دانشگاه بین‌المللی امام خمینی
IMAM KHOMEINI INTERNATIONAL UNIVERSITY
Imam Khomeini International University
Vol. 3, No. 4, Winter 2019, pp. 1-5

Mineral Resources Engineering
نشریه مهندسی منابع معدنی
Journal of Mineral Resources Engineering
(JMRE)

DOI: 10.30479/jmre.2019.1590

An Improvement In To The Common-Diffration-Surface (Cds) Stack Method

Shahsavani H.[1*], Karimi Sh.[2]

1- Assistant Professor, Dept. of Minig, Faculty of Engineering, University of Kurdistan, Kurdistan, Sanandaj
h.shahsavani@uok.ac.ir

2- M.Sc Student, Dept. of of Minig, Faculty of Engineering, University of Kurdistan, Kurdistan, Sanandaj
s.karimi@uok.ac.ir

(Received: 06 Jul. 2018, Accepted: 24 Oct. 2018)

Abstract: The Common Diffraction Surface (CDS) stack method has been introduced to solve the conflicting dip by merging the concepts of Common Reflection Surface (CRS) stack method and Dip Move-Out (DMO). The method proposed considers a continuous range of operators in pre-stack data set to simulate a Zero-Offset (ZO) sample which handle the conflicting dip problem in to full extent. However this method still contains artificial events and noise to the ZO stack section. As the coherence of each operator is available before stacking, it is proposed to use this coherence as criterion for accept or reject an operator for the stack. In this way the operators, which have not coherence with any seismic events, will be illuminated. By implementing the proposed method not only it is possible to solve the conflicting dip in to full extent but also the signal to noise ratio will be increased.

Keywords: Coherence, Conflicting dip, CRS, CDS.

INTRODUCTION

The development of the seismic reflection data processing was enterd to the new stage in 1962 by introducting the Common-mid-point (CMP) method [1]. This method, which was based on assumtion of horisontal reflectors, has been developed to consider the dipping refectors later on [2]. But the fan shape of Dip-Move-Out (DMO) operator can not calculte the reflector respones approprately. Based on two hypothetical wave front experiment [3] the traveltime of the wave has been calculated [4-8]. By using this traveltime the Common-Reflection-Surface (CRS) stack method has been introduced and applied on a real data set [9-13]. As the CRS method for each smaple just consider one operator, which has high coherence with seismci event for the stack to the Zero Offset (ZO) samples and neglect othere events, it can not handle the confilicting dip in the simulated ZO sections [9,10]. The conflicting dip cause to cover the tail of diffractor by high enrgy reflectors or vise versa [14]. Consiquntely, it is porposed to use a range of operators for stacking, instead of one operator [9]. Afterward by integration the DMO and CRS, a method called Common-Diffraciotn-Surface (CDS) stack, has been introduced. The CDS method is appiled on the real data with a very good results [15,16]. As the CDS method carries a data driven manner, it was very time consuming the model driven CDS has been intruduced, which uses the dynamic and kinematic ray tracing [14]. The model-based CDS has been applied on the Sigsbee2A synthetic data set [17] and can handel the confilicting dip in to full extent. As the CDS method consider many operator for the stacking, consiquntely it bring a lot noise to the simulated ZO stack section. In this paper we propose to use a number of operators for the stacking which has the coherecne more than a predefine thershold. In this way it is possible to make blance between solving the confilcting problem and the amount of the noise in the simulated ZO stack section.dfdf.

THEORY

Base on two hypothetical wave front so called kinematic wavefield attributes, the scond orther approximation of traveltime is obtained which read as:

$$t^2(x_m,h) = \left[t_0 + \frac{2sin\alpha}{v_0}(x_m - x_0)\right]^2 + \frac{2t_{0\,cos^2\alpha}}{v_0}\left[\frac{(x_m - x_0)^2}{R_N} - \frac{h^2}{R_{NIP}}\right] \quad (1)$$

where h is half offset, xm is the mid point of source and receiver, x0 and t0, is the ZO sample that the stacked amplitude is allocated, RN, RNIP, and alpha are the so called kinematic wave field attributes.

For a diffractor on a depth the RN is equal to RNIP hence the equation (1) is simplified to:

$$t^2(x_m,h) = \left[t_0 + \frac{2sin\alpha}{v_0}(x_m - x_0)\right]^2 + \frac{2t_{0\,cos^2\alpha}}{v_0 R_{CDS}}[(x_m - x_0)^2 - h^2] \quad (2)$$

It is possible to obtain the unknown parameter in equation (2) by kinematic and dynamic ray tracing efficiently [13].

IMPLEMENTATION

In CDS stack method the coherence of all operators is ready before stacking step. Hence, it is possible to use this coherence value as a criterion to accept or reject an operator to apply on the stacking process. In this way, the operators with no relation to the seismic event are neglected, which causes increasing the signal to noise ratio.

For this purpose, a threshold is considered for the coherence. The operator with higher coherence of this threshold is accepted and the operator with lower than this threshold is rejected for the stacking process. It is clear that if this threshold is low (close to zero) the signal to noise will not increase and if this threshold is high (close to one) the conflicting problem will not solve in the simulated zero offset stack section. Subsequently, the threshold should to be considered in such a way that there is a balance between solving the problem of conflicting dip and increasing the signal to noise ratio.

CASE STUDY

In this paper the proposed method is applied on the Sigsbee2A synthetic dataset, which was developed by the SMAART JV Company [16]. The stack section of this data set obtained by the model-based CDS whit the threshold of 0.0 is depicted in Figure1.

The focus on the right hand side window in Figure 1 is illustrated for different coherence threshold i.e. 0.0, 0.03 and 0.06.

As depicted in Figure 2a and Figure 2b by increasing threshold many artifices and noises are diminished while the conflicting dip is still solved. By increasing the threshold from 0.03 to 0.06 in Figure 2b to Figure 2c the noise and artifices eliminated in to full extent. But the problem of conflicting dip is not solved. In Table 1 the signal to noise ratio with the respect of the threshold is compared.

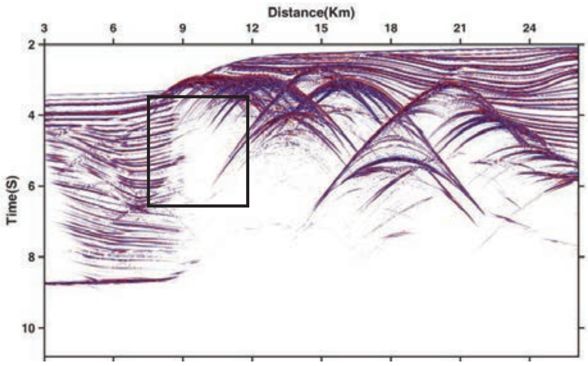
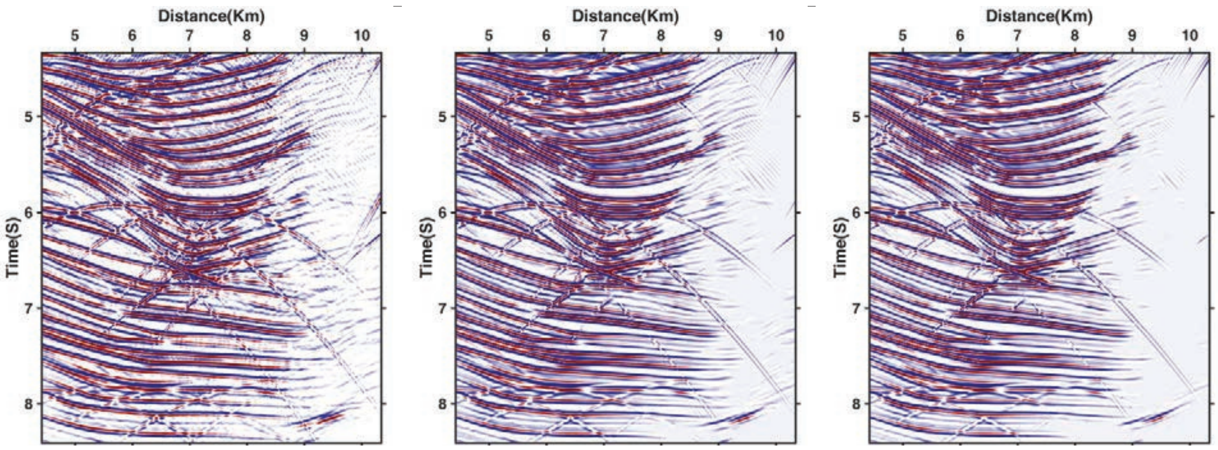


Figure 1. The CDS stacked section with threshold 0.0



a) b) c)

Figure 2. The stacked section of the right hand side of Figure 1 a) stacked with threshold 0.0, b)stacked with thershold 0.03, c)stacked with thershold 0.06

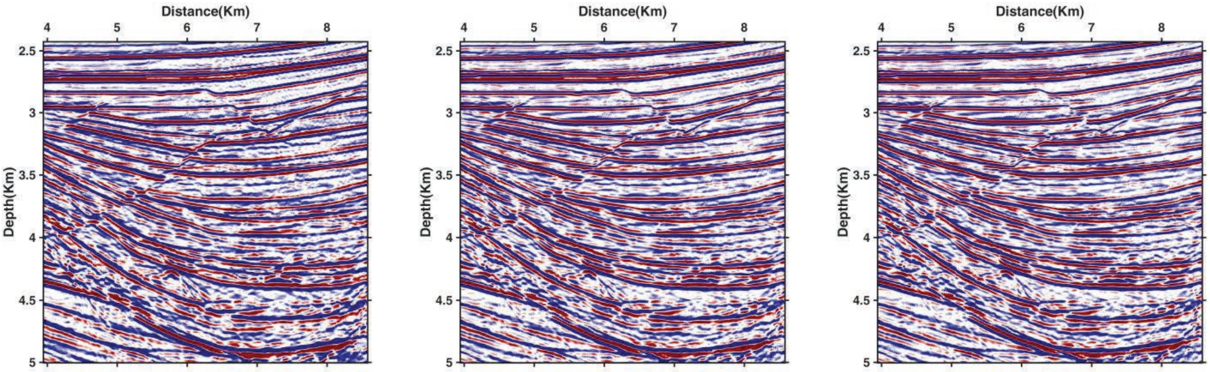
Table 1. Comparison of signal to noise ratio with the respect to threshold of the stacked sections

Threshold	Signal to Noise ratio (dB)
0.00	17.14
0.03	21.17
0.06	23.01

This table shows that by increasing the threshold the Signal to Noise ratio will increase. But it has to be considered that by increasing the threshold the conflicting problem will arise. Hence in this work the threshold 0.03 is an efficient one.

To have a better comparison, the sacked sections have been migrated. The migrated section is shown in Figure 3.

As it is illustrated from Figure 3a to Figure 3b many artifacts are removed but in Figure 3c some parts of the faults are not well imaged which are because of conflicting problem.



a) b) c)

Figure 3. The right hand side migrated section in Figure 1 a) migrated the stacke section with the thershold 0.0, b) migrated the stacke section with the thershold 0.03, c) migrated the stacke section with the thershold 0.06

CONCLUSION

The common-diffraction-surface stack method considers a range of operators to simulate a Zero Offset sample, which causes to produce the artifice and noise in the Zero Offset stacked section. In this work, we proposed to use the coherence of each operator as a criterion to accept or reject an operator for the stack. In proposed method, a threshold for the coherence is considered, and then the operators which have the higher coherence than the assumed threshold are considered for the stacking and the operators which have the lower coherence are neglected. The results of this work in both stacked section and migrated section show that by defining an efficient threshold it is possible to remove the noise and artifice and still solve the problem of conflicting dip. As the coherence of operator in different Zero Offset samples has various coherences, it is possible to consider the operator for the stacking with the respect of the maximum coherence in each Zero Offset sample.

REFERENCES

[1] Mayne, W. H. (1962). *"Common reflection point horizontal data stacking techniques"*. Geophysics, 27(6): 927–938.

[2] Hale, D. (1991). *"Dip Moveout Processing"*. Soc. Expl. Geophys., Tulsa.

[3] Hubral, P. (1983). *"Computing true amplitude reflections in a laterally inhomogeneous earth"*. Geophysics, 48(8): 1051-1062.

[4] Schleicher, J., Tygel, M., and Hubral, P. (1993). *"Parabolic and hyperbolic paraxial two-point traveltimes in 3D media"*. Geophysical Prospecting, 41(4): 495–514.

[5] Tygel, M., Müller, T., Hubral, P., and Schleicher, J. (1997). *"Eigenwave based multiparameter traveltime expansions"*. In Expanded abstracts, 67th Ann. Internat. Mtg., Society of Exploration Geophysicists, 1770–1773.

[6] Höcht, G., de Bazelaire, E., Majer, P., and Hubral, P. (1999). *"Seismics and optics: hyperbolae and curvatures"*. Journal of Applied Geophysics, 42(3,4): 261-281.

[7] Hubral, P., Hocht, G., Jager, R. (1998). *"An introduction to the common-reflection-surface stack"*. 60th European Association of Geoscientists and Engineers (EAGE), DOI: 10.3997/2214-4609.201408165.

[8] Mann, J., Jäger, R.,Müller, T., Höcht, G., and Hubral, P. (1999). *"Common-reflection-surface stack- a real data example"*. Journal of Applied Geophysics, 42(3,4): 301-318.

[9] Mann, J. (2002). *"Extensions and applications of the Common-Reflection-Surface Stack method"*. Logos Verlag, Berlin.

[10] Mann, J. (2001). *"Common-Reflection-Surface stack and conflicting dips"*. In Extended abstracts, 63rd Conf. Eur. Assn.

Geosci. Eng. Session P077.

[11] Jäger, R., Mann, J., Höcht, G., and Hubral, P. (2001). *"Common-Reflection-Surface stack: image and attributes"*. Geophysics, 66(1): 97-109.

[12] Garabito, G., Cruz, J. C. R., Hubral, P., and Costa, J. (2001). *"Common reflection surface stack: a new parameter search strategy by global optimization"*. In Ann. Report, Wave Inversion Technology Consortium, 4: 35–48.

[13] Müller, T. (1998). *"Common reflection surface stack versus NMO/stack and NMO/DMO stack"*. 60th Conference European Association of Geophysical Engineering.

[14] Shahsavani, H. (2011). *"A model-based approach to the Common- Diffraction- Surface Stack method—a synthetic case study"*. PhD thesis, Shahrood University, Shahrood, Iran.

[15] Soleimani, M., Piruz, I., Mann, J., and Hubral, P. (2009a). *"Common-Reflection-Surface stack: accounting for conflicting dip situations by considering all possible dips"*. Journal of Seismic Exploration, 18(3): 271–288.

[16] Soleimani, M., Piruz, I., Mann, J., and Hubral, P. (2009b). *"Solving the problem of conflicting dips in Common-Reflection-Surface stack"*. In Extended Abstracts, 1st Internat. Conf. & Exhib., Shiraz, Iran, European Association of Geoscientists & Engineers.

[17] Pfaffenholz, J. (2001). *"Sigsbee2 synthetic subsalt data set: image quality as function of migration algorithm and velocity model error"*. In Workshop on velocity model independent imaging for complex media, Extended abstracts, Society of Exploration Geophysicists, Session W5-5.