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BADANIE SYSTEMU KORELACJI Z ORTOGONALNYMI FILTRAMI LAGUERRE'A ANALIZUJĄC SYGNAŁY SEJSMICZNE SŁABEJ INTENSYWNOŚCI

Streszczenie: Praca jest poświęcona problemom obróbki sejsmicznych sygnałów słabej intensywności w korelacjach systemach z poprzednią ortogonalną obróbką. Przeprowadzono szereg praktycznych eksperymentów i otrzymano wyniki analizy pracy typowego systemu korelacji i korelacji systemu z wejściowymi ortogonalnymi filtrami Laguerre'a przy nadejściu sygnału pod postacią poli-harmonicznego gasnącego sygnału i przeszkód, które są prezentowane w postaci liniowych losowych procesów stochastycznych.

Słowa kluczowe: sygnał sejsmiczny, przeszkoda, przetwarzanie korelacji, Laguerre'a ortogonalny filtr

RESEARCH OF THE CORRELATION SYSTEM WITH LAGUERRE ORTHOGONAL FILTERS IN ACTION LOW INTENSITY SEISMIC SIGNALS

Summary: The work is devoted to problems of processing seismic signals of weak intensity in correlation systems with previous orthogonal treatment. A number of practical experiments were conducted and results achieved showing an analysis of a typical correlation system and correlation system with Laguerre orthogonal input filters receiving the amount of desired signal as a poliharmonic fading signal and noise that are presented as a linear random processes.

Keywords: seismic signals, noise, correlation processing, Laguerre orthogonal filter

Scientific and technical problems of mineral exploration, including oil and gas are strategic problems in each country. The main method of geophysical exploration of mineral resources based on the study of the surface structure earth crust is seismic. This method is the most used and one of the most accurate and reliable methods of exploration. Introduction of the modern environmentally clean non-explosive vibration seismic research methods leads to decrease intensity of useful signals, which

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carry out information about the structure of geophysical environment and thus reduce the signal / noise ratio on the inputs seismic sensors, the action of various kinds of noises that arise at distribution of resilient waves.

Actual task of seismic research is detection and measure characteristics of the seismic signals low intensity the presence of noise. On the foreground the task of improving accuracy, noise immunity and reliability of the results of research and development of effective methods of their solution using noise protected correlation and orthogonal methods.

Therefore, scientific problem improving of mathematical models seismic signals and correlation method using orthogonal processing and create the appropriate algorithms and software for the implementation digital signal processing techniques in seismic systems is actual and important.

The general structure of the investigated correlation system of signal processing shown in Figure 1, where $R_{12}(\tau)$ response for a typical system and $\overline{R}_{12}(\tau)$ for orthogonal correlation measuring system.

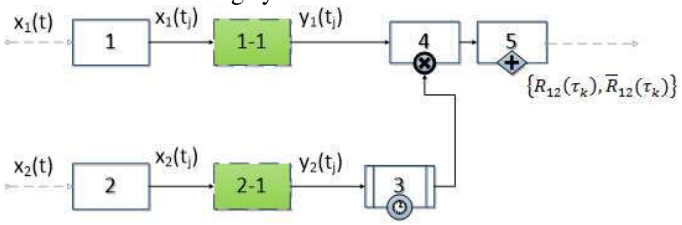


Figure 1. The general structure of correlation measuring system with Laguerre orthogonal filters: 1, 2 - ADC analog seismic signals, 1-1, 2-1 - discrete Laguerre orthogonal filters, 3 – modulus shift by time signal with discrete argument; 4 - signal multiplication module; 5 – adding (integrator) module products of signals

Using the results of research published in [1] at the output of the correlation system we get the correlation transform $\overline{R}_{12}(\tau_k)$

$$\overline{R}_{12}(\tau_k) = \sum_{l=0}^{N} h_{12}(\tau_l) R_s(\tau_k - \tau_l) + \overline{R}_z(\tau_k), \quad (1)$$

where $h_{12}(\tau_l)$ - cross-correlation transform Laguerre function, $R_s(\tau_k)$ - cross-correlation transform useful seismic signals, $\overline{R}_z(\tau_k)$- correlation transform of the noise, which is determined by the formula (2)

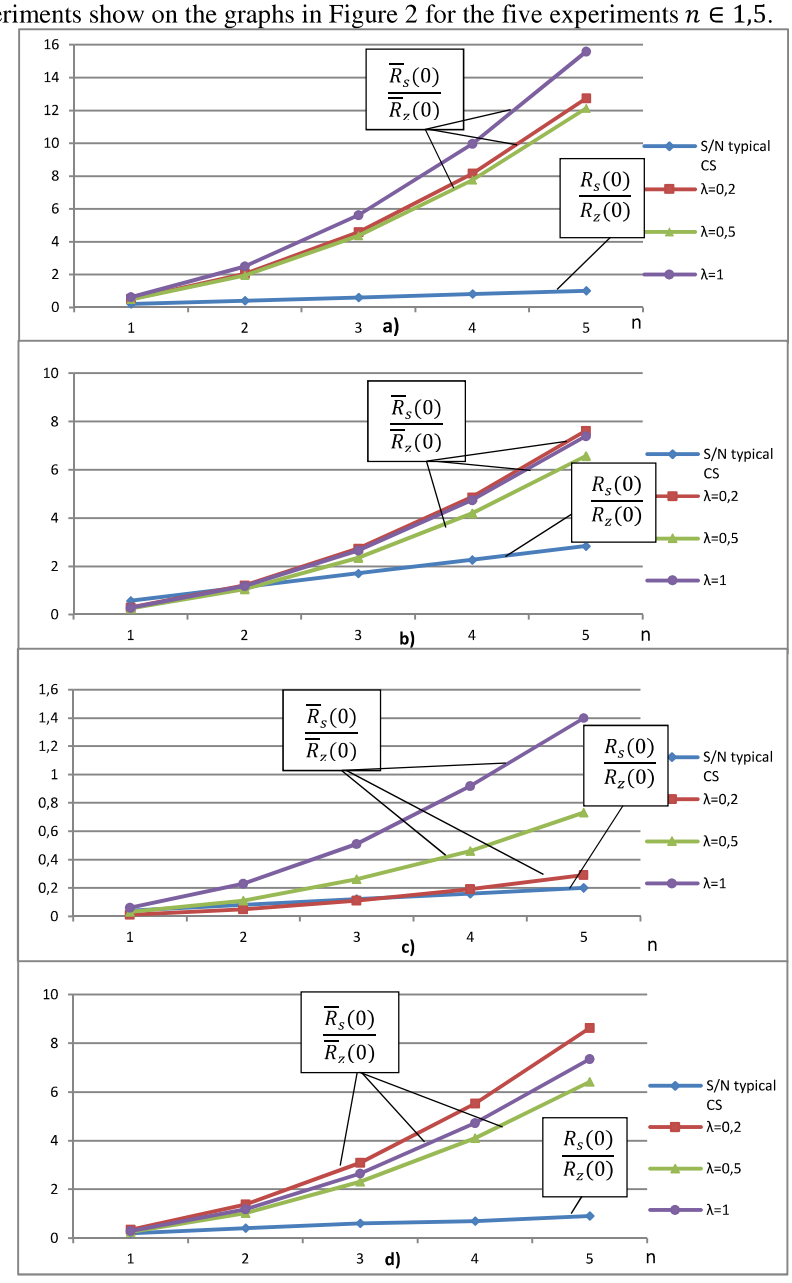
$$\overline{R}_z(\tau_k) = \sum_{l=0}^{N} h_{12}(\tau_l) R_z(\tau_k - \tau_l), \quad (2)$$

where $R_z(\tau_k)$ – correlation function of the input noise.

Justification mathematical models of seismic noise, and analysis of their processing in correlation systems with the previous orthogonal filtration given in [2, 3, 4]. In [5] presents the results of research useful seismic signals in correlation systems with the orthogonal filtration.

To determine the efficiency of correlation system with Laguerre orthogonal filters compared with the typical correlation system used the signal /noise ratio, that is $\frac{\overline{R}_s(0)}{\overline{R}_z(0)}, \frac{R_s(0)}{R_z(0)}$.

Have been conducted computer simulation experiments with different signal / noise ratio at the input of the systems. For an example the results of the computer experiments show on the graphs in Figure 2 for the five experiments $n \in \overline{1,5}$.



a) - white noise b) - painted noise c) - RC noise, d) - RLC noise

Figure 2. The results of experimental signal/noise ratio research at the output of the correlation system.

At the computer modeling used the following characteristics of useful signals and noises:

- useful signal represents the sum of the four harmonic signals with different amplitudes and frequencies,
- variance, ie $R_z(0)$ in all experiments select as a constant for different type of noises.

This made it possible to generate signals with different signal / noise ratio at the input of the researched correlation system and with the further definition the relation of their output.

As shown in Figure 2 the use of previous orthogonal filtration to correlation system makes it possible to improve the signal / noise ratio by the selection Laguerre filter settings. Particularly in figure 2b in the first experiment, the typical correlation system showed the best result. In processing the of useful seismic signal with noise hindrance type RC (Figure 2c) increase parameter λ = 0,5; λ = 1 Laguerre orthogonal filter allowed to improve the result of processing input signal

The results of the experiments are shown in the graphs illustrate under what conditions the correlation system with Laguerre orthogonal filters is more effective than the typical correlation processing by the action of the seismic signals of low intensity.

Based on the proposed model was developed a software for modeling seismic signals and processing in simulation experiments.

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