Summaries of All Articles

A. D. Agaltsov

Inversion and uniqueness theorems for Radon-type integral operators

In this paper, Radon-type integral operators and the generalized Radon transform over level hypersurfaces of positively homogeneous functions are studied. Such Radon-type integral operators arise in the generalized Houthakker-Johansen model of pure industry, with account taken of the substitution of production factors at the microlevel. For these operators, the inversion formulas and the unicity theorem are obtained. An example of nonuniqueness is gtven.

Key words: Radon-type integral operator, generalized Radon transform, profit function, inversion formula, uniqueness theorem, example of nonuniqueness.

Aung Lin, A.I. Lobanov

On the particles velocities distribution in shear flow for low volume fraction of particles

The mathematical velocity distribution model of finite-size particles in shear flow is based on consideration of the laws of conservation of mass and momentum. Velocity distribution plays a key role in shear diffusion models. The model describes the change in the velocity profile, depends on the particle size to vessel ratio. The model reproduces the effect Fåhræus–Lindqvist and Fåhræus. It is based on simple geometric.

Key words: Poiseuille flow, continuity equation, inhomogeneous flow, finite size particle.

G. E. Ivanov, M. S. Lopushanski

Convex parameters calculus for the Minkowski sum of strongly and weakly convex sets with respect to an unbounded quasiball

We consider strongly convex and weakly convex sets with respect to an unbounded and nonsymmetric quasiball. We obtain the theorems on convex and closedness parameters calculus for the Minkowski sum of strongly convex and weakly convex sets.

Key words: strong and weak convexity, metric projection.

A. Yaakbarieh

On the semigroups generated by Cauchy problem for hyperbolic functional differential equations with space argument deviation

We obtain the well-posedness condition of Cauchy problem for the functional differential hyperbolic- type equation with space argument deviation of an unknown function. The representation of the semigroup of Cauchy problem solutions to the studied hyperbolic functional differential equation is given.

Key words: difference-differential equations, semigroup, Cauchy problem.

A. A. Kokotkin, A. M. Raigorodskii

On the realization of subgraphs of a random graph by graphs of diameters in the plane and in space

In this paper, new bounds are obtained for the maximum number of vertices in an induced subgraph of the random Erdős–Rényi graph, which, with high probability, can be realized as a diameter graph of dimension 2 or 3 and has the largest chromatic number for this dimension.

Key words: diameter graph, random graph.

M. H. Numan Elsheikh, V. Zh. Sakbaev

Schrödinger operators on graphs

We consider the Laplace operators on graphs with the finite or countable number of edges. In particular, a description of self-adjoint extensions symmetric Schrödinger operator, initially defined on a smooth function whose support does not contain the branch points of the graph. The results are obtained for graphs with a single vertex, graphs with multiple vertices and graphs with a single vertex and a countable set of rays.

Key words: Laplact operator, finite or Schr odingtr, graphs.

N. I. Amelkin, A. V. Zykov

On equilibrium and stability of a satellite with a system of two-degree-of-freedom powered gyroscopes in a central gravitational field

Equations of motion of a satellite carrying an arbitrary system of two-degree-of-freedom powered gyroscopes in a central gravitational field are obtained. It is shown that all age-long stable equilibrium of a satellite with a parallel system of two-degree-of-freedom gyroscopes can be achieved by using a single two-degree-of-freedom gyroscope.

Key words: satellite, powered gyroscope, equilibrium, stability, asymptotic stability.

K.A. Prutko

Modeling of radiative high-temperature air in front of a spacecraft entering the atmosphere with superorbital velocity

In the heat transfer analysis of a spacecraft entering the atmosphere of the Earth with superorbital velocities after planned missions to the Moon or to Mars the most difficult problem is a choice of a radiative model, which should take into account both the gas flow dynamic features (shock-layer, boundary layer) and the regions with strong nonequilibrium parameters and different optical thicknesses. In the case of high temperatures of gas in the shocklayer ($T \geqslant 9500 \,\mathrm{K}$), at velocities of $V = 10 - 12\,\mathrm{km/s}$, the atomic components prevail in the major part of this layer, which determine the emission capability of gas.

In this case, the processes in most contributed radiative heat transfer to the surface of the entering spacecraft are: photon ionization recombination and bremsstrahlung emission (continuum spectrum), linear radiation of the atoms. The present work analyses the boundaries of applicability area for the equilibrium radiative model of large entering spacecrafts, and the method for calculation of spectral intensity and radiative heat transfer for high temperature air, which is conditioned by atomic components, is suggested.

Key words: entry spacecraft, radiative heat flux, atomic radiation, shock layer.

A. V. Sakharov

Rotation of a body without external drivers by a rotor

A rigid body with a cavity on a rough plane is considered. The Amontons-Coulomb law is used as a friction law between a body and the surface. To determine contact stresses we use a dynamic collaborative model. Rotation of a body on the surface is performed by a rotor inside the cavity. The rotor is located in two ways: in the vertical and horizontal planes. We formulate and numerically integrate equations of motions of a body.

Key words: dry friction, Amontons-Coulomb law, dynamic collaborative model, contact stress.

A. A. Tirtichny

Choice of suspension of micromechanical inertial sensors for control systems of small space vehicles

We give the results of research of the effect of design features of inertial mass' elastic suspension on the characteristics of a micromechanical gyroscope, which are operating in the selfoscillations' mode. In particular, These characteristics are the amplitude of the oscillations along the excitation axis and the output axis. One of the angular positions of elastic suspension's elements leads to resonance. This position allows one to greatly increase the amplitude of the output oscillations and accordingly the sensor sensitivity. The method for determining this position is described.

Key words: micromechanics, angular rate sensor, gyroscope, autooscillation, self-oscillations, elastic suspension, rigidity, resonance, sensitivity.

Yu. M. Ahmetov, E. I. Zangirov, A. V. Svistunov

Possible mechanism of eddy currents swirling flows

We solve the problem of determining the mechanism of a gas flow in a vortex tube. We carry out the direct numerical simulation of the gas flow on the highway in the vortex tube application package Computational Fluid Flow Simulation 2012. In contrast to the known results, the numerical simulation shows the presence of different structures in the gas flow and reveals the nature of their interaction.

Key words: vortex tube, throttling, mathematical model, direct numerical simulation, large-scale vortex structure.

I. S. Bosnyakov, G. G. Soudakov

Simulation of turbulence by the large eddy simulation second-order method

Dissipation of homogeneous isotropic turbulence is studied. There exist theoretical estimates for the turbulence intensity decrease law as well as for a correlation velocity tensor. These estimates are used as a baseline for verification of the industrial numerical method (2nd order on space and time). Large eddy simulation is used for solving the problem. The obtained results are within the range of values provided by other authors.

Key words: homogeneous isotropic turbulence, large eddy simulation, decay of turbulence, numerical simulation.

V. V. Vyshinsky, A. A. Kornyakov, Yu. N. Sviridenko

Disturbed flow field simulation in the vicinity of the "Mistral"-type helicopter carrier

The paper presents the problem statement and the results of the disturbed flow field simulation in the aircraft carrier vicinity in the pennant wind. The obtained results utiliz in flight simulators and pilot-in-the-loop simulators for realistically modeling the aircraft takeoff and landing on the aircraft carrier moving in the surface wind boundary layer. Artificial neural nets are used for real time modeling.

Key words: surface boundary layer, flight simulator, pilot-in-the-loop simulator, aircraft carrier, mathematical simulation, Reynolds averaged Navier–Stokes equations, artificial neural nets.

I. I. Lipatov, Tuan Vinh Pham, A. A. Prihodko

Numerical simulation of the buffeting's appearance for NACA0012 airfoil

This paper shows the result of the numerical study of buffeting's appearance on Naca0012 airfoil. We determine the condition under which the oscillation models buffeting of a shock appears in the presence of interaction in the boundary layer. The Mach numbers and angles of attack are also given. Moreover, investigations are also carried out in some control modes in the boundary layer for the purpose of changing the buffeting boundaries.

Key words: transonic flow, oscillations of shock wave.

Hong Phong Nguyen, V. I. Biryuk

Research on optimization of structural layout of the straight-wing aircraft made from composite materials

This paper considers the wing of an unmanned flight vehicle made from composite materials. The possibility of reducing design loads on the wing using the anisotropy of composite material is investigated in the paper. The 'various anisotropy versions are also investigated in order to get an optimal ratio of orientation angles of composite layers. The different strength criteria for the composite wing skin are applied and a comparison of optimal versions is made.

Key words: optimization, composite materials, structural layout, straight-wing, wing box, unmanned aircraft.

M. A. Burnusuzyan

Estimation of the impact of exchange rate on the structure of the national economy: case of Armenia

In this paper, the impact of the exchange rate on the structure of the national economy of placecountry-region Armenia is investigated. We obtain the quantitative characteristics of the impact of the exchange rate on industry, agriculture, services and construction. We also have the quantitatively estimated impact of the exchange rate on the mining industry and on the domestic price of petrol in the Republic of Armenia.

Key words: Exchange rate, national currency, agricultural products, industry, services, mining industry.

M. S. Vasilev

Road networks schemes reorganization and transformation

The aim of this work is to show a new method of work with road networks, which consists in their representation as a geometric graph and their further transformation. The method of work with schemes of the road networks presented in this article allows us not only to simplify the road networks by reducing the number of network elements, change the movement organization or the geometric provision of some network elements, but also to build new road networks based on the already existing ones.

Key words: graph, entrance, exit, the maximum number of realized routes, cohesion, coherence full and incomplete schemes, excess scheme, minimum structure, zeroing of a site of the scheme, division – consolidation (D-C) scheme, division of the scheme into subscheme, consolidation of subscheme in the scheme, frequency rate of an edge of the graph.

S. L. Semakov, A. S. Semakov

Management of price discounts in trading networks

The results obtained by using the earlier offered algorithm on management of discounts for the price of seasonal goods in trading networks are presented and discussed in detail. The algorithm is directed on the elimination of lagging of the actual sales from the planned and revenue maximization from sales. The presented results are obtained by algorithm introduction in the real-life large trading network consisting of several hundred clothing stores.

Key words: sales management, trading networks, revenue maximization, price discounts.

N. M. Boev

Methods for improving the spectral and energetic efficiency of unmanned aerial vehicle digital communication systems

The problems of increasing the spectral and energetic efficiency of unmanned aerial vehicle (UAV) digital communication systems are studied. The author proposes methods of adaptive changing of the main communication system characteristics. The problems of synchronization of digital communication systems by using global navigation satellite systems (GNSS) are considered. The synchronization system is presented and described. The author proposes a data transfer method in wireless networks that can be used for distribution of energy efficiency between communication channels of the communication system. The transmitter and receiver structures are described.

Key words: digital communication system, software-defined communication system, unmanned aerial vehicle, energetic efficiency, spectral efficiency.

V.E. Gai

Information approach to the description of a sound signal

An approach to the problem of prior uncertainty disclosure of a sound signal is considered. The approach is based on a successive application to the signal operations of integration and differentiation. It allows getting out of impropriety arising at the stage of signal preprocessing. The method of identification of sound recordings, which is suggested in this work, is based on the use of this approach.

Key words: digital signal processing, sound signal, active perception, sound identification.

V.P. Sivokon, A.V. Kubyshkin, V.V. Bogdanov, N.V. Cherneva, I.V. Agranat, A.S. Serovetnikov

Whistlers as possible indicators of active experiments influence on the ionosphere

The results of experimental measurements from placeKamchatka region show some irregular waveforms of whistlers (whistling atmospherics) due to external electromagnetic pulses amplitude modulation which has approximately 1 sec duration and 1,1 kHz filling frequency. Thereupon the authors put forward an idea of possible use of whistlers as indicators of high frequency active auroral experiments. Thus, the parameters of ionospheric heating can be restored directly from the analysis of whistler circumflex, and the frequency dispersion information contains the electron concentration evolution data set.

Key words: whistlers, ionospheric heating, amplitude modulation, frequency dispersion.

S. Yu. Sharov

Analytical model of a hybrid communication channel with cold backup

This paper considers a hybrid communication channel based on free space optic (FSO) which is backed up with the help of the radiofrequency (RF) channel. We develop a mathematical model to describe the proposed system. This paper provides the complex analysis of the proposed analytic model of a hybrid system allowing us to calculate the main characteristics of the hybrid communication channel with cold backup. We also provide a condition when the stationary mode exists.

Key words: hybrid communication channel, free-space optic channel, radio-frequency millimeter wave band, mathematical modeling.

A. L. Shishkin

Combined method for constructing multicomponent network codes

The paper proposes a new method for constructing multicomponent network codes based on rank subcodes. The method combines lexicographical sorting and greedy search for finding components of network codes, and the use of irregularly bounded rank codes to encode inside components. Examples of codes are given, cardinality of constructed codes is obtained, a comparison with the upper theoretical bound is exercised.

Key words: network coding, constant dimension codes, greedy search.