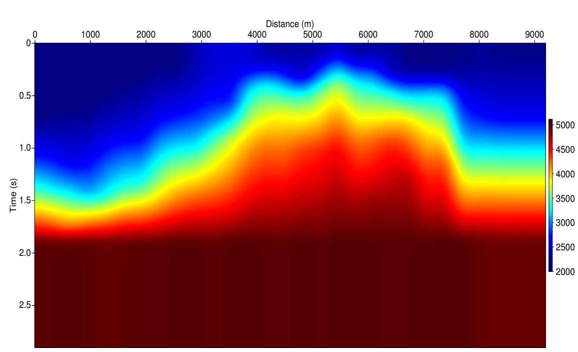

Figure 3: Speed model semblance in time.

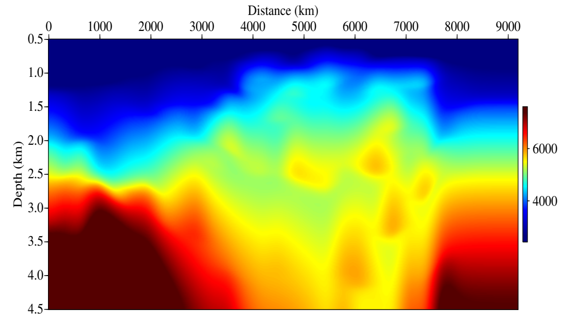

Figure 4: Semblance velocity model converted to depth.

After the NMO correction, the NMO given whose result is shown in Figura 5.

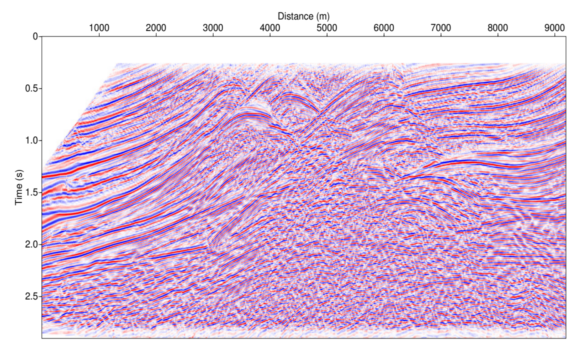

Figure 5: Stacked section NMO.

In this figure it is observed that most of the information recorded corresponds to shallow events and with good continuity. However, many diffractions as the depth increases. The results of post-stacking Kirchhoff migration, in time and depth, are shown in Figures 6 e 7, respectively.

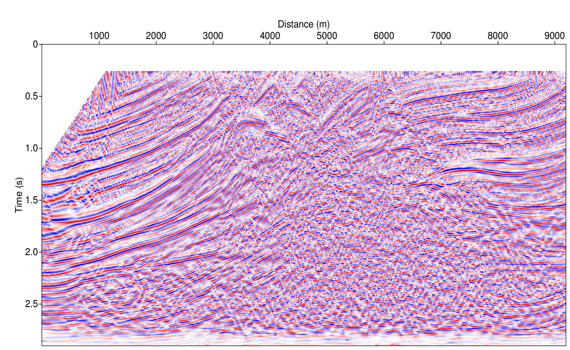

Figure 6: Kirchhoff migrated section in time.

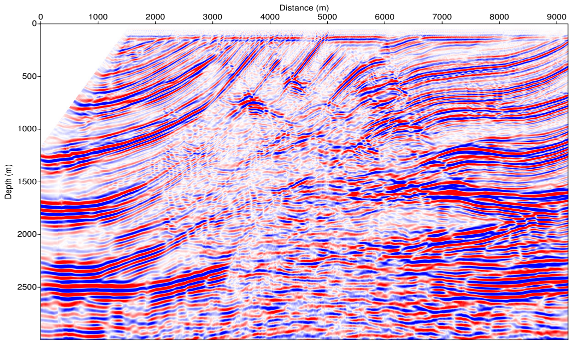

Figure 7: Kirchhoff migrated section in depth

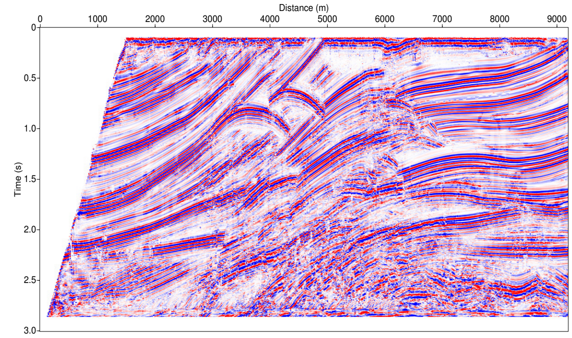

Figure 8: CRS stacked section.

Analyzing Figures 6 and 7 one can observe the small displacement of geological structures in relation to Figure 5, the retrieval of the subhorizontalization of the structures, designed by the best continuity of reflectors, the collapse of diffractions and the correction of geological features. Section 7 is of superior quality than Figure 6 due to the recovery of events in large Depths and the absence of arcs on points diffractors ("smiles").

CRS stacking flowchart of Marmousi data are shown in Figure 2.

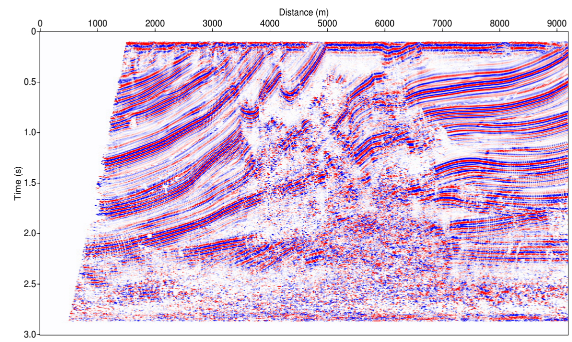

Figure 9: CRS-migrated section.

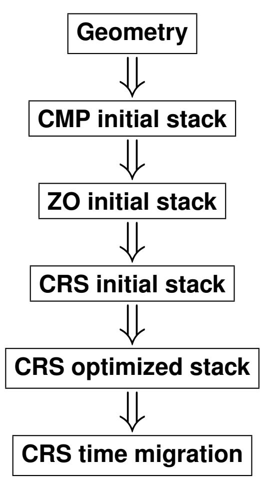

Table 2: CRS stacking flowchart.

Following with the CRS stacking flowchart, Sub-products were selected, such as the CRS sections Stacked (see Figure 8) and migrated (see Figure 9) First Fresnel Zone Design.

Figure 10 shows the Kirchhoff migration in time using the velocity model of Figure 3 and the section stacked CRS optimized of Figure 8.

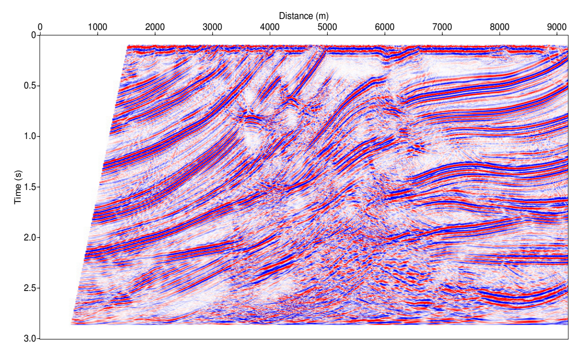

Figure 10: Kirchhoff migration using the speed semblance and stacking CRS.

The stacked section CRS presents better quality than the NMO in the sense of plus the structures due to better continuity of events Reflectors and the large amount of diffraction.

The enhancement of the free surface multiple is also larger, as the greater coherence for the reflection events primary.

On CRS migration, one can observe the collapse diffraction, the correction of geological faults, the Continuity of reflective events, the large amount of of granulations, the absence of arcs on the points Diffraction ("smiles") and the attenuation of multiple free surface.

The Kirchhoff migration in time using the speed semblance and the stacked CRS section shows many diffractions and a large amount of arcs above diffraction points ("smiles"), mainly for the events at great depths, demonstrating the low quality of the section and the incoherence of the methodology.

DISCUSSION AND CONCLUSIONS

The conclusions on the results of the NMO and CRS stack, are clearly showing difficulties and serious limitations, as well as cases that merit further. Attention to the implementation of the theories studied, and serve as a reference for future work.

From the comparative point of view between the sections obtained, the stacked CRS section has vertical resolution and horizontal section above the stacked NMO section, since in the CRS section one can better distinguish the interfaces and reflecting continuous structures through section, in addition to highlighting more clearly the of diffraction. The comparison between the migrated sections of these two methodologies shows that CRS migration has better visual quality and continuity of events reflectors.

As suggestions for future work, we propose the application of other post-depth based on equation such as PSPI (PhaseShift Plus Interpolation), SS (Split-Step), RTM (Reverse Time Migration), and FFD (Fourier Finite Difference), for comparison with the Kirchhoff migration, and the generalization of the results obtained with the CRS and the NIP wave tomography for the 3D case.

Acknowledgments

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References