18. A finite point method in computational mechanics. Applications to convective transport and fluid flow / E. Onate, S. Idelsohn, O. C. Zienkiewich, R. L. Taylor // Int. J. Numer. Methods Engrg. — 1996. — Vol. 39. — P. 3839–3866.
19. Власюк А. П. Чисельне розв’язування задач консолідації та фільтраційного руйнування ґрунтів в умовах тепло-масопереносу методом радіальних базисних функцій / А. П. Власюк, П. М. Мартинюк. — Рівне : Вид-во НУВГП, 2010. — 277 с.
20. Кириенко И. И. Гидротехнические сооружения. Проектирование и расчет : учеб. пособие / И. И. Кириенко, Ю. А. Химерик. — К. : Вища шк., 1987. — 253 с.

Nonlinear problem of saturation of soil media due to intensive rains has been regarded. Its mathematical model has been built. The stability of this soil mass has been investigated by method of circular cylindrical sliding surfaces. The results of numerical experiments and their analyses have been given.

Key words: *landslides, mathematical modeling, moisture transfer, soil media, slopes stability.*

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RECOVERING DYNAMIC DISTORTIONS ON OUTPUT OF CHANNEL TRANSMITTED CONTINUOUS SIGNALS

Signal restoring algorithms, subjected to essential dynamic distortions in channels transmitting continuous signals in conditions of noise availability are considered in this paper. It is shown, that the application of developed algorithms digital filtration made possible to avoid unstable operation of operator inversion of the channel. For maintenance stability of the delivered problem solution with the purpose of maximum use additional a priory information on required signal and noise regularization methods of ill posed problems are used. Some results of computer experiments are shown.

Key words: *signal restoration, regularization methods.*

Means of registration (sensors) and signals transmission (the communication channels) introduce dynamic distortions, that limit the speed of the information transmission and parameters measuring accuracy. Analogue or digital adjusting filters are used for recovering of dynamic distortions. In an elementary case this is a low-frequency filter, which simply cuts a noisy high-frequency part of a signal spectrum. The equaliser — set of strip filters for alignment of the magnitude-frequency characteristic channel is a more complex system for correction of dynamic distortions of the communication channel. However, distributed and nonlinear dynamic distortions, which are essential in a majority of practical cases, can not be adjusted.

The best solution of this problem is compression of the frequencies band of transmitted signal. Earlier, it was the telegraph (alphabet Morse), now there exist a digital telephony and computer modems. The faster is the speed of information transmitting, the bigger are the high-frequencies area, and the working frequencies area and the stronger is the influence of dynamic (inertial) distortions. In aggregate with noise distortions they essentially hinder the received information recognition.

The list of some practically important problems, which are reduced to the solution of inverse problems of signal restoration in real time, are the following.

1. Restoration of a true value of a signal, which is measured with the help of a sensor with inertial or integrated properties (speed measurement, fast thermal processing measurement by inertial thermocouples and etc.). Solution of this problem allows to decrease the measuring errors with using the mathematical methods.
2. Increasing the quality of connection line in telephony communication net by decreasing the influence of noise and attenuation in telephony communication line.
3. Increasing the quality of communication and increasing the exchange information speed in computer networks taking into account quality of communication line (attenuation in computer connection line and noise presence).
4. Increasing the quality of sound reproduction, recorded on magnetic tapes, as well as increasing the record density with preservation of reproduction quality.

At present in the field of computer processing of continuous signals the significant experience [1] is accumulated. The principles of computer increasing the resolution capability of supervision systems accept to increase the speed of existing telecommunication means.

The accepted signal can be analogue or digital. A digital signal is, as a rule, a sequence of rectangular pulses of different duration or sinus packs of several frequencies, that is possible to be treated as a continuous signal This signal is digitized with a small-sized, slow on time and low level wore length, and passes through algorithm digital filtration, which suppresses dynamic distortions. Further, this digital signal will be transformed to initial digital or analogue signal. In a given work a problem of synthesis of algorithm digital filtration for suppression of dynamic distortions is discussed.

Consider some algorithms of signals restoration [2]. Suppose that the mathematical model of the channel is known and described in the class of linear dynamic systems with concentrated parameters. In this case the problem of signal restoration is reduced to the channel operator inversion. The structure of signals restoration algorithms depends on a mathematical model of the channel, and that hinders the formulating possibility of problem solution in a general way.

Traditionally, the analogue models for realizing the rational transfer function analogue are applied by using the integrators. The elementary method of the discrete model constructing consists, in replacement, of the analogue integrator (or differentiator) by a digital one. Last mentioned integrator may be simply realized with the use of the usual recursive digital filter. The main problem exists in additional errors that arise at the discrete model applying. This factor can be very essential in solving ill posed problems of signal restoration.

The ambiguity of known methods of transition from a continuous model to a discrete (including numerical methods of the solution of differential equations) exists in the algorithm choice of integrator or differentiator approximation. Thus, it is better to use additional priori information on character of signals. So, for example, if it is known, that the signal has passed through some inertial parts, it has certain smoothness and, hence for the achievement of a maximum accuracy of its numerical integration a square formula of the appropriate order should be used. If it is known, that the problem is ill posed (solution is very sensitive to errors of initial data), the use of square formulas is higher than the second order.

The equation of inverse operator can be obtained as before, and after discretization. Moreover, it is possible to redistribute a part of operations according to a design of the inverse operator concerning moment discretization. All the above mentioned this substantially influence the obtained results.

One of the elementary traditional models of the channel consists of inertial unit with additive normal white noise on its output. The mathematical model can be presented in a kind of a differential or integrated equation or transfer function $W(p)$

$$Y(p) = W(p) \cdot X(p) + N(p), \tag{1}$$

where $Y(p)$, $X(p)$, $N(p)$ — image of output, input and noise signals, p — independent variable Laplace transformation. From (1) it is possible to obtain an equation of the restoring analogue filter

$$X(p) = W(p)^{-1} \cdot \left(Y(p) + N(p)\right), \tag{2}$$

at $N(p) = 0$, the equations from (1) and (2) are simplified

$$Y(p) = W(p) \cdot X(p), \tag{3}$$

$$X(p) = W(p)^{-1} \cdot Y(p). \tag{4}$$

Usually, a transfer function $W(p)$ has inertial property. That is why for obtaining the restored signal $X(p)$ from (4) it is necessary to differentiate the recorded signal $Y(p)$. The described problem concerns class ill posed problems [3]. Small and fast changing $Y(p)$ disturbances can make a restored signal rather far from initial one $X(p)$. The problem of simulation of the channel (3), on the contrary, is correct. Small $X(p)$ disturbances are decreased at the $Y(p)$ obtaining.

Let us know the a priori information about noise distortion. For example, $N(p) = -rX(p)$, where $r = const$ — small size, close to zero. This is not a traditional high-frequency sinus or a white noise low (concerning signal magnitude, but it is a simple hardly loosed input signal of the channel. This is a quite allowable weak distortion, in the working frequency range. In this case the equations (1) and (2) have the following form

$$Y(p) = W(p) \cdot X(p) + rX(p), \quad (5)$$

$$X(p) = \left(W(p) + r\right)^{-1} \cdot Y(p), \quad (6)$$

at $r = 0$ the equations (5) and (6) will be transformed in (3) and (4). The more r, the less the degree of dynamic (inertial) distortion in a channel, as the part of the input signal of the channel arrives at its output without distortions.

Make different forms of analogous transformations (1), (2), (5) and (6) we can obtain different variants of simulating and restoring a digital filters. The transversal differentiating part dominates in restoring a digital filter, and the recursive smooth part dominates in simulating one.

Restoring a digital filter can be divided to a consecutive connection of two digital filters, namely pure transversal and purely recursive. It is convenient either for analysis or for hardware realization. For linear systems the order of this two filters is not significant. The following variant should be preferable: at first the transversal filter is realized, and then the recursive one is realized at hardware realizing. In this case (in comparison with an inverse one) the quantity of memory elements for storage of the previous value input and output signals is decreased two times.

However, in solving a restoration problem this variant requires the availability of a rather long digit grid, as it is necessary to calculate differences of very close values. In this case the variant rejected above may be more economic: at first a recursive filter is realized, and then — a transversal one. The recursive digital filter performs operation of smoothing and does not require the high word length.

The transversal digital filter perform the usual numerical differentiation without regularization. The whole regularization is concentrated in a recursive digital filter.

Here the results of computer experiments are shown. The signal in the input of communication line (input of sensor) is the pseudo random signal with 5 levels (-2, -1, 0, 1, 2) and it changes its value every 0.2s. This signal passes through the communication line (sensor) with the decrement time constant 0.4s. A noise level in the input signal is 1%. 20 realization of the signal on the output of communication line (signal from sensor) is in the fig. l and reproduced signals using one of proposed methods using is in the fig. 2.

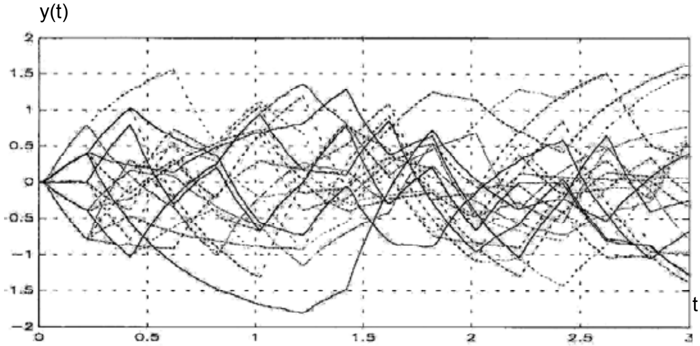

***Fig. 1.** Output signal lines*

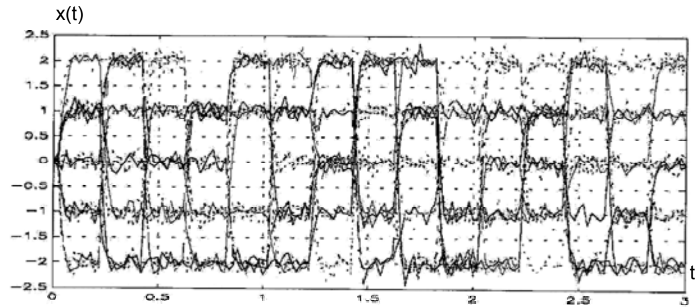

***Fig. 2.** Playback signals using one of the proposed methods*

Thus, we come to the following conclusions according to the synthesis of restoring digital filters. It is expediently the inversion of the operator of an initial problem to carry out after stage of discretization. For providing the stability the introduction of the additional smoothing (regularization) of the recursive digital filters (as low-frequency) with small constant time in comparison with initial model of the channel is expedient, hi other words, before restoring the signal, it is necessary "to spoil" it, just as the channel mares it (but to a smaller degree). This measure is necessary only for suppression of high-frequency errors.

The other source of corrector instability is noncoinciding the parameters of a channel model with a real one. So, a little change of constant time of channel model (which is used in a corrector) leads to noticeable distortions of the restored signal. For the removal of such defect a regular identification of the channel and updating of corrector parameters is necessary.

References

1. Верлань А. Ф. Методы и алгоритмы восстановления сигналов и изображений: монография / А. Ф. Верлань, И. О. Горошко, Е. Ю. Карпенко, В. Ю. Королёв, Л. В. Мосенцова. — К., 2011. — 367 с.
2. Сизиков В. С. Математические методы обработки результатов измерений / В.С. Сизиков. — СПб. : Политехника, 2001. — 240 с.
3. Грановский В. А. Динамические измерения: основы метрологического обеспечения / В. А. Грановский. — Л. : Энергоатомиздат, 1984. — 224 с.
4. Методы и устройства интерпретации экспериментальных зависимостей при исследовании и контроле энергетических процессов / А. Ф. Верлань, Б. Б. Абдусатаров, А. А. Игнатченко, Н. А. Максимович. — К. : Наук. думка, 1993. — 208 с.

В статті розглядаються алгоритми відновлення неперервних сигналів, на які динамічно впливають істотні спотворення у виглядів шумів. Показано, що розроблені алгоритми цифрової фільтрації можна застосувати для стабільної роботи оператора інверсії каналу. Для забезпечення стійкості розв’язку некоректних задач застосовуються методи регуляризації з максимальним використанням додаткової апріорної інформації про сигнал і шум. Приведено результати комп'ютерних експериментів.

Ключові слова: *відновлення сигналів, методи регуляризації.*

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РАСПАРАЛЛЕЛИВАНИЕ АЛГОРИТМОВ РЕШЕНИЯ СЛАУ

Рассмотрены параллельные алгоритмы решения СЛАУ методами мельчайших квадратов по схеме Холецького и сингулярного разложения с использованием преобразования Хаус-холдера. Дана оценка временной реализации рассмотренных алгоритмов.

Ключевые слова: параллельные алгоритмы, сингулярное расписание, метод Холецького, преобразования Хаусхолдера.

Введение и постановка задачи. Проблема распараллеливания вычислений вообще и алгоритмов решения СЛАУ, в частности, привлекает внимание исследователей с момента появления вычислитель-