Registration System of Sea Seismic Geophysics Data with Correction Channels

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***Abstract*— The paper is dedicated to the development of control system of spatial coordinates of seismic information acquisition points in sea condition. The characteristic features and basic tasks of sea seism investigation are considered . The increasing ways of registration accuracy of sea seismic signals are analyzed. The structure scheme of collection and processing system of sea seismic geophysics' data is developed, where two correcting channels are added to measurement channel, that the first consists of bend angle sensors and another consists of magnetic compasses and both serve for definition of seism receiver real coordinates in spatial coordinate system.**

Keywords— seismic signals; sea seismic, geophysics; development of control system; bend angle sensors; seism receivers

I. INTRODUCTION

The basic task solved in information measurement systems of sea seismic exploration is achieving of exact and correct information, the interpretation of its results could allow drawing the map of underground slots adequate to space condition researched structure.

The notation systems of sea seismic exploration consist of seismic receivers, communication cable and complex of devices maintaining the signal conversion and information processing. The acquisition of elastic seism waves is performed by piezo-electric pressure receivers capable to convert weak pressure signals to electric.

The seism receiver cable stretched by boat sailing with 7.5 km/hour middle speed. During seism investigation works in marine condition it's impossible to keep stable the coordinates of seism receivers. While sailing in the water the communication line deflects from profile in certain degree. It causes with some fault in processing and interpretation of seismic results. This kind of deflection brings to cinematic errors in record speed definition of waves. That in turn causes with distortion of results, measurement of marine explorations and the spatial condition of geological objects.

The output signal of piezo-receiver depends on range of depth along the vertical axes direction(change of hydrostatic pressure).

The hydrostatic pressure appeared while during in depth brings to change of output characteristics of seism receivers and one must take into account while working with work vertical seismic communication lines.

II. PROBLEM STATEMENT

The marine information measurement systems seismic exploration witch contain seism receivers, amplifiers and magnetic recorders, also complex of devices that perform signals receiving, conversion, control and other functions. This type seismic measurement system built by defines the information about the spatial coordinates of seism receivers beforehand and the exchange of spatial coordinates of receivers in measurement system are not considered. But in other hand the real conditions of the seism receivers deflects in each spatial axis and at this time the corresponding faults appear and summed with efficient signal. The analyzing of existing marine seismic information measurement system shows that there are several geophysics notation systems that are eligible to separate efficient signal from noise, appeared during exchange of seismic receivers. In the registration system of sea seismic geophysics data with correction channels witch is offered in this paper, the real spate coordinates seismic receivers are determined buy using to kinds receivers - bend angle sensors and sensors with magnetic compasses in the real times scale.

III. PROBLEM DECISION

Due to methods and modifications different technical ways are used for notation of seismic explorations. The information measurement systems of marine seismic exploration contain seism receivers, amplifiers and magnetic recorders, also complex of devices that perform signals conversion, control and observation functions.

The usage of multi time profiling method in geophysics investigation works in marine condition allows to apply figure seism note measuring systems to these investigation works.

As it can be seen from common structure in the signals after seism receivers passed to wide stripped, filtered initial amplifiers. The outputs of these amplifiers through the commutator passed to basic amplifiers, former ADC tract, and then to processor. The synchronization of all devices of the system and observation to its working are performed by control device.

The seismic measurement system built by this principle defines the information about the spatial coordinates of seism receivers beforehand and the exchange of spatial coordinates of receivers in measurement helding are not considered. It means that, application of this type of systems is considered effective when the basic information carrier – i.e. piezo-electric seismic receivers are settled strictly in certain profile on seismic cable.

But in real condition of marine geophysics investigation works this condition is not legible. In real conditions the seism receivers deflects in each spatial axis and at this time the corresponding faults appear and summed with efficient signal. The existing marine seismic information measurement system analyze shows that there are several geophysics notation systems that are eligible to separate efficient signal from noise, appeared during exchange of seismic receivers.

In the system, shown in the information about the exchange of seism receivers i.e. information about seism cable space condition, collection and passing of seism receivers signals are held by an extra communication channel which has no common with the basic channel.

In exploded seismic notation systems the output voltage of seismic receivers can be given as follows:

$$E_E = E_m(P) + E_{kmf},$$

where $E_m(P)$ is output voltage from measured value of piezo-electric receiver; E_{kmf} is output voltage sum of piezo-electric receiver in the result of hydrostatic pressure change.

Analogically, the signal is defined noted in system:

$$N_E = N(P) + N.$$

According to this formula, the output voltage change is proportional to the A amplitude of exchange during hydrostatic pressure change. As it was noted before amplitude of exchange can be viewed by seism receiver cable deflection angle α.

Therefore, the spatial deflection angle will be changed corresponding to the amplitude of exchange of measurement converter output signal (frequency):

$$F = kfA,$$

where k_f transfer function of measure converter. After making some alternation, one can get the equality representing hydrostatic pressure change and at the same time correction frequency signal to the values of seism receivers:

$$N_{ht}^{f} = \frac{Nf}{cf} = k\gamma_p \sin \omega t \cdot$$

Though, the difference between this system from others is in the information notation tract, where the frequency to code conversion is performed by simplified method.

In this system the correcting signals depending on spatial place of seism receivers are gotten from space deflection angle transmitter. In modern geophysics systems for processing of data on computers, analog signals of receivers are converted to binary digital code during this procedure there is an information loss. So, in this system there are following disadvantages.

1. An initial information is gotten in an analog form of less power electric voltage continuous pulse. Therefore the double amplification – initial (before the commutator) and basic (after the commutator) are applied. This brings to increase of equipment size and fault.
2. As a useful information for measuring an amplitude of piezo-electric receiver output signal is taken. And this brings to some fault (is some cases comparable with useful signal). For exception this kind of faults, different filters are applied.

One of the modern systems, which uses magnetic compass sensors for deflection angle definition is developed by PRAKLA-SEISMOS. Advanced 3-D marine surveys now days require a much higher degree of accuracy in so reamer positioning than was possible until recently. Dense grids in conjunction with multi line and strike line shooting make the tolerances allowable for the determination of streamer positions even more stringent.

In order to obtain all angles and distances with the required accuracy PRAKLA-SEISMOS added new features to the existing measuring systems and the associated computer software. These efforts aim to pur-point each common reflection point within ±10 m. The new techniques to resolve the difficulties involved were adopted after careful research into the problems of sensing angles and tensions, pertaining to the seismic streamer, as primary input parameters in deriving the streamer position. The following hardware components are utilized in deriving streamer locations under the new scheme:

1. Gyro Compass system – is the master instrument which provides reference North for all measurement of bearing conducted with all the survey vessel. This system reduced the error against true North to within ±0.12m. degree.
2. Magnetic Heading Compass – the relative positions of the streamer an divided from the angle indicators of magnetic compasses arrayed along the streamer at set intervals. The compasses used are manufactured by COURSE or by SYNTRON.
3. Precision Direction finding system, developed by PRAKLA-SEISMOS, controls and adjusts the streamer compasses. Reference North is provided by a specially assembled multiple gyro system. An automated control system monitors all on board even in real time. The system determines the fail end of the streamer to within ±0.2m. degree.
4. Lateral Deflection Angle measurement Unit is used to measure the horizontal angle between the vessel' s axis and the towing cable of the streamer to within ±0.2 degree.
5. Stretch Section Distance Measuring Unit: to record the actual distance between the towing cable and the first hydrophone graipe within ±1 m.
6. Real-time Processing and Quality Control: to provide a quick reference of headings, positions and coverage on screen and table plotter.

In the post processing stage a highly reliable motion model is established by cross correlating multiple sequences of angle measurement, thereby taking full advantage of the redundancy in the data. This procedure improves the real-time data significantly.

THE STRUCTURE SCHEME OF INFORMATION MEASUREMENT SYSTEM OF SEA SEISMIC EXPLORATION

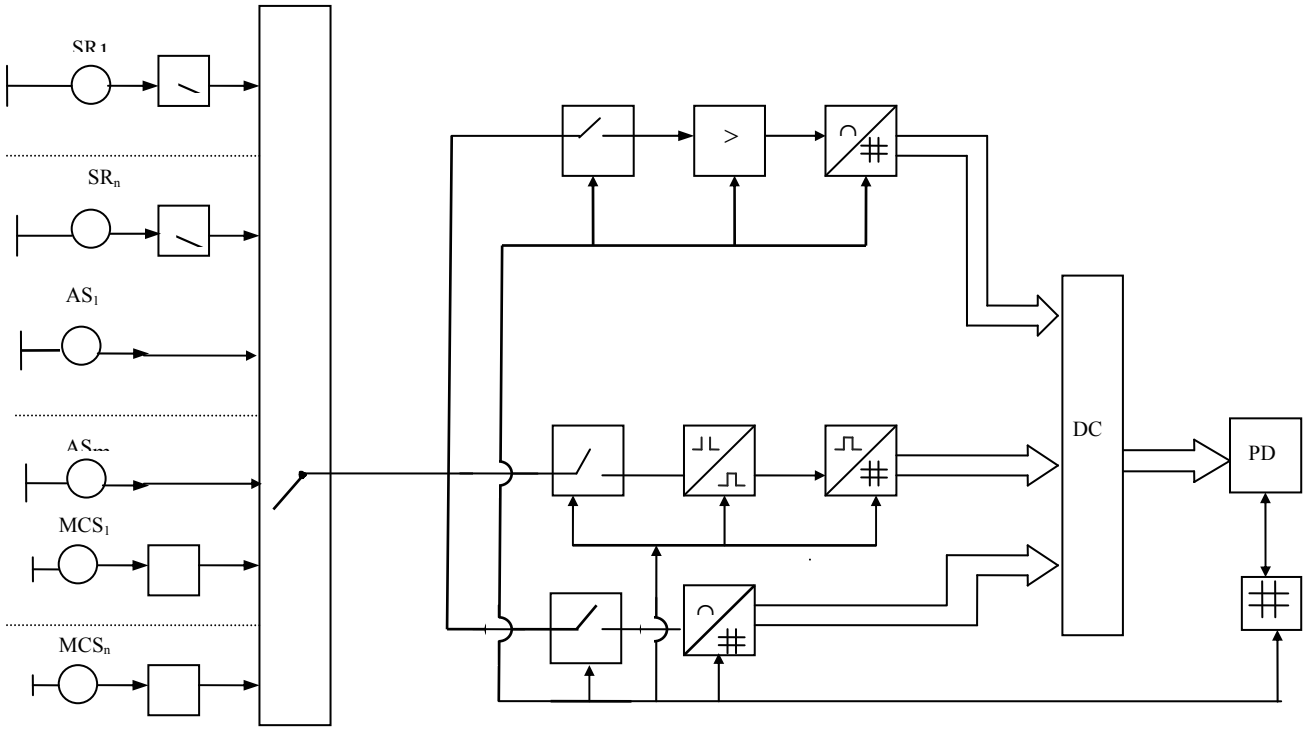

Figure 1.

Making of the cinematic correction, requires the usage of two extra correction channels except communication channel.

According to all these requirement the structure scheme of marine seismic explorations information measurement system is given in the fig.

An inquiry of seism receivers, bend angle sensors and magnetic compass sensors is held through one ***C*** commutator. K_1, k_2, k_3 are connected to the output of commutator, connect each sensor group to sending line correspondingly.

When K_1 key is switched on, the outputs of seism receivers are amplified, filtered, converted with the help of ADC and pass to processor. After the processing finished the K_1 is switched off and K_2 is switched on, and bend angle sensors outputs converted on FCC and then after being converten on code to figure converter send to processor. By this rule K_3 key supplies an inquiry of magnetic compass and gotten information after being converted in ADC was sent to processor.

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