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Generation of electron beam plasma near the surface of conductive and dielectric disks

Beam-plasma formations that occur near the surface of metal disks and metal disks with dielectric coating when irradiated with a continuous or intermittent electron beam were experimentally investigated. As a plasma-forming gas, air was used, the pressure of which varied within the range of $10^{-1} - 2 \cdot 10^1$ Torr. As a result of processing of optical images of Beam-plasma formations, the influence of gas pressure on the geometry of plasma clouds and their location relative to the disk surface was found. The study of the transient charging/discharging of disks showed that the front and rear edges of the electrical signal (disk potential relative to «earth») from the disc with a dielectric coating differed significantly from the shape of the fronts from uncoated metal disks.

Key words: electron beam plasma, interaction of plasma with the surface of matter, electrostatic charge of bodies in plasma.

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Evolution of a quantum package in the stationary accelerating potential

The solution of a Schrödinger equation in the form of the generalized Gram-Charlier series for the any time independent accelerating potential, not time-dependent is obtained. Quantum amendments for driving time of electrons are found. The expression for a minimum duration of a quantum package when driving in this potential is obtained. It is shown that in the course of driving the duration of a package can become shorter, than the calculated one by the indeterminacy relation «energy–time».

Key words: Schrödinger equation, Gram–Charlier series, Hankel function, Airy functions, Gamma function.

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About violation of the time–energy uncertainty relation in a task of driving electron impulse in the accelerating field

It is shown that in the course of driving duration of a package can become shorter, than calculated on an Uncertainty Relation Time–Energy.

Key words: Schrödinger Equation, the Principles of Indeterminacy in a Quantum Mechanics.

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Electron beam plasma processing of powders and chitosan solutions: possibilities and technological approaches

Approaches to the controllable processing of chitosan powders and solutions using of low temperature Electron Beam Plasma and Hybrid Plasma are described. Watersoluble chitooligosaccharides with weighted-average molecular mass $M_w \sim \sim 600$ Da and polydispersity 1.5 are formed by the plasma chemical treatment of original chitosan. Advantages of plasma chemical technologies based on electron beam plasmas over conventional chitosan methods are considered too.

Key words: electron beam plasma, hybrid plasma, chitosan, plasma stimulated processing, green technologies.

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Experimental test of the ability to detect weather patterns by a new landing radar

The paper examines a possibility to use a new landing radar (PRL) developed by «NIIDAR» to detect clouds and determine precipitation intensity based on the use of the energy characteristics of reflected signals. A brief description of the method, the methodology of the experiment and its results are given. Problems arising in the practical implementation of the new method are considered. The conclusion of a possibility of its use of a radar for the detection and classification of meteorological events is made. The capture range is extended by the wave propagation model.

Key words: landing radar, precipitation intensity, signal energy characteristics, signal processing, hazardous weather detection.

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Specific features of the combustion of rich hydrogen air mixtures

Hydrogen is a promising and ecological fuel. Hydrogen is a simple diatomic gas but its combustion and detonation processes are not well understood yet. It generates a lot of dispute in the scientific community. The combustion of rich model hydrogen air mixtures at initial temperatures of 20°C is considered in this paper. The results of experiments in the pipe 1 m long with inner diameter of 66 mm are presented. In combustion of mixtures with a hydrogen concentration from 77% to 78% we discover the effect of existence of two pressure maxima. The theoretical explanation proposed.

Key words: combustion, hydrogen, chain-branched reaction mechanism, hydrogen-air mixtures.

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Influence of the geometric shape of an ITO semiconductor nanoparticle on optical plasmon sensor sensitivity

The effect of the shape of an ellipsoidal semiconductor nanoparticle of indium tin oxide on parameters of surface plasmon resonance arising on these nanoparticles is considered. The sensory properties of the optical a plasmon sensor, which can be implemented on their basis, are calculated. It is shown that the sensitivity of this sensor is proportional to the semiaxis of the ellipsoid along which the incident radiation polarization is directed.

Key words: semiconductor nanoparticle, indium tin oxide, ITO, plasmon resonance, optical plasmon sensor.

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Investigation of semiconductor nanospheres, nanoellipsoids and nanorods in terms of possible applications in optic plasmon sensors

We devote our work to the theoretical investigation of optic properties in sensor materials based on semiconductor nanoparticles. In particular, we present a physico mathematical model of radiation absorption by materials based on nanospheres, nanoellipsoids and nanorods. We assess various ITO, ZnO and Sn in semiconductor state nanoparticles with various shapes in terms of sensor application. We consider and compare the sensitivity of materials based on these nanoparticles.

Key words: semiconductor nanoparticles, localized surface plasmon resonance, optic sensors, nanoellipsoids, dipole approximation, absorption cross section.

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Normal extensions of semigroups and embeddings of semigroup C^* -algebras

The article deals with the normal extensions of cancellative abelian semigroups and the reduced semigroup C^* -algebras. For a normal extension generated by one element of a semigroup, we consider two reduced semigroup C^* -algebras defined by this extension. It is shown that there exists a natural embedding of the semigroup C^* -algebras.

Key words: cancellative semigroup, extension of semigroup, normal extension of semigroup, exact sequence, reduced semigroup C^* -algebra, Toeplitz algebra, embedding of semigroup C^* -algebra.

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Selfsimilar reduction of the difference differential equation to study its asymptotics

The paper compares asymptotics of the solution of the difference differential analogue of the Korteweg–de Vries–Burgers equation which describes new technologies diffusion in the shumpeterian dynamics model and the solution of the continuous version of this equation obtained by the selfsimilar Fermi–Ulam reduction.

Key words: difference differential equation, selfsimilar reduction, asymptotics of the solution, technologies diffusion, shumpeterian dynamics.

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Smart Monitoring technology for the remote monitoring of power, gas, water and thermal energy consumption in Smart City

The paper describes the technology of remote collection of detailed data (Smart Monitoring) of the consumption and quality of energy resources in the public services. In this paper under energy resources (hereinafter referred to as resources) imply electric power, water (hot and cold), heat and gas. The data of the resource quality refers to the parameters characterizing the resource consumed. We also present an option of the data acquisition system structure based on Smart Monitoring technology. Particular attention is given to security in the system and centralized management of its elements. The data flow in this system carries information of the behavior of energy consumers and the household equipment they use. Energy consumption data for billing purposes in this system is just one of many and not the most important features. The development of Smart Monitoring technology is aimed to develop the market of IT services and mass services based on the analysis of the collected detailed data of energy resources consumption.

Key words: remote monitoring, energy consumption, detailed data, NILM, IoT, Big Data, Smart Meter, Smart City.

A. E. Mazur

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On weak convergence of the tail empirical process for copula time series

In the literature of statistics of extremes the conditions used to obtain the results of weak convergence of the tail empirical process for dependent sequences are given. In the model of time series with heavy tails constructed by the transformation of the Gaussian time series with Gaussian description of dependency we can show that the conditions, which are technically difficult to check in practice, could be replaced by easily checked conditions on decreasing of the correlation function of time series.

Key words: Gaussian sequence, maximum domain of attraction Fréchet, empirical quantile function.

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Development of a text-mining program for analysis of documentation on the disposal of radioactive waste problem

The program of contextual and thematic analysis of documents is presented. The program processes documents in PDF format, builds a reverted index of corpora, and other service information, which allows the user to search for fragments of text that meets the entered query or selected topic. In case of the topic search, the program searches for texts similar to the training examples. The thematic analysis of the text corpora allows user to detect the presence or absence of those or other typical topics, assesses the completeness of the information provided.

Key words: natural language processing, semantic analysis, contextual search, machine learning.

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Adaptive gradient methods for some classes of nonsmooth optimization problems

We propose several adaptive algorithmic methods for problems of non-smooth convex optimization. The first method is based on a special artificial inexactness. For its implementation the corresponding analogue of the concept of an abstract inexact model of the objective functional is proposed. For this concept, analogues of gradient and fast gradient methods with adaptive tuning of some parameters of this model are proposed and an assessment of the quality of the solution is obtained. It is shown that it is possible for nonsmooth problems to modify the proposed method to guarantee the convergence in the function with a close to optimal rate. A similar concept of an inexact model is introduced for variational inequalities and saddle point problems. Estimate of the convergence rate of the corresponding adaptive version of the proximal mirror method is presented. Analogues of switching subgradient schemes are proposed for convex programming problems. In this case, assumptions close to the recently proposed condition of the relative Lipschitz continuity are considered, which allows us to obtain an estimate of the quality of the solution with relative accuracy for the problem of minimizing a homogeneous convex functional using fairly general assumptions.

Key words: gradient method, fast gradient method, adaptive method, Lipschitz continuous gradient, nonsmooth optimization, mirror descent, relative Lipschitz continuity, relative accuracy.

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Numerical study of dynamics of a celt on a horizontal plane with viscous friction

The problem of the motion of a celt on a fixed horizontal plane with viscous friction is considered. On the plane of the parameters of the problem, stability regions of uniform rotations about the vertical are constructed. Numerical studies of the full-size model of a celt are carried out in various initial conditions.

Key words: viscous friction, celt, stability.

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Three-dimensional modeling of acoustic noise in wellbore induced by the source in reservoir

We consider three-dimensional modeling of wellbore acoustic fields induced by the fluid flow noise in the reservoir. The goal is to develop highly accurate mathematical models to improve the quality of interpretation of acoustic noise logging data for oil and gas producing wells. Using the spectral element method, we simulate acoustic fields in wellbore, analyze their spatial frequency patterns and the fine structure of the resulting 3D resonance modes. In the axisymmetric case we compare the results with the previously found solution simulated by the two-dimensional finite-difference algorithm.

Key words: passive acoustic noise logging, noise induced by fluid flow in reservoir, acoustic resonance, spectral element method.

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Engineering method of determining the most important engineering product attributes as the basis for identification of critical technologies

For this purpose the authors develop an engineering method, improved quality function deployment (QFD) for Improved House of Quality». It is proved that it allows users to successfully overcome five drawbacks of classical QFD, including identification of user needs, prioritization of customer requirements more accurately than the classical QFD does, and also to solve problems of Model-Based Systems Engineering, including reduction of time spent on SysML (Systems Modeling Language) diagrams development from several days to some minutes using widely available software.

Key words: QFD, iQFD, HoQ, iHoQ, MBSE, SysML, systems engineering, method, needs, requirements, prioritization, digital twin.