# A METHOD OF CORRECTION FOR MARINE SEISMIC ACQUISITION

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## 1. INTRODUCTION

Steamer towing acquisition is the main method of acquiring marine seismic data. In this method, a vessel with air guns acts as the seismic source, and tows many streamers with narrow separated hydrophones to acquire seismic data. In practical applications, the qualities of acquired seismic data are influenced by the many factors such as the design of acquisition system, the weather and the ocean wave in the acquisition period. Variations in shot and receiver positions produce errors of acquired data. Eiken et al. analyzed results from experiments in the North Sea, and corrected the variations in lateral positions by sample spatial interpolation and a frequency-domain interpolation method published by Duijndam et al. for the streamer feathering problem [1][2]. Naess measured and predicted the positional errors before planning survey to obtain good geometrical repeatability [3]. Koenitz designed a new acquisition method which using short streamer and an additional source vessel in acquisition configuration [4]. We analysis the genesis and the influence of variations in lateral positions and propose a sub-pixels interpolation based method to correct variations. Application to real data set shows that the new method effectively enhances the resolution of acquired seismic data.

## 2. MEHTOD

Ocean current is produced by many factors such as wind, tide, and diversity of temperature and salinity in the marine. It is difficult to be predicted before acquisition. Since streamers in the marine will be moved by ocean currents, hydrophones on streamers shift form predefined position in time and lateral directions, as Figure 1 showed. Figure 2 demonstrates stack with the acquired data shifting in lateral direction could make the reflection from an ideal point of a stratum layer come from the adjacent area. Moreover, shifting in time direction is another reason of stack section resolution reduction [1].

As variations of receivers cannot exceed separation of streamer [3], the errors of stack section exist in sub-pixel domain. A common reflection point (CRP), $g(t,x,y)$, is obtain from the acquisition of a real seismic section, $h(t,x)$.

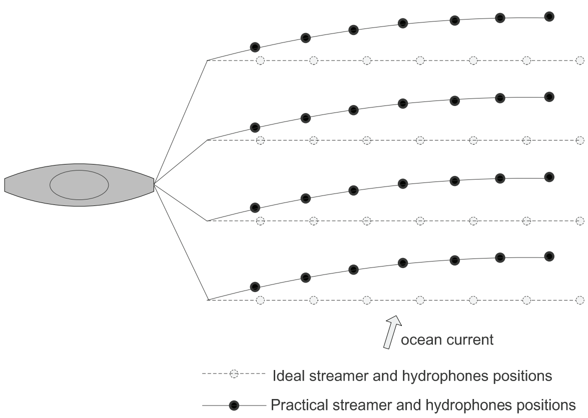


**Fig. 1.** Illustration of the influence of ocean currents for streamers and hydrophones position shifts.

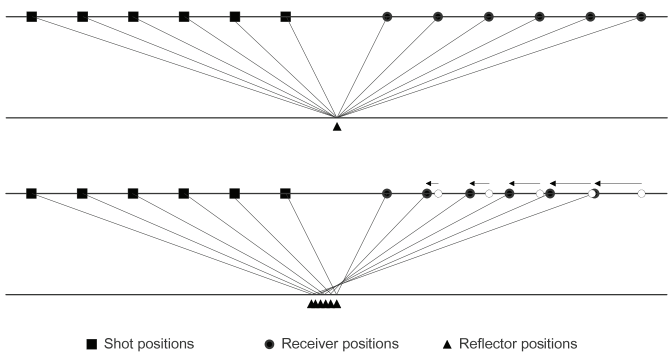


**Fig. 2.** Stack of signal from one reflector in ideal (top) become from mutilple reflectors (bottom) in practical for the influence of receiver poistions shifting in the lateral direction.

The first step of our method is stacking the CRPs to get the template $m(t,x)$. Since CRPs with small offset have minor shifting as Figure 2 demonstrated, we only use near CRPs to generate template by

$$m(t,x) = \frac{1}{L}\sum_{y=1}^{L} g(t,x,y) \tag{1}$$

where $L$ is the threshold of offset. We represent the *k*-th section of $g(t,x,y)$ as $g_k(t,x)$. Since $m(t,x)$ is the average of data with better sample quality, it should be more approximate to $h(t,x)$ than $g_k(t,x)$. Supposing size of $g_k(t,x)$ is $M \times N$, we interpolate each $g_k(t,x)$ into a large section with the size of $rM \times rN$. Thus, each points in $g_k(t,x)$ will be interpolated into $r \times r$ points. After that, we extract data from the large section with same separation of $r$ to get $r$ images. Next, we match those images with the template by finding the maximize cross-correlation in a certain $W \times W$ size window as follow:

$$\underset{\Delta t,\Delta x}{\text{Maximize}}\{C[\Delta t(t,x), \Delta x(t,x)]\} = \sum_{u=-W}^{W}\sum_{v=-W}^{W}[g_k(t+u+\Delta t, x+v+\Delta x)m(t,x)], \quad \Delta t = 0,\cdots,r, \quad \Delta x = 0,\cdots,r \tag{2}$$

For each point of $g_k(t,x)$, we find the most matching point in $r$ images, and replace the value of this point with that of the matching point. After that, we finish correcting a section of CRPs. Applied this method section by section, we could correct variations in time and lateral direction of acquired data.

## 3. EXAMPLE

To demonstrate the performance of the proposed method, we apply it to a real dataset from a field of China. Figure 3 shows the stack section before (left) and after (right) correction by our method. It could be seen from the figure that our method enhanced the resolution of the section to make faults more distinct and events more successive.

## 4. CONCLUSION

Acquisition seismic data by towed streamer is influenced by ocean current for variation of receiver positions in time and lateral direction. We proposed a new method to correction the errors of acquired data by generating a template and matching it with interpolated section in sub-pixels domain. Application results on the real dataset demonstrate the effectiveness of our method.

## 5. ACKNOWLEDGMENTS

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## 6. REFERENCES

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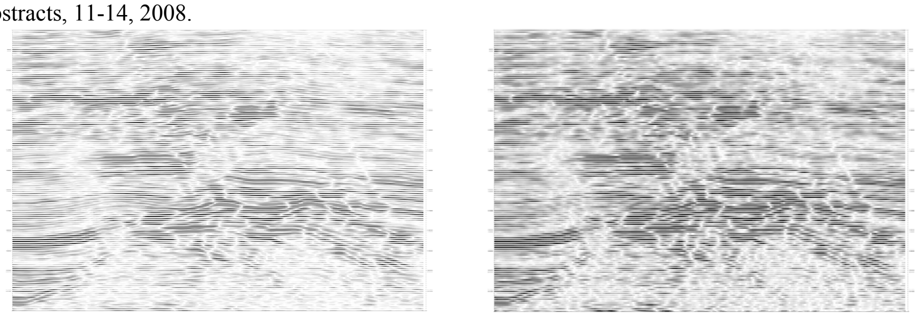

**Fig. 3**. Stack section before (left) and after (right) correction by the proposed method