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Seismic Data Acquisition Instrumentation System

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Abstract: - Centralized control systems is that the control of the whole instrument system unified digital logic circuit is completed. In the data collection process, the entire signal processing is: after seismic signals picked up by the detector, the ground vibration signal into an analog voltage signal, which analog signal transmission Tai line filter to filter out common mode interference and high frequency interference signal after filtering is supplied to a low noise preamplifier, in order to facilitate the subsequent filtering. The amplified signal is supplied to high-pass filter, a low-pass filter, notch filter analog filtering process. Finally after one sub-multiplex each channel signal samples to send to send instantaneous floating-point amplifier (IFP) variable-gain amplifier, and the analog signal IFP adjusted into 15 successive approximation type A/D converter the analog switch. IFP produced 3 gain code and A/D converter bits into the formatting circuit arrangement in accordance with a predetermined format, the results of choreography into the digital tape recording

Key words: *- seismic data acquisition, seismic signals, forward modeling*

I. INTRODUCTION

Generally, the centralized control of digital seismograph detector is connected via an analog signal line and the acquisition system. Due to the large distance transmission line chamber analog signal transmission and relatively far away, so the signal is easily affected by various interference factors. With the deepening of the application of computer technology in the seismograph, people data acquisition system amplifiers, filters, A / D converters, control logic, and data transfer is completed with the overall control CPU. The collection station to prevent the detection point, each collection station by a digital signal lines or wirelessly with the central recording connected to the host when the rational combination between the collection station and record the host, can constitute a distributed data acquisition system.

Telemetry system transmitted between the central station and collection record of the host is a digital signal, the host record collection station and can be flexibly combined. Thus, the effects of signal are significantly increasing the number of channels seismograph.

Form structure of IFP amplifier collection stations and the internal structure of computer control seismographs front of basically the same. The main circuit the number of road construction and computer control seismographs corresponding circuit is basically the same, but the collection station is generally 6-8 road can make the detector through a shorter distance to access collection station. But IFP type collection station is also problematic, since the structure of the IFP collection stations uses a lot of analog and digital devices, the circuit structure is very complicated, power consumption is relatively large. Therefore, a seismic data acquisition station new structure to meet the needs of modern high resolution seismic exploration.

The effect of vortex detector application is not obvious, because it increases the sensitivity with frequency only 6dB increase rates, which cannot make up much ground to absorb high-frequency signal attenuation. Vortex detector sensitivity is smaller than conventional detectors 50 times, which is undesirable.

II. INSTANTANEOUS FLOATING POINT AMPLIFIER

2.1 Instantaneous floating point amplifier function

Sub-sample voltage α is floating point amplifier K_F times, then quantized by the A/D, although the absolute quantization error constant, but it changes the relative quantization error:

$$\delta = \frac{\varepsilon_q}{a \cdot K_F} \qquad (2\text{-}1)$$

As can be seen from the above equation, this quantization ratio directly from A / D, the quantization error is reduced relative K_F times. The quantization precision is increase. The weaker the signal, namely α smaller, the greater the K_F precise level of increase is greater.

Instantaneous floating point amplifier gain is not all amplified sub-sample are the same, but according to the magnitude of the amplified sub-sample to set, so it's not a fixed gain but floating, denoted by KF. The range of floating is K_{Fmax}-K_{Fmin}. After setting the instantaneous floating-point amplifier, analog quantization range that is converted to floating-point maximum and minimum values are as follows:

$$a_{\min} = \frac{q}{K_{F\max}}, a_{\max} = \frac{E}{K_{F\min}} \quad (2\text{-}2)$$

In order to maximize the accuracy of quantization of each sub-sample of instantaneous floating-point amplifier gain adjustment is necessary within the range that satisfies a formula selected sub-sample maximum allowable gain K_F, because both the gain of the sub-sample to reach the largest possible quantization precision, without causing sub-sample is amplified beyond the A / D range recording distortion caused, it is called the sub-sample $K_F = 2ij$. Here G_{ij} referred to as i like the second son of the j-channel floating-point exponent, it is called the four binary coded subsample gain code.

2.2 Examples of instantaneous floating-point amplifier (attenuated MMPA)

This is a maximum fixed gain amplifier simultaneously with appropriate attenuation to complete the IFP amplifier gain adjustment, and its block diagram shown in Figure 3-5. A1 is the output buffer stage, a gain of 1.05; A2, A3 and A4 as the basic amplifier stage gain are 23.68. The maximum gain of the system is less than 214, but considering the DFS-V preamplifier gain is calibrated gear 1.25 times, which was converted into the main discharge, then the maximum gain of IFP's DFS-V 214. A5, A6 and A7 for the attenuator, attenuation coefficient change can adjust the main discharge purposes [1].

When heavy rain IFP output window comparator level on the line, the gain of the comparator issued INCREASE = 0 and DECREASE = 1, the gain adjustment counter is decremented one count, form a logical switch control instruction by attenuating the attenuation coefficient increases 22, the gain is reduced 22 . When IFP window comparator output is less than the lower limit level, the gain comparator issued INCREASE = 1 and DECREASE = 0, gain adjustment counter is incremented one count, form a logical attenuation coefficient reduced by the attenuation switch control command 22, the gain increases 22 . The amplified signal is sent to the high-pass filter, low pass filter, notch filter to simulate the filtering process. IFP produced 3 gain yards and 15 A / D converter bits into the formatting circuit arrangement in accordance with a predetermined format, the results of choreography into the digital tape recording.

When IFP output level is within the level of the window comparator, the comparator gain issue INCREASE = 0 and RECREASE = 0, gain adjustment counter is not counting, attenuation coefficient constant, the gain constant. Attenuator A5 has four attenuation profiles, respectively 20, 22 and 26. A6 and A7 have three attenuation profiles, respectively 20, 22 and 24.

III. Δ–∑A/D CONVERTER

3.1 Δ–∑A/D basic theory

High resolution seismic exploration seismic signal dynamic range requirements of up to 120dB, which requires data acquisition system A / D converter is not less than 20, which is not possible in traditional data acquisition system. But because of the emergence and application of Δ -ΣA / D is changed all that, in the field collecting accounts set 24 Δ -ΣA / D can solve this problem[2].

Δ modulation type A / D conversion technique is based Δ -ΣA / D conversion techniques, and conventional A / D conversion technique different, the basic operation Δ modulation type A / D converter operates only the signal of adjacent discrete points the difference is converted to a binary code, that the results of the existing sub-sample voltage a / D conversion only increase from the previous sub-sample from the bottom 1 or minus 1.

Δ modulation type A / D conversion principle can be described in conjunction with Figure 1, x (t) is a continuous analog voltage input signal, y (t) is a digital output, y (t) after D / A conversion output an analog voltage XP (t), which represents the former a discrete point value by oversampling guarantee XP (t) and x (t) the difference is small. When x (t) -XP (t)> 0, e (t)> 0, D flip-flop output Q = 1, the accumulator plus 1; when x (t) -XP (t) <0, e (t) <0, D flip-flop output Q = 0, the accumulator is decremented.

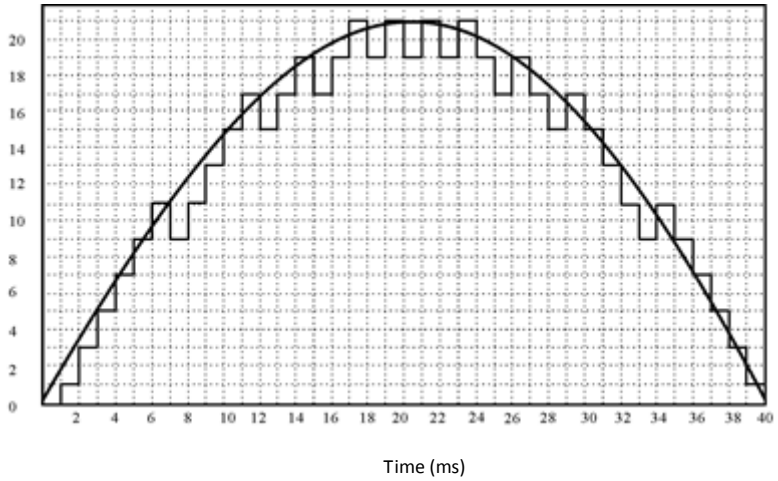

Fig. 1 Input signal and tracking signal

3.2 Oversampling technology

A / D conversion technique is apparent from ∆ modulation type A, the signal difference between adjacent discrete points must be sufficiently small, otherwise it will be caused a large error quantization. The solution is to increase the sampling frequency of the signal frequency hundreds of times, saying this is the oversampling. In the conventional A / D conversion technology, sampling anyone within a signal cycle requirements, the number of discrete points should be more than two. In oversampling technique, one should have hundreds or thousands of discrete points within the signal cycle.

As can be seen from the above analysis, XP (t) is a voltage level, a stepped transverse oversampling interval, a longitudinal step to the amount of voltage ∆ small, the entire A / D quantization is the process of step voltage XP (t) tracking continuous analog voltage x (t) process. Mathematically, the small amount of accumulation is integral, so that the integrator accumulator. The staircase signal XP (t) may consist of an analog integrator integrating positive and negative voltage having a certain size to obtain.

IV. SEISMIC SPECTRUM EQUALIZATION FILTERING TECHNOLOGY FORWARD MODELING ANALYSIS

4.1 2D seismic forward modeling

Doing seismic forward modeling do first is to establish a geological model has a certain structure form, after determining the type and parameters of wavelets. Use two-dimensional convolution method to calculate seismic response. Formation and spectral attenuation equalization compensation calculation is performed in the frequency reduction within the two-dimensional seismic response calculated into the frequency domain, its vibration spectrum multiplied by the corresponding attenuation factor of the stratigraphy and the corresponding spectrum equalization filter transfer function.

In this model the seismic design are two, they are thin sandstone wedge and inter-layer model, select the frequency of the Ricker wave 200Hz as the exaction wave seismic lateral channel number 90, the slope of the wedge inclined interface is 1, original design earthquake corresponding turning point in the first 40 or so, time domain sampling interval t = T / 2 * 59 = T / 118, where T is the period, as the original seismic reflection wave. Thin interceded basic model layer thickness at a wavelength of about one-sixteenth of thin interceded model interface sides inclined slope of 0.5[3].

4.2 The effects of random noise spectrum equalization filter

In the discussion and research spectrum equalization filter technology are not considered in the conduct of random noise, and random noise is an objective reality, its sources include two aspects, one random noise inside the instrument, two instruments the external environment of random noise, the impact of its spectrum equalization filter technology must be considered [4]. The spectral characteristics of random noise has a white noise, its impact on the effective signal mainly at high frequencies in the band since the effective signal to noise ratio is greater than outside the signal band of the high frequency 1 signal to noise ratio is less than 1 high-frequency noise to the fore. Substance spectrum equalization filtering of higher frequency components give higher gain amplification, and signal to noise ratio has been less than a high frequency, higher gain means more exaggerated high-frequency noise, which of course must be avoided[5].

V. CONCLUSIONS

High resolution seismic exploration requires acquisition instrument should have a real high-frequency compensation (or high frequency boost) functions. According to the formation attenuation characteristic, design spectrum equalization filter to compensate for the formation of high-frequency attenuation. Oil key issue thin reservoir detection is to improve the resolution of seismic exploration technology, strict definition resolution is the delay time from the ground to a depth of a single sub-waves. The study of theory and actual calculation is more practical Ray Leigh guidelines, the guidelines state that the resolution of seismic exploration, as the half cycle wavelet (a quarter wavelength)

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