All parameters used in the popup window need to be set. In this study, there is the following change space:

local - variable local variables only in Stateflow diagrams;

input - only variables for accessing Stateflow diagrams; output - only variables that flow out of Stateflow diagrams.

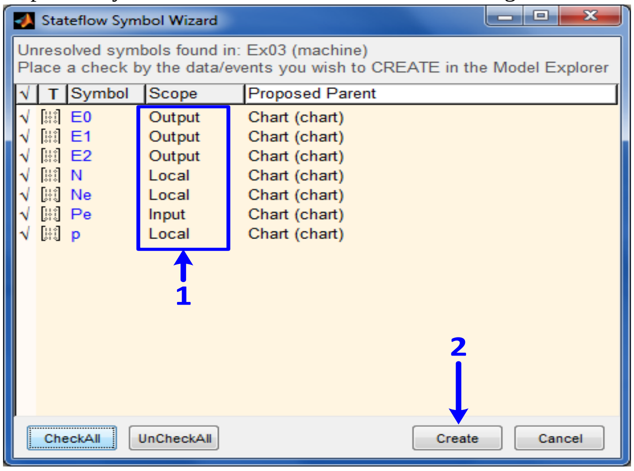

Fig. 6. Variable publishing window for Stateflow diagrams

Once the parameters have been changed, the appearance of the "Chart" block in the Simulink model will come to mind in Figure 7.

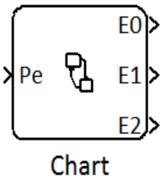

Figure 7. View of the Chart after the Stateflow Charts have been created

After these actions, the "Chart" block is added to the "Display" block, and the "Constant" block is added (Figure 8).

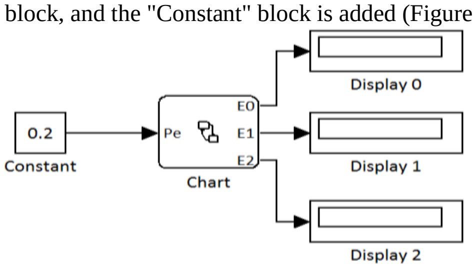

Fig. 8. Binomial binary symmetrical channel diagram in Matlab-Simulink

Display and Constant blocks are obtained from the Sinks block library and the Sources block library. Display and Constant blocks are obtained from the Sinks block library and the Sources block library.

Conclusion. In summary, these studies can be used to teach experimental training on "Theory of Information and Coding", which is taught to the "Telecommunication Technologies" personalities through virtual immitation modeling. The reason for this is that students are not allowed to collect and use telecommunication devices in their home environment, and this program can easily be used in the home environment to capture the Matlab system using the standard interface elements and blocks of the input circuit interface block, can learn. In particular, "Telecommunication technologies" specialists will be able to further improve their knowledge and to further strengthen their knowledge by applying an independent 60-70% of their experiences through Matlab software.

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Rakhimov Temurbek Omonboyevich

Urgench branch of Tashkent University of Information Technologies named after Muhammad al-Khwarizmi

Email adress: Rahimov_timur@bk.ru

Моделирование состояния дискретных каналов модулем гилберта с помощью Matlab

Аннотация: В статье рассматривается использование модели Гилберта для обнаружения и исправления ошибок в дискретных каналах, а также для борьбы с шумом при обеспечении надежности и устойчивости информации. Кроме того, модель Гилберта основана на моделировании дискретных каналов с использованием программного обеспечения Matlab и удалении обнаруженных ошибок виртуальной моделью.

Ключевые слова: информация, сообщение, канал, сигнал, система, модель, память модели.

UDK 755.12.8

Yakubov M.S., Xujaqulov T.A.

Forecasting changes of the state of water ecosystems

Abstract. The article highlights the risk of adverse effects in the aquatic environment every year, the need to develop "human - natural" research methods in the system, one of the most commonly used methods in modern science, methods of forecasting and mathematical modeling of the sequence of projection stages, the development and implementation of the algorithm, the approximation of external phenomena using mathematical symbols, mathematical models of completed real processes, including complex and non-traditional functional-differential equations

Keywords: risk of adverse, aquatic environment, forecasting methods, math modeling.

Introduction. In scientific and industrial circles, the concept of the normalization of discharges of pollutants into water bodies was recognized, which is based on the system of maximum permissible concentrations. Sanitary and hygienic standards ensure the protection of human health, while control with the maximum permissible concentration (MPC) does not protect the ecosystem from various types of pollution.

The system of criteria for assessing the quality of the environment based on MPC has a number of shortcomings, for example, it does not take into account the interaction of various pollutants among themselves, accumulation in organisms, interaction with bottom sediments, etc. Despite the fact that the rates of rationing of polluting substances in the environment are accelerated, to date, the standards still can not fully meet the requirements.

Difficulties of rationing are that for the majority of polluting substances, MPCs of which are established, there are no reliable analytical methods of control; Some forms of substances are often normalized, while in water bodies there are others, with other MPCs. For example, the toxicity of pollutants depends on the specific hydro chemical, hydro biological situations against which it appears; The processes of transformation of pollutants in aquatic ecosystems include a number of stages, often intermediate products are more toxic than the original pollutants, etc. In addition, it is important to take into account the function of the water body under investigation and, depending on this, to make certain requirements for water quality.

One of the most important factors that have a negative impact on human health and its habitat is water pollution, since it is not only the environment for the spread of harmful discharges, but also the direct source of pollutants from industrial and motor transport discharges into the human body. Since the danger of undesirable consequences of changes in the aquatic environment increases annually, the methods of studying the system "man - the natural environment" should be improved. One of the most frequently used in modern science is the methods of forecasting.

Main part.

Forecasting involves the sequential execution of the following stages: construction of a forecasting model for the process under study, development of a calculation algorithm and a program for implementing it on a computer.

The prognostic model is an approximate description of a certain class of phenomena of the external world with the help of mathematical symbols.

The prognostic models of the real processes under investigation are complex and include systems of nonlinear functional-differential equations.

The kernel of the prognostic model is partial differential equations. The study of predictive models is based on the methods of computational mathematics, which are based on difference methods for solving problems in mathematical physics. The modern stage of applied mathematics was characterized by the study of prognostic models with a wide use of computer facilities.

To formulate the problem, possible ways of their entry into the water object under study, the initial concentrations of heavy metals, were analyzed. We have considered the diffusion, convective and diffusion-convective mechanisms of the distribution of pollutants in water. The diffusion mechanism for the propagation of pollutants is used in describing processes in water bodies with stagnant or low-flowing water (reservoirs, ponds, lakes, canals, pipelines, etc.). At the heart of the construction of a predictive model of predominantly diffusion, transport of matter lies the diffusion equation.

The intensity of ingression and mixing of pollutants in water massifs depends on climatic conditions, relief, landscape features, terrain soil, etc.

We consider the one-dimensional diffusion problem with reference to a narrow extended pond with standing water: a small river, a stream, a pipe or a channel, into which a limited volume of pollutant enters. In this ecological situation, the problem can be considered one-dimensional, i.e. width and depth of the reservoir are neglected, since they are insignificant in comparison with the length, to consider diffusion only in one direction - along the length of the reservoir.

Differential equations of parabolic type are used for predictive modeling of diffusion processes in one-dimensional cases, since physical processes can be characterized by functions of two independent variables: one spatial coordinate and time.

The problem of one-dimensional diffusion with initial conditions has the form:

$$\frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2}$$

$$C(0,t)=C_{\circ}I, \quad C(x,0) = 0 \qquad (1)$$

where C is the concentration of the substance; C0 is the initial concentration; t is the propagation time, and x is the length of the investigated section.

Using the representation of the solution in the form of a Poisson integral

$$C(x,t) = \frac{1}{2\sqrt{\pi}}\int_{-\infty}^{\infty} \frac{1}{\sqrt{Dt}} e^{\frac{-\left(x-\frac{1}{4}\right)^2}{4Dx}} \varphi(\xi)d\xi \qquad (2)$$

you can get a solution in the form:

$$\mathrm{C(x,t)} = \mathrm{C}_{\circ}[1-\Phi(z)] \qquad (3)$$

where φ (ξ) is the action of the initial concentration;

$\Phi(z) = \frac{2}{\sqrt{\pi}}\int_0^z e^{-\alpha^2} d\alpha$ error function for $z = \frac{x}{2\sqrt{Dt}}$

Note that using equation (3), one can find the concentration distribution C (x, t), and also estimate the time at which the concentration of pollutants at the point with coordinate x in the reservoir will become larger than the maximum allowable concentration.

To estimate the time tp to reach the maximum admissible concentration of impurity C_n at a certain point of the channel x, it can be represented as $Cn = \gamma \cdot C_0$, where γ <1. Then, using the relation

$$Cn = \mathrm{C}_{\circ}\left[1-\Phi\left(\frac{x}{2\sqrt{Dt_{\circ}}}\right)\right] \qquad (4)$$

Express

$$t_{\circ} = \frac{x^2}{4D^2k^2}$$

where k is the root of the equation, *Ф(z) = 1 – γ*.

It can be seen from the literature that inorganic pollutants have diffusion coefficients from 0.4 to 3.0 cm^2 / day, and organic ones from 0.3 to 1.8 cm^2 / day.

In practice, when pollution of reservoirs with industrial wastewater, the concentration of pollutant in the source is maintained at a constant level of C_0, at the beginning of the channel, the substance enters, which inevitably leads to some convection. To partially take into account this factor, it is possible to introduce a longitudinal mixing coefficient, or convective diffusion coefficient, which is one or two orders of magnitude greater than the calculated values of the diffusion coefficient (determined experimentally).

For a one-dimensional diffusion problem with a constantly acting pollution source, the initial and boundary conditions take the form*: C (0, t) = C0 (t), C (x, 0) = 0, C (0, 0) = C0, C (∞, t) = 0*. It is assumed that *C0 (t)* is the known dilution of the initial concentration of the source *C0* with the time t, for example, in the first approximation, we can take *C0 (t) = C0-k · t.*

Let us imagine that the entry of heavy metals into a body of water occurs at some part of the boundary of the reservoir (Fig. 1). This case is quite common, for example, when discharging pollutants into a vast, shallow water massif.

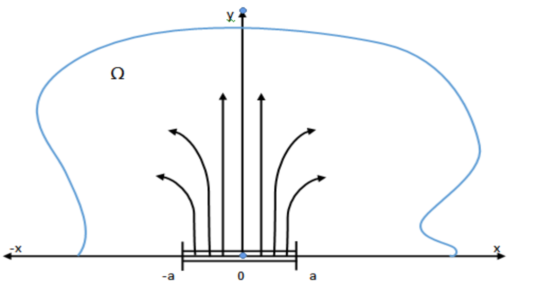

Fig. 1. A source of constant power at the boundary [-a; a]

We will assume that the dimensions of that part of the boundary through which contamination occurs are small in comparison with the dimensions of the entire boundary of the reservoir. In addition, we assume that the distribution of heavy metals over the depth of the reservoir occurs uniformly, and the main diffusion process occurs along the length and width of the reservoir.

These assumptions make it possible to consider the two-dimensional diffusion equation given in a certain region *Ω*, which has the form:

$$\frac{\partial C}{dt} = D\left(\frac{\partial^2 C}{\partial x^2} + \frac{\partial^2 C}{\partial y^2}\right) \tag{5}$$

In the case where a continuously acting source of contamination with density *p (x, t)* is located at the boundary section from *-a* to + *a*, and the initial concentration of pollutant in space is zero, the following can be chosen as boundary conditions:

C(x,y,0) = 0,

$$\frac{\partial C}{\partial y} = \begin{cases} p(x,t) npu - \alpha \le x \le \alpha, \\ 0\ npu\ x[-\alpha, \alpha] \end{cases} \tag{6}$$

where p (x, t) is the impurity flux density; x, y - the corresponding coordinates along the length and width of the reservoir.

C(x, 0) = C0; –a ≤ x ≤ a;
C(x, y) =0; C(x, y) = 0;

An analogous problem can be considered for the three-dimensional nature of the propagation of a spherical diffusion. Such an ecological situation is typical for the case when the pollution source is in unlimited space, for example, at some depth of the reservoir, and in the environment the initial concentration is zero, that is, $C\ (r,\ 0) = 0\ for\ r \neq 0$. Propagation of the impurity in a homogeneous environment occurs symmetrically in all directions: x, y, z. Consequently, the equation of spatial diffusion has the form

$$\frac{\partial C}{\partial t} = D\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}\right) \tag{7}$$

where *D* is the diffusion coefficient; *C* is the concentration of pollutants at the point with coordinates (x, y, z) at time *t*.

In a spherical coordinate system, equation (7) can be represented as:

$$\frac{\partial C}{\partial t} = D\left(\frac{\partial^2 C}{\partial r^2} + \frac{2\partial C}{r\partial r}\right) \tag{8}$$

Here $r = \sqrt{x^2 + y^2 + z^2}$ is the radius vector of the point with the coordinates (x, y, z).

Problems that take into account the movement of water have a more complex mathematical formulation.

On the basis of these mathematical expressions, calculations have been made that allow one to determine the concentration of a pollutant when a certain amount of a pollutant hits a body of water for a certain period of time.

The calculations were carried out using the integrated MathCAD system, the results obtained are partially presented in Fig. 2-4.

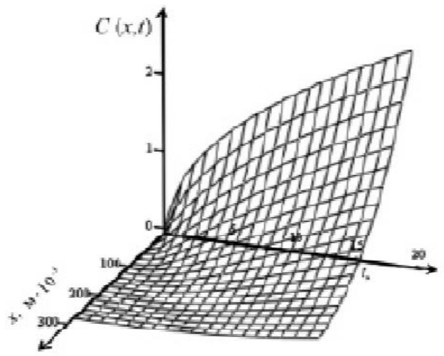

Fig. 2.

Fig. 2 shows how the time to reach the maximum permissible concentration C_n changes with a change in the initial concentration of matter by a factor of ten: 1 - at $C_0 = 1\ M / l$; 2 - at $C_0 = 10\ M / l$.

An example of the concentration distribution at the points of a flat reservoir adjacent to the pollution source at a fixed time *t* is shown in Fig. 4. To verify the adequacy of mathematical models, a numerical simulation of the full-scale experiment is carried out, and the calculated values of the concentration of pollutants as a function of the x coordinate are compared with the results of a real field experiment.

The comparison makes it possible to conclude that the values obtained as a result of the numerical experiment are in good agreement with the experimental data.

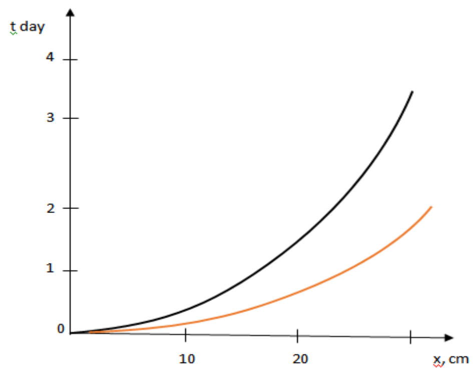

Fig. 3. Dependence of the achievement time

C_n on the distance for one-dimensional diffusion for different values of the initial concentration of pollutants

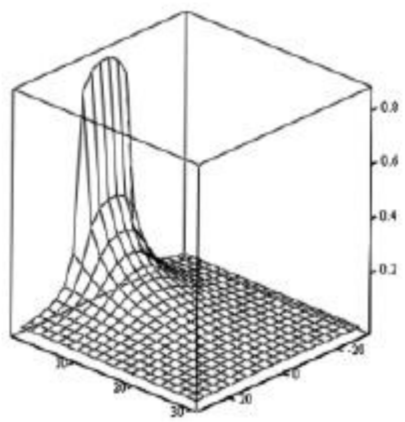

Fig. 4. An example of two-dimensional diffusion

Conclusion. Thus, along with the traditional methods used in hydro monitoring in assessing the state of aquatic ecosystems, it is possible to use the forecasting method. This method allows not only to determine the qualitative and quantitative composition of natural waters under anthropogenic influence, but also allows forecasting the course of certain chemical and physicochemical processes taking place in the aquatic ecosystem, taking into account the hydrological and hydro chemical parameters of the natural object under consideration. Of course, when drawing up such models, it should be limited to a small number of factors that take into account the distribution of pollutants, can predict the behavior of pollutants not only in a temporary order, but also for a long distance.

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Yakubov Maksadxan Sultaniyazovich
Prof. “Information technology” department, TUIT
Phone: (+ 99871) 238 – 64 -37).).
E-mail: maksadhan@mail.ru

Xujakulov Toshtemir Abdihafizovich
“Information technology” department, TUIT
Phone: (+ 99897) 535-52-76 (s.).).
E-mail: temur.avlod@mail.ru.

M.S.Yakubov., T.A.Xujaqulov.
Прогнозирование изменений состояния водных экосистем.

В статье подчеркивается риск неблагоприятных воздействий в водной среде каждый год, необходимость разработки «человек - природных» методов исследования в системе, одного из наиболее часто используемых методов в современной науке, методов прогнозирования и математического моделирования последовательности. этапов проектирования, разработка и реализация алгоритма, аппроксимация внешних явлений с использованием математических символов, математических моделей завершенных реальных процессов, в том числе сложных и нетрадиционных функционально-дифференциальных уравнений.

Ключевые слова: риск неблагоприятных воздействий, водная среда, методы прогнозирования, математическое моделирование.

УДК:517.8: 519.6

Чупонов А.Э.

Ҳудудий гидроиншоатлар сув ресурсларини бошқариш тизими кўрсатгичларини шакллантириш

Аннотация. Мақолада худудий гидроиншоатлар тизимилари заҳиралари мониторинги ва сув ресурслари тизимини бошқаришни ташкил этувчилари, тизимли таҳлил тадқиқотлари босқичлари, функционал боғланишлар хамда гидроиншоатлар заҳиралари мониторинги ва сув ресурсларини бошқариш тизимига тегишли кўрсатгичларни аналитик аниқлаш, тизим учун башорат ва моделлаштириш масалалари кўрилган.

Калит сўзлар: гидроиншоат, мониторинг, сув ресурслари, тизимли ёндошиш, тизимли таҳлил, имитацион моделлаштириш, бошқариш тизими, башорат ва оптималлаштириш.

Ҳукуматимизнинг сув хўжалиги сиёсати сувдан оқилона фойдаланиш ва сув ресурсларини химоя қилиш, мамлакат сув хўжалиги мажмуини бошқариш самарадорлиги хамда ишончлилигини ошириш, мавжуд инфратузилмани реконструкция қилиш, ундан фойдаланиш ва техник хизмат кўрсатиш учун ресурслар ажратиш орқали сувни кафолатли етказиб бериш, жамият ва табиий экотизимларга зарур сервис хизмати кўрсатишни таъминлашга йуналтирилган [1].

Маълумотлар сув хўжалиги фаолиятининг асосий устувор йўналишларидан бири бўлган, барча соҳаларда сувни истеъмол қилишда уни тежаш ва сув ресурслари сифатини яхшилаш йўналишида, олиб борилаётган худудий гидроиншоатлар тизими мониторинги асосида