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Robust software design for nanosatellites with single board computer

In this paper, we will present our approach to solving the problem of lacking a rigorous and reliable way to develop robust software for nanosatellites, which is based on the usage of the Behavior Interaction Priorities (BIP) framework. We also discuss a possibility to use it in single board on board computers and resolve difficulties and challenges arising in testing and simulations.

Key words: nanosatellites, rigorous approach, BIP framework.

V. V. Kien

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Transmission of two component codes over the binary memoryless symmetric channel

The system transmission of two component subspace codes over the binary memoryless symmetric channel is considered. The simulation program Matlabis is conducted. Decoding is performed according to the Hamming distance minimum principle. The obtained characteristics are the relative frequency of events, viz. erroneous solutions, correct decisions and rejections. Theoretical calculations of probabilities of these events are carried out. Comparison of theoretical and experimental modeling data is made.

Key words: binary symmetric channel, subspace code, rank code, two-component codes, decoding.

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Tasks of optimal control of per capita consumption with the equation of connection for the capital labor ratio

The optimization problem of maximizing the integral discounted utility of consumption with the equation of relation for the capital labor ratio which follows from the Solow economic growth model is considered. As you know, Solow builds his model on the basis of the Cobb-Douglas production function. However, other production functions are widely used in mathematical models. Statistical studies show that in practice both the Cobb–Douglas production function and other well-known production functions describe the dependence of national economic productivity on the capital labor ratio only approximately. Therefore, of particular interest is the formulation of optimization problems in which the equation following from the Solow model acts as a communication equation for the arbitrary nature of the dependence of the national economic productivity on capital labor ratio. It is in this form that the coupling equation, the following from the Solow model, is a convenient tool for economic research. The development and study of such productions are the goal of this paper.

Key words: Solow model, economic growth, capital labor ratio, per capita consumption, marginal utility, aversion to risk.

D. A. Pasechnyuk

Presidential Physics and Mathematics Lyceum № 239

Scheduling strategies for resource allocation in a cellular base station

The problem of scheduling the (time) resource allocation of a base station (cell tower) that interacts with clients (users of wireless mobile devices with Internet access) and servers from which they download web pages (files in general) is studied.

Key words: automated scheduling, scheduler, cellular base station, index strategies, computational experiment.

A. K. Skiba

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Finding in the model of gas fields the maximum length of their common «shelf»

A continuous aggregated dynamic model of the gas fields group is considered. The problem of maximizing the length of the common «shelf»of gas fields is posed and solved. The proposed problems belong to a class of optimal control problems with mixed constraints with nonfixed time and movable right end. The main mathematical apparatus is the Pontryagin maximum principle in Arrow form, which uses Lagrange multipliers. The obtained results are analyzed.

Key words: optimal control, Arrow proposition, gas field model, nonfixed time, movable right end.

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Using navigation spectra for Internet media sites classification

Recommendation systems play an important role in the modern Internet, providing users with the information they need. The development of recommendation systems requires both an understanding of user behaviour and continuous improvement in the quality of the information provided. In this paper we demonstrate how the use of the method of navigation spectra can significantly improve the quality of media sites classification. We describe how the application of this method allows us to build whitelists of media sites for more than a hundred countries. These lists are later used in the real recommendation system.

Key words: internet analysis, user behaviour, internet navigation, web sites classification, recommendation systems.

L. H. Pham

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Codes in the term rank metric

This paper investigates codes with term rank distance. These codes can be used to correct row and column errors in the $(M \times N)$ matrix. These errors can be found in memory chip arrays, magnetic tape recordings or in the parallel channel system with interference. In this paper, we discuss the new construction of boundary rank codes. This paper describes the single error correcting codes in the term rank metric and create a generator matrix and a parity check matrix for term rank codes.

Key words: term rank metric, parallel channel system, term rank distance, finite field, binary matrix, parity check matrix, generator matrix.

O. O. Khamisov

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Disturbance approximation based frequency control

Frequency control in power networks is one of the most significant problems. Frequency is an indicator of power balance in power network and any imbalance leads to frequency deviations from the nominal value (50 Hz), which can lead to equipment damage or complete power network shutdown. A new frequency control scheme based on the disturbance approximation is presented in this work. Numerical experiments show that the developed control scheme is more effective than the one currently used as it provides better frequency convergence to the nominal value in the case of an imbalance.

Key words: power systems,frequency control, linear system stability, stability to a part of the variables computing experiment.

A. E. Khuzieva

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On the strong colorings of a random 4-uniform hypergraph

The paper deals with the problem of estimating the probability threshold for the property of the strong colorability for a random 4-uniform hypergraph in the binomial model $H(n,4,p)$. A coloring of the hypergraph vertex set is said to be strong if any two vertices $u \neq v$ that are contained in the same edge, are given different colors. We estimate the probability threshold of the existence of a strong coloring with r colors for $H(n,4,p)$. The threshold corresponds to the so called sparse case when $p = cn/\binom{n}{4}$ for fixed $c > 0$. We prove that for $c \leqslant \frac{r\ln r}{6} - \frac{13}{36}\ln r - \frac{1}{6} - r^{-1/9}$ the random hypergraph $H\left(n, 4, \frac{cn}{\binom{n}{4}}\right)$ is strongly r-colorable with r colors with probability tending to 1 as $n \to \infty$.

Key words: random hypergraphs, coloring of hypergraphs, strong coloring, strong chromatic number, second moment method.

V. A. Astapenko, E. V. Sakhno

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Excitation of the 0→1 transition in a quantum oscillator under the action of an electromagnetic pulse of the Gaussian form

The paper is devoted to the study of the features of excitation of a harmonic quantum oscillator without damping by electromagnetic pulses, with account taken of nonlinear effects. The dependences of the excitation probability of the 0→1 transition on duration and carrier frequency are studied for various amplitudes of the electric field of a Gaussian pulse. It is shown that for small values of the electric field, the dependences have a single maximum. Increasing of the electric field amplitude leads to a transition of this maximum to a minimum with simultaneous appearance of two new maxima.

Key words: quantum oscillator, probability of quantum transitions, Gaussian pulse.

V. A. Burtelov, A. V. Kudryashov, E. P. Sheshin, Huda Khalid khameed Majmaa

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Compact sources of X-Ray radiation

A brief review of the history of the discovery and the first stages of the study of the properties of X-rays is made. The early stage of practical application is illustrated by historical examples. The key properties of X-rays and engineering directions of their application are compared in compressed form. The main stages of the improvement and technical specialization of X-ray tubes, some of their fundamental limitations as compact X-ray sources are shown. A brief survey of current state standards in Russia concerning x-ray tubes and some other compact X-ray sources is given. Compact X-ray sources, alternative to X-ray tubes, based on linear and cyclic accelerators, parametric radiation, plasma, laserelectron, isotope and pyroelectric, are considered. Key properties, operating principle and examples of execution are described.

Key words: X-ray radiation, characteristic radiation, bremsstrahlung, electron emission, ionization, Compton effect, pyroelectric effect, massive anode, prostrelny anode.

Ye Hlaing Htun, Aung Kyaw Oo, M. N. Vasiliev

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Experimental study of electrophysical properties of electron beam plasma generated near the surface

Electron Beam Plasma (EBP) generation near the surface of solid bodies and liquids is studied experimentally. Conductive and dielectric materials are used as subjects of beam plasma action and various molecular gases (air and its components, noble gases, gaseous hydrocarbons) are plasma generating media. Plasma generation is studied in a wide range of the gas pressure $10^{-1} - 20$ Torr. Peculiarities of plasma clouds near the surface of thermionic ceramics are detected. Material evaporation from the target surface contacting with the EBP is found to significantly influence the plasma cloud shape and its luminescence.

Key words: electron beam plasma, plasma surface interaction.

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Determination of the elasticity and strength characteristics of the composite material of shell structures

Methods and methods for determining the complex characteristics of the elasticity of the composite material of cylindrical shells are considered. Methods for determining the elastic moduli in axial circumferential and radial directions and poisson's ratio are discussed when testing shells and tubular samples.

Key words: shell, composite material, elastic characteristics, methods of determination.

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Surface design of the wing with horizontal tail in transonic cruise flight

The method of profiles design of the wing and horizontal tail configuration is considered. The minimum induced and wave losses in balanced transonic cruise flight for a fixed lift coefficient and Mach number are achieved. The wing and tail plan forms and thickness distribution are constant. The method consists of the direct aerodynamic calculation of the wing tail configuration based on the solution of a full velocity potential equation, analytical approximation of the wing sections profiles and the extremum seeking algorithm. The target function is the product of the maximum local Mach number and the induced drag of the wing tail configuration. The results of designing the wing tail configuration for a typical passenger aircraft are show.

Key words: transonic cruise flight, wing tail configuration, extremum seeking