Summaries of all articles

O.V. Bogatova, T.V. Rakitina, I.A. Kostanyan, V.M. Lipkin

On cell localization and potential partners for a new protein haponin

We recently discovered in the human progranulocytic leukemia cell line HL-60 a new protein haponin (HLDF-alike protein), a structural homologue of the translation initiation factor EIF1A. Transient transfections reveal GFP fused haponin to accumulate in the cell nucleus in the CHO-K1cell line, which is proved by confocal microscopy and western-blotting experiments. The stable CHO-K1 clone producing a fusion protein proliferates slower than the parental line or the CHO-KI derivative, which produces GFP. Expressed in the baculovirus system, 6 His-tagged haponin pulls down glyceraldehyde-3-phosphate dehydrohenase (GAPDH) and elongation factor 2 (EF2) from cell lysates, which are its potential protein partners.

Keywords: haponin, EIF1A, GAPDH, EF2, nucleus, proliferation.

D.A. Voznyak, A.K. Chibisov, N.K. Petrov, M.V. Alfimov

Specificity of photophysical processes in cyanine dyes in a mixture of polar and nonpolar solvents

Photophysical processes in thia-, indo- and imidacarbocyanine dyes are studied in a mixture of DMSO and toluene. In mixtures of solvents containing more than 20vol% of DMSO the dyes, which exist as solvated cations, are characterized by both the high efficiency of trans $\rightarrow$ cisphotoisomerization and fluorescence in contrast to very low efficiency of intersystem crossing. An increase in toluene content in a solvent mixture results in the formation of ion pairs between cationic dye and anion Cl^-, Br^-, I^-, BF_4^-. For Br^- or I^- as counter ions, there is a strong increase in the yield of triplets and the shortening of their life-time. The results are discussed in terms of the «external heavy atom effect» in ion-pairs.

Keywords: cyanine dyes, binary solvent mixtures, ion-pairs, heavy atom effect.

Z.I. Zubtsova, E.N. Savvateeva, D.A. Zubtsov, S.B. Popletaeva, R.A. Yurasov, M.V. Tsybulskaya, A.Y. Rubina

Development of a multiparameter test system for detection of oncological diseases of the female reproductive system

A prototype of the diagnostic test system for the simultaneous quantitative detection of several serological tumor markers on the biological microarray: AFP, HCG, CEA, CA125, CA15-3, and CA19-9, is developed on the basis of the hydrogel biochip technology. This tumor markers panel is used for the diagnostics of the most widespread diseases of the women reproductive system: breast and ovarian cancer. The analytical characteristics of the developed prototype of the test system are estimated. It is shown that the biochip-based test system allows the detection of tumor markers within the range essential for clinical analysis and the repeatability and sensitivity of the method satisfy the requirements for the immunoanalytical test systems. The results of the simultaneous quantitative detection of six tumor markers in serum blood samples of oncological patients and healthy donors produced on biochips are compared with the data obtained by the individual assay of these tumor markers in the same serum samples using commercial EIA-systems.

Keywords: breast cancer, ovarian cancer, tumor markers, biological microarrays, multiparameter immunoassay.

G.S. Krasnov, A.A. Dmitriev, A.V. Kudryavtseva, E.A. Anedchenko, N.I. Oparina, V.N. Senchenko

New programs used for quantitative measurements of gene transcription levels and copy numbers

The real-time polymerase chain reaction (PCR) method is currently one of the most common approaches to the quantitative measurements of gene transcription levels. However, there are a lot of issues to take into account, viz. difficulties with a selection of high-quality primers and probes, problems of analyzing genes with several isoforms, influencing the amplification efficiency of different factors distorting the quantitative data. We develop two applications to the selection of high-quality primers and probes and to processing the real-time PCR data, with account taken of amplification efficiencies. Comparison with the existing analog applications is done.

Keywords: qPCR, reaction efficiency, primer design, gene expression, mRNA level.

I.A. Martchenko, N.V. Tsvetkov

Third-generation cylindrical dendrimers based on L-aspargic acid in solutions- hydrodynamic and electrooptical properties

Samples of third-generation cylindrical dendrimers with molar masses varying over the interval 20000–60000 Da are studied by methods of equilibrium and nonequilibrium electrical birefringence, molecular hydrodynamics and optics. It is found that the absolute values of Kerr and flow birefringence constants exceed the values obtained for analogous dendrimers of lower generations. The reorientation mechanism proves to be strongly dependent on the physical and chemical properties of the solvent. In chloroform solutions, the studied dendrimers align to the microwave-frequency electric fields by a large-scale mechanism. In dichloroacetic acid solutions, the observed reorientation mechanism is a low-scale one, which is explained by the degradation of intermolecular hydrogen bonds. The terminal dendritic substituents of macromolecules are experimentally proved to be oriented mainly along the main polymer chain.

Keywords: cylindrical dendrimers, Kerr effect, flow birefringence, diffusion, spherocylinder.

A.M. Perepuhov, S.L. Shestakov

Inverse Laplace transform algorithm for complex relaxation curve analysis

The inverse Laplace transform algorithm which allows decomposing complex kinetic dependences into exponential components is implemented. The algorithm resolution is estimated depending on the number of points and the signal-to-noise ratio by testing model functions. The results of the inverse Laplace transform are compared with those of the standard approach (alignment of kinetic dependences in the logarithmic scale) by the example of NMR relaxation data processing.

Keywords: inverse Laplace transform, NMR, heterogeneous materials, relaxation, diffusion, multiexponential kinetic curves.

O.N. Tkachenko, A.A. Frolov

Electroencephalographic indices of drowsiness and monotonous operator activity

The EEG-based methods of monotonous operator activity monitoring are discussed. The experimental data of twelve sleep-deprivated subjects performing the task of car simulator driving is analyzed to test several EEG classification methods in the alpha frequency range. The advantages of CSP and Bayes methods over the widely used Tietze method are shown.

Keywords: EEG, drowsiness, monotony.

S.S. Bel'mesova, L.S. Efremova

On quadratic mappings of some one-parameter family close to the unperturbed map

We prove the existence of a one-parameter family of unbounded invariant curves for a one-parameter family of quadratic mappings in the plane R^2 $F_\mu(x,y) = (xy,(x-\mu)^2)$ for $\mu \in (0.1]$.

Keywords: quadratic map, Jacobian, invariant curve.

K.K. Gluharev, N.M. Ulyukov

In addition to the transport flow theory

A single-row flow of cars is considered. Each car is supposed to be a particle which interacts with a neighboring particle according to the safety distance law. The safety distance law is based on the known results of the experimental observation of transport flows [1]. Differential-functional equations of particle flow and their solutions are derived. The suppositions are: 1. each inner particle of the flow is the leader of a neighboring particle and the follower of the previous particle; 2. the smooth trajectories of cars can be approximated by piecewise-linear nondecreasing functions (backward motion is forbidden); 3. the changing speed algorithm of the follower is based on safety distance keeping criteria. The simulation results to illustrate the typical flow effects and the development of a network-level discrete flow theory are given.

Keywords: transport flow, discrete flow, safety distance law, differential-functional flow equations, typical flow effects.

N.A. Gusev

On the dependence of the gradient of the solution to the Neumann problem for the Laplace equation on a parameter

The Neumann problem for the Laplace equation with the boundary condition dependent on the parameter $t \in [0,T]$, $T \in \mathrm{R}$, is considered. The regularity of the gradient of the solution to this problem is studied. The estimates of the gradient in Hĺder spaces are derived. It is shown that these estimates cannot be improved. Using these estimates, some estimates in Hölder spaces for projectors onto the spaces of potential and divergence free vector fields (Leray–Helmholtz projectors) [1] are found.

Keywords: gradient of solution, Neumann problem, Laplace equation, Hölder space, boundary condition dependent on a parameter, Leray–Helmholtz projector.

V.M. Ipatova

The problem of a prescribed minimum point

A new statement of the variational data assimilation problem is proposed. The existence and uniqueness theorem of its solution is proved. For the main operator of the problem, its eigenfunctions and eigenvalues are calculated. The numerical algorithm for solving the problem of a one-dimensional heat conduction equation is considered.

Keywords: inverse and optimization problems, variational data assimilation, eigenvalues, numerical algorithms.

A.B. Korchak, A.A. Evdokimov

Parallel computing methods for separated systems of ordinary differential equations with multiple steps

In this paper, we develop a method for computing heterogeneous models with different time steps, which is based on a family of algorithms for the parallel solution to systems of differential equations of large dimension. We analytically estimate and directly measure the error of these algorithms as to weakly coupled ODE systems. We define the advantages of the algorithms computational cost over the exact methods.

Keywords: partition of ordinary differential equation system, parallel numerical processes, fast ODE system solution algorithm.

L.A. Gaydukov, B.A. Orinbaev

Influence of borehole zones on the gassers production

Various ways of modeling the deterioration of the properties of a borehole zone are considered. Its influence on drag coefficients and the indicated curve is investigated. The relative permeability is thought to be dependent not only on the layer compressibility and the obstruction effect but also on the pressure gradient and the imperfection of a well.

Keywords: well production, near bore zone, reservoir damage, reservoir compressibility.

M.L. Zaytsev, V.B. Akkerman

Nonlinear description of reaction front motion

The complete system of hydrodynamic equations, which describes the development of the hydrodynamic instability of a reaction front, is reduced to a closed system of surface equations using Lagrangian variables, special integrals of motion and their analogues. The vorticity is shown to play a fundamental role in the motion pattern of hydrodynamic discontinuities, imparting a differential form to the equations. In the isentropic approximation, it is demonstrated how to take into account the fluid density oscillations caused by sound.

Keywords: reaction front, deflagration, hydrodynamic discontinuity, hydrodynamic instability, integral and differential equations, hydrodynamic motion.

S.V. Kiriyan, B.A. Altoiz

Rheology of motor oils with quasiliquid-crystal layers in a friction triad

Motor oils micron interlayers' optical anisotropy and higher viscosity in comparison with its «volume» value are experimentally set. These features are related to interlayers' structural inhomogeneity — adjacent-to-wall epitropic liquid-crystal layers organization on a bounding substrate. These interlayers are researched in a model friction triad using optical and rheological methods. The estimates of the birefringence value and layer's thickness, which dercrease with increasing deformation rate, are derived. The effect of the surface-active agent additive as a surfactant, which leads to layer structural organization, is considered.

Keywords: motor oil interlayers, friction triad, viscosity, rheology, optical anisotropy, wall-adjacent structural layers, epitropic liquid crystals.

I.V. Kleev

The method of thermal dynamical errors of strain-gage balance monitoring

The paper describes the heat model of strain-gage balance. The temperature gradient sources and the method of dynamical error monitoring are considered.

Keywords: monitoring, strain-gage balance, heat model, temperature gradient, dynamical errors.

I.I. Lipatov, T.A. Chzho

Disturbance propagation in supersonic boundary layers

In this paper, we investigate disturbance propagation processes in two-dimensional boundary layers for the strong interaction case. We determine the velocity of upstream disturbance propagation dependences as a function of the specific heat ratio and the Prandtl number. A formula for velocity propagation of disturbances is derived by characteristics and subcharacteristics analysis corresponding to the gasdynamic wave processes and convection and diffusion processes.

Keywords: boundary layer, strong interaction, waves propagation, asymptotic analysis.

S.S. Ravdin, A.V. Pruglo, V.N. Lagutkin, F.A. Kozin

Simulation of the spatial distributions of supersonic gas and particle mixture flow parameters

The computer model for simulating the spatial distributions of parameters in a supersonic gas and particle mixture flow issuing into a cocurrent air flow is developed. The model is based on the numerical solution using a grid method in conjuction with the method for splitting a set of partial derivatives equations, which describes a heterogeneous flow. The model takes into account all major physical factors which affect the flow formation. The supersonic gas and particle mixture flow is simulated in moderately noncalculable and strongly noncalculable modes. The results obtained are in agreement with the general physical rules of the structure and parameters evolution along the flow against the parameters of the cocurrent flow.

Keywords: computer model, supersonic gas and particle mixture flow, heterogeneous flow, cocurrent flow, turbulence.

S.P. Rodionov, L.N. Sokolyk

Determination and application of modified relative phase permeabilities to the transformation of a geological model into a hydrodynamical model

In this paper, a technique for determining the tensors of modified relative phase permeabilities in the transformation of a geological model into a hydrodynamical model (upscaling) is presented. The areas of application of this technique are discussed.

Keywords: reservoir model, upscaling, pseudofunctions.

A.V. Safronov, Y.V. Fomin

Method of the numerical solution of a gas dynamics equation by correlations on ruptures

Our ultimate goal is to develop a high-efficiency program complex of imitation modeling of the hydrodynamics of launching rockets for improving the new space- purpose carriers. At the first stage, the algorithms of the numerical account of heavy explosive currents of a gas are considered. The results of test accounts characteristic of the currents in a wide range of parameters, which confirm the efficiency of the approach, are given.

Keywords: Godunov's scheme, compound discontinuous gas flow, approximation flow at the border of cells, gas dynamics compound problem, maximum grade of wave velocity.