Multichannel Abnormal Amplitude Reserving Attenuation Based on Data Random Reconstruction and Its Application

Introduction

In some complex seismic exploration environment, seismic data often contains some continuous multi-channel abnormal amplitudes caused by environment factors (wind, grass, water, etc.), which seriously affects the signal-to-noise ratio and imaging quality of seismic data. This kind of noise has certain randomness, it has no certain frequency and apparent velocity, existing almost in the whole record length in time, but it also has some determined properties, which is it happens in some certain areas in survey. Due to the random properties and the continuous existence in a large number traces, it is very hard to remove this kind of multi-channel strong energy noise completely under the amplitude preserved conditions directly in shot domain or detection domain or other domain, and the residual strong energy noise will still seriously affects the final imaging quality.

In this paper, we propose a method to remove environment noise with continuous channel abnormal amplitude completely and amplitude-persevering. We reconstruct the seismic data by random function to separate the continuous channel noise in common offset domain and then use the median filtering with proper parameters to remove the noise. We implemented this method in the land seismic data of a complex surface geological condition area in southwest China. The practice shows that the method is very effective in removing the continuous abnormal amplitude noise of land seismic data in a developed water system area in southwest china.

Method and/or Theory

As the continuous channel noise in complex shooting and receiving conditions area has no certain frequency and apparent velocity but abnormal amplitude, we could just distinguish the noise and signal by amplitude of seismic data (figure1).

![Figure 1](image)

*Figure 1*: (a) strong energy environment noise in shot gather, blue line is the RMS amplitude of each trace, red line is the elevation; (b) in common offset; (c) in receiver gather; (d) spectrum of seismic data in window 1 in figure(b); (e) spectrum of seismic data in window 2 in figure(b)

Median filtering technology can effectively eliminate the peak noise in non-stationary signals and usually used to suppress high amplitude noise in data processing. However, median filtering still produces too much smoothing effect, for the abnormal energy amplitude of strong continuous channel, it doesn’t work very well. In figure 2, we suppress the environment noise by median filtering directly in shot domain, though the statics window in traces is large enough, only small part of noise removed and energy of residual environment noise is still strong. Moreover, using median filtering in the shot or receiver domain will occur the zero amplitude value in energy statistics in some time window as the discontinuous trace length, which will damage useful signals and fuzzy discontinuous structure features.
Therefore, we proposed a new method to solve above problem by median filter technology, the work flow shows in figure3.

**Figure 2:** (a) strong energy environment noise in shot gather, (b) after medium filtering in shot domain ;(c) noise removed

**Figure3:** work flow of amplitude preserving attenuation method for multichannel abnormal environment noise

We sort the seismic data into common offset domain, order the traces in random sequences, and then using median filter with small window in trace direction to suppress the noise, and then sort the data into shot domain. The strong energy noise of adjacent multiple channels on the shot records is remove almost completely (figure4)
Figure 4: Attenuation of environment noise with continuous channel abnormal amplitude real seismic data. (a) Seismic data with continuous channel environment noise in shot gather; (b) sort the data into common offset gather; (c) order the data in random sequence; (d) suppress the strong energy environment noise by medium filter technology; (e) resort the denoised data in shot gather; (f) compare to medium filtering in shot domain.

Examples

We implemented this method in the seismic data of a complex surface geological condition area in southwestern China, seismic data in this area is seriously affected by developed water system, figure 5 shows the relationship between the elevation and shot RMS amplitude in this region. There are a lot of continuous strong energy amplitudes in shot gather in river region, and the value of abnormal energy amplitudes is more than 300 times of the normal channel, the spectrum of them are almost same. We implemented this method in the seismic data of a complex surface geological condition area in southwestern China, seismic data in this area is seriously affected by developed water system, figure 4 shows the relationship between the elevation and shot RMS amplitude in this region. There are a lot of continuous strong energy amplitudes in shot gather in river region, and the value of abnormal energy amplitudes is more than 300 times of the normal channel, the spectrum of them are almost same.

Figure 5: (a) The elevation attribute of a survey with complex shooting and receiving condition in southwest China, (b) RMS amplitude of seismic data in this survey. The abnormal energy traces almost located in the river region.

We filtered the environment noise with continuous channel abnormal amplitude real in above region by our method, multichannel abnormal amplitudes were effectively preserved removed, QC the filter.
results by stack section. Figure 6 is the stack section of before and after environment noise removing, we can see strong energy noise is almost completely and amplitude-persevering remove, the reflection events covered by environment noise is reappear, while no reflection signals in noise stack section.

**Figure6:** QC environment noise attenuation by our method on stack section and it’s spectrum. (a) stack section before denoise; (b) stack section after denoise; (c) filtered noise stack section; (d) spectrum of stack section; (e) spectrum of filtered noise stack section

**Conclusions**

In this paper, we propose a method for multichannel abnormal amplitude noise attenuation, as the real land seismic data implement, our method can almost completely and amplitude-persevering remove this kind of environment noise.

**References**


