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Small subgraphs and extensions in a family of random subgraphs of dense distance graphs

Earlier, the results concerning the distribution of small subgraphs and extensions in a random symmetric distance graph were obtained. In this paper, we generalize these statements to a wider family of random distance graphs.

Key words: distance graphs, random graphs, small subgraphs, extension properties.

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Development of the palletization algorithm for a fully automated logistics warehouse

The problem of three-dimensional packing of boxes into a pallet, belonging to the class of NP-complete problems is studied. Several heuristic approaches to its solution are proposed, viz. the modification of the genetic algorithm and an approach based on the layering heuristics. An approach to assessing the quality of stacking based on the percolation coefficient and the stability factor is proposed. A weak dependence of the stacking quality on the accuracy of setting the dimensions of the boxes is shown.

Key words: box packing, genetic algorithm

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Boxes size measurement on the basis of real time video stream processing

We propose the solution to the problem of boxes size measurement on the belt of warehouse conveyor. Our approach uses only the videostream data to make the measurements. The solution consists of the proper geometric model (central projection) and searching for object vertices.

Key words: video processing, belt of warehouse conveyor.

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Cellular automata algorithms for matrix permutations

Four algorithms of matrix elements mixture based on cyclic shifts of rows and columns are described by cellular automata formalisation. One of the algorithms shows an interesting behaviour for odd matrix orders, when, as a result of permutations, the matrix undergoes $\pm 90°$ and $180°$ (reflection relative to the centre) rotations. The period N growth rate is more than exponential. Based on the analysis of the short series $n = 3, 5, \ldots, 11$, a hypothesis is proposed that N is equal to the lowest common multiple of the odd numbers less than $2n$, i.e. $N = \mathrm{LCM}(3, 5, \ldots, 2n - 1)$. Arguments in favour of the hypothesis are given. The dynamics of permutations are analysed using the two «metrics» introduced by the authors, which reflect the degree of mixedness. The results of this work can be used to generate pseudorandom numbers.

Key words: cellular automata, permutation, rearrangement, pseudorandom numbers, cryptography, metrics.

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Comparison of the behavioral concepts of equilibrium on an example of «11-20» game

The aim of this work is to study the two-player game «11-20». Unlike the previous research work on this game, various behavioral concepts of equilibrium are studied in an attempt to qualitatively model the game players behavior. In order to improve models predictive power the attitude of players to risk and propensity for cooperation are studied too. The software implementation of the game «11-20» is created and several laboratory experiments are conducted with subsequent results analysis.

Key words: game theory, «11-20» money request game, mixed Nash equilibrium, quantal response equilibrium, cognitive hierarchy, k-level reasoning.

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Algorithm for computing term rank of binary matrices

We consider methods for correcting errors in the system of parallel channels with interference. The space of square matrices over a finite field is suggested. The term rank of the binary matrix A is defined to be a minimum number of rows and columns that contain all nonzero elements of the matrix. In this paper, we discuss the algorithm for computing the term rank of the matrix. Key words: term rank, lattice construction, finite field, binary matrices, distance of codes, row sum vector, column sum vector.

Key words: term rank, lattice construction, finite field, binary matrices, distance of codes, row sum vector, column sum vector.

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Some specific properties of the boundary layer optics on an airfoil model at high subsonic speeds

Analysis of the optical flow pattern obtained by the schlieren method in the boundary layer on a supercritical airfoil model in the wind tunnel experiment is provided. Origins of the characteristic light patch in the airfoil rear region and its washing out at high Mach numbers are established.

Key words: high subsonic flows, boundary layer, optical investigations, schlieren method.

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On the existence of local formulae of the transfer velocity of local tubes that conserve their strengths

In the paper we discuss different approaches to express Fridman velocity, which is the transfer velocity of vortex tubes that conserves their strengths in a viscous fluid. It is known that Fridman velocity exists for any elementary vortex fragment, though it is not unique. The existence of such expressions (which we call local) of Fridman velocities depending only on the velocity components and their derivatives, has been an open question for nonstationary incompressible flows where the scalar product of vorticity and its curl is nonzero. This question is of importance for the development of numerical vortex methods. In this paper, in terms of the examples of cylindrical flows, we demonstrate the existence of flows with nonzero scalar product of vorticity and its curl, which have local Fridman velocity; as well as the existence of the flows where only nonlocal Fridman velocity is possible.

Key words: vorticity transfer, Fridman velocity, diffusion velocity, vortex methods.

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Modeling panel flutter in the framework of the asymptotic theory of viscous gas flows

The processes of strong local viscous inviscid interaction in the flow around the flexible surface are studied. Linear and nonlinear processes of flow interaction in the laminar boundary layer with an external supersonic flow are investigated.

Key words: asymptotic theory of viscous gas flows, plate oscillation, fluid structure interaction.

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Synthesis of the shape of the elastic axis of a closed wing of the aircraft and the study of its stress strain state by the speckle holography method

Features of the stress-strain state of the joined wing of the aircraft. Algorithm for finding the optimal shape of the elastic axis of the wing. We adapt the shape of the aircraft to the flight mode using actuators of alloys with shape memory. Speckle holography is used to clarify the VAT of multiply connected designs.

Key words: joined wing, adaptive structure, speckle holography.

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Influence of temperature on combustion and detonation limits for propane-butane-air mixtures. Experimental results

The pressures and pulses are significantly different in different flame propagation regimes of the hydrocarbon-air mixtures. Therefore, to predict the real picture of accident development in fuel concentrated objects, it is necessary to know the boundaries of the existence of each regime as accurately as possible. The combustion of mixtures of the most common alternative motor fuel (AMF), the liquefied petroleum gas (LPG) with air, is considered in this paper. The results of experiments in a detonation tube with obstacles, which model the obstructed space, are presented too. The temperature influence on the burning velocity and concentration limits of various flame propagation regimes is demonstrated. The results presented in this paper can be used in the development and verification of computer codes to analyze possible accident situations.

Key words: combustion, detonation, hydrocarbon-air mixtures, concentration limits, burning velocity, obstructed space.

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Two- and three-dimensional simplified Ising model

We consider the two- and three-dimensional Ising model assuming that only one square or one cube is contained in the crystal lattice. The periodical conditions are added at the ends of these structures. The heat capacity and magnetization are derived. The conclusion is that the analytical results of this simplified model are similar to cumbersome computer solutions of systems consisting of a large number of squares and cubes.

Key words: Ising model, heat capacity, magnetization, ferromagnetism.

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Beam Plasma Technologies for Processing Cellulose and Lignins

Applications of nonequilibrium low temperature plasmas for the processing of biopolymers (cellulose, lignin and its derivatives) are described. The techniques based on plasma-assisted processes are developed, viz. destruction of biopolymers solid powders in electron beam plasma (EBP), generated by the injection of the electron beam into dense gaseous media; functionalization of polysaccharides materials and lignins in hybrid plasma produced by an electron beam injection into RF gas discharge plasma.

The formation of oligosaccharides with molecular weight 800–2000 Da and polymerization degree varying from dimers to heptamers during the EBP-stimulated destruction of cellulose, chitin, and chitosan powders is observed. The EBP- and HP-treatment of polysaccharides sponges were found to change the surfaces morphology, improve hydrophilicity and cause the formation of chemically active groups. Further grafting of the blood clotting protein thrombin and lactic acid is performed in HP modified surfaces of cellulose sponges, hydrolyzed lignin and lignosulfonates.

Key words: cellulose, lignin, powders, surface modification, electron beam plasma (EBP) and hybrid plasma (HP).

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Computation of electromagnetic wave multiple scattering in one-dimensional diffraction gratings by the matrix Riccati equation method

Resonant scattering of a plane electromagnetic wave on one dimensional diffraction gratings is considered. Reflection spectra and spatially reflected field patterns are calculated using the matrix Riccati equation method for silver grating with triangular cross section and rectangular grating in silicon-on-insulator based structure with different parameters (period and height of the grating, oxide layer thickness).

Key words: diffraction grating, multiple scattering, Riccati equation, matrix reflection coefficient, inhomogeneous dielectric media, Wood's anomalies.

Htet Ko Ko Zaw, Zaw Ye Myint, T. M. Vasilyeva

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Beam plasma technologies for producing chitooligosaccharides with phytostimulation properties

A possibility to obtain chitooligosaccharides using electron-beam plasma (EBP) and confirming their phytostimulating activity is experimentally investigated. In this case, we observe the threshold dependence that connects the degree of degradation of the polymer with the duration of the beam plasma action, which allows one to optimize processing and eliminate the unproductive energy consumption. Low molecular water soluble products of chitosan EBP destruction have the properties of plant growth stimulants.

Key words: electron beam plasma of oxygen, chitin and chitosan, chitooligosaccharide, phytostimulating activity, destruction of biopolymers, active form of oxygen.