

### 3. MATHEMATICAL MODELS OF MEDICAL AND BIOLOGICAL SYSTEMS

#### *Abstracts*

*Andreev N.S., Stepenko N.A.* **Design of the difference periodic time series models**

For the temporary periodic ranks with small deviations the algorithm of creation of difference linear model is given. Enough exact approximation of the considered temporary ranks is reached.

*Babin A.V., Kotina E.D.* **Data processing of radionuclide ventriculography SPECT**

Mathematical data processing of radionuclide tomography is an actual and important problem. In the work some aspects of data processing of ventriculography SPECT are considered. Among them are the construction of parametrical images of heart, a problem of allocation of volumes of the left ventricle and finding diagnostically significant parameters. The program for representation and visualization of results of processing has been developed.

*Barabanova S.A., Shmyrov A.S.* **On the problem of estimating the parameters of the Zubov's approximation sums**

The problem of obtaining the estimates of the approximation sums parameters is considered. The class of distributions for the parameters of those can be constructed efficient estimations are found.

*Bure A.V.* **Estimation of the crisis time of patient's state using medical database**

In the article the problem of choosing the optimal point of time, minimizing the expected loss, is discussed. Mathematical expectation is found using the conditional distribution of a random variable, that is the moment of crisis in the patient's condition. If the conditional distribution is unknown, then the minimax approach can be applicable. In both cases, the optimal solution is found.

*Gordeev D.F.* **Dosimetric data's processing for initialization of SCANPLAN**

The problem of dosimetric data's processing for initialization of SCANPLAN, radiation therapy planning system, is considered in the article. The problem of smoothing of the dosimetric data leads to the problem of approximation's parameters determination, providing a minimum of a quadratic functional. The software providing such minimization is described. This automation makes processing of the dosimetric data simpler.

*Ericheva E.V., Stepenko N.A.* **Defining the parameters of nonlinear dynamical systems of certain natural phenomena**

Nonlinear dynamic models with uncertain parameters for some natural phenomena are considered. The first approach is determined by temporary ranks of these supervision parameters of the accepted model. In the case of essential deviations of predicted data from supervision the algorithm of correction of parameters of system is given.

*Ivanova A.A.* **The use of binary logistic regression for estimation the effect of factors on emergence of atrial fibrillation**

Atrial fibrillation is the most common cardiac arrhythmia, that is associated with high morbidity and mortality. Therefore, the selection of predictors that determine its origin is of great significance in medicine. A database of 61 patients was analyzed. Binary logistic regression model was used to estimate the effect of various factors on the emergence of atrial fibrillation.

*Lakrisenko P.A.* **On boundedness of solutions of the switched Lotka – Volterra system**

The switched Lotka – Volterra system is investigated. It is assumed that switching occurs between two subsystems, and solutions of each of the subsystems are bounded. It is proved that, by means of a special choose of switching low, the unboundedness of solutions of the corresponding hybrid system can be provided.

*Mamochev V.A.* **On separation of three sets in the identification problem**

The problem of identification of the points of three sets is discussed in the paper. A method employing the existing algorithms of identification of two sets is proposed. A software for this method is constructed and tested on a real database.

*Morozov P.D.* **A wavelet transform of acoustic signals**

The program performing wavelet transform of the input signal is developed. Some signals are restored using this program. So-called "Mexican hat" is used as the mother wavelet.

*Morozov P.D., Mikheev V.S.* **Detection of threshold speech audibility using amplitude modulation**

A series of experiments with the encoding of human speech using acoustic amplitude modulation was hold. To identify the frequency limits of distinguishability of coded speech by the human ear, the carrier frequency was administered in a range from 4.6 to 32 kHz. In the range from 8.7 to 19.2 kHz, speech recognition had probability 1. Using the speakers with different pitch showed a better distinguishability of speech, spoken in a high voice.

*Nikitina I.P., Gubar E.A.* **The model of epidemic process in risk group in structured population**

In the paper a model of the epidemic process in risk-group and in the mass of the urban population is considered. The risk-group is characterized by a high

probability of infection with acute respiratory illness. Risk-group is selected from the total mass of the urban population according to social or age-related factors. A numerical simulation is presented, using the Gillespie algorithm, which allows us to estimate the duration of the epidemic process and the beginning of the epidemic.

*Sudarev O.I.* **Analysis of initial data of patients before cardiac resynchronization therapy**

In the paper the problem of analyzing the initial data of patients with heart failure is considered with a goal of further using these data for solving problems of patient selection for cardiac resynchronization therapy. Qualitative and quantitative assessments of source data are carried out, nonparametric test series of the Wald-Wolfowitz is used.

*Fotina L.A., Gubar E.A.* **Vaccination effect to the epidemic process in structured populations**

In the paper an epidemic process in the case of the seasonal rising of acute respiratory viral infections with the possibility of partial vaccination of the population is considered. The total mass of the urban population is divided into three subgroups: susceptible, infected and immune and subgroup susceptible is vaccinated. This model is based on evolutionary dynamics model. The stable states of the population are studied. The numerical experiment using the Gillespie's algorithm is presented.

*Shcherbakova A.A.* **The application of discriminant analysis to classify the children's eye diseases**

The solution of applied problem of classification of children's eye diseases is considered. The mathematical model is created. Numerical calculations are made and analysis of the results are given.