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SOLITONS IN AN EXTENDED NONLINEAR SCHRÖDINGER EQUATION WITH THE PSEUDO-RAMAN SCATTERING AND NONLINEAR DISPERSION

Purpose: Evolution of solitons is addressed in the framework of a third-order nonlinear Schrödinger equation (NLSE), including nonlinear dispersion and a pseudo-stimulated-Raman-scattering (pseudo-SRS) term, i.e., a spatial-domain counterpart of the SRS term which is well known as a part of the temporal-domain NLSE in optics. In this context, it is induced by the underlying interaction of the high-frequency envelope wave with a damped low-frequency wave mode. Also spatial inhomogeneity of the second-order dispersion (SOD) is assumed.

Approach: The investigation was considered as analytically as numerically.

Findings: As a result it is shown that the wavenumber downshift of solitons, caused by the pseudo-SRS, can be compensated with the upshift provided by decreasing SOD coefficients. The soliton is stable in negative nonlinear dispersion case and unstable in positive one. Analytical results and numerical results are in a good agreement.

Key words: Third-Order Nonlinear Schrödinger Equation, Soliton, Stimulated Scattering, Inhomogeneous Second-Order Dispersion, Nonlinear Dispersion.

A.V. Aristov, V.P. Zelenskii

INTERACTIVE APPLICATION INTEROPERABILITY IN A NETWORKED ENVIRONMENT

Subject: The subject of this study is the open computer systems architecture.

Purpose: The aim is to create application interfaces model, which reduces the cost of creating complex information systems.

Design/methodology/approach: A theoretical framework is proposed based on methodology of open systems in computer science, cross-platform data formats and UML.

Findings: The results can be applied to the design and researching of scalable, extensible integrated information systems whose components operate on different hardware and software platforms.

Research limitations/implications: The present study provides a continuation and development methods of constructing integrated information systems in a networked environment.

Originality/value: Model describing application interfaces, which can be used in the construction of complex interactive systems, with interoperability of their components was proposed.

Key words: heterogeneous environment, semantic interoperability, models, hypervisor, virtualization.

M.A. Kalinin, V.Y. Karpychev

METHODS OF OPTICAL FLOW ESTIMATION FOR 3D SCENE ANALYSIS

Purpose: This article considers the problem of restoring 3D structure of the scene by using the properties of optical flow. We also discuss the application of different methods of optical flow estimation for given problem.

Design/methodology/approach: This article provides an introduction to mathematical basis of differential methods of estimating optical flow.

Research limitations/implications: The present study provides a starting-point for investigation of possibility of improving this result by using of Lucas–Kanade method.

Originality/value: In scope of this study, we have obtained a pretty much stable result for Farneback algorithm for all points on the scene

Key words: computer vision, optical flow, Lucas–Kanade method, Farneback method.

T.V. Kozhevnikova
WAVEGUIDE LOAD COMPUTATION ON THE BASIS OF SHORT CIRCUITED
RECTANGULAR
VOLUME ABSORBING LOADED WAVEGUIDE SEGMENT

Purpose: It is to compute the volume absorbing waveguide load reflection coefficient.

Design/methodology/approach: The collocation method has been used to solve the problem of wave diffraction at the junction of a hollow rectangular waveguide and a lossy partially filled waveguide.

Findings: Algorithm computing techniques have been stated. Precision of solutions with the help of the developed algorithm has been researched. The paper shows frequency dependence of the dominant wave reflection coefficient on the waveguide load in different conditions.

Research limitations/implications: This research is the basis to develop the computation of longitudinally inhomogeneous lossy systems by the collocation method.

Originality/value: Computation methods have been proposed to coordinate a lossless system and a longitudinally inhomogeneous lossy system.

Key words: waveguide, volume losses, reflection coefficient, LM- waves, complex solutions, collocation method.

A.N. Moshkova, E.I. Erlykina, Yu.I. Tsarapkina, A.V. Bolonenkov, Ya.Yu. Kozlova
USAGE OF EMPIRICAL DEPENDENCES FOR PROGNOSTICATION
OF HYPOXIC PRECONDITIONING OPTIMAL REGIME IN TERMS
OF BRAIN GLYCOLYSIS INDICATORS ANALYSIS

Objective: Prognostication of hypoxic preconditioning optimal regime on the example of the analysis of quantitative relationship between the indices of glucose, lactate and pyruvate in rat brain in development of animals' adaptation to oxygen regime violation.

Methodology: the current study solves the problem of curve selection to approximate dependent ratios of animal brain glycolysis under hypoxic influence of 310 mm Hg, 60 minutes duration, within 1, 4, 7, 14 and 28 days. The evaluation and analysis of the effectiveness of hypoxic preconditioning steps, promoting formation of resistant animals' adaptation to severe hypoxia have been conducted.

Results and field of application: optimal short-term preconditioning has been established to belong to interval of 4-7 days. The optimal long-term regime of hypoxic preconditioning is for 28 days. Development of an adaptive state of experimental animals, with 7-day preconditioning and long-term 28-day hypoxia was confirmed by additional experiments in the flow-type pressure chamber at atmospheric pressure of 145 mm Hg. for 10-30 minutes. Rat mortality in this case was 50%, indicating the formation of persistent adaptation to an extreme violation of the oxygen regime. The obtained results can be recommended for the development of non-drug methods of brain adaptation to severe hypoxia.

Resume: Mathematical analysis of the quantitative relationship between the experimental parameters in the brain of animals in different conditions of hypoxic preconditioning allowed to determine the best regimes of short-term and long-term preconditioning, which should be used for the rehabilitation of the brain to the adverse effects of the environment, dangerous for vital activity of the body.

Key words: glucose, lactate, pyruvate, hypoxic preconditioning, statistical analysis.

O.V. Matysik
**THE ITERATION METHOD OF IMPLICIT TYPE FOR SOLVING OPERATOR
EQUATIONS IN HILBERT SPACE**

Purpose: Suggest regularizing algorithm for ill-posed problems, study its properties and to compare it with the previously known methods.

Design/methodology/approach: To construct the iteration method used is the most common of the currently known approaches to solving ill-posed problems - an approach based on the entered academician A.N. Tikhonov regularizer concept, as well as the general theory of ill-posed problems, the theory of functional analysis and computational mathematics.

Findings: Designed and studied effective implicit iteration method for ill-posed problems described by operator equations of the first kind.

Research limitation/implication: There are some unresolved questions - the study of convergence of the method in the case is not exactly given operator.

Originality/value: The research results can be applied for solving applied incorrect problems encountered in economics, spectroscopy and tomography, geophysical, engineering and management.

Key words: Implicit iteration method, regularization, ill-posed problem, Hilbert space, operator equation of the first kind, self-adjoint operator, the energy norm.

P.A. Shagalova, E.S. Sokolova, T.G. Shcherbatyuk, M.I. Yashanova
**RECOGNITION OF CRYSTAL STRUCTURES OF THE BLOOD PLASMA
BASED ON CONVOLUTIONAL NEURAL NETWORK**

Purpose: Researching of convolutional neural network for recognition of crystal structures of the blood plasma.

Design / methodology / approach: Application of artificial neural networks.

Findings: Implement of neural network system for detection of crystal structures used for diagnosis of diabetes.

Research limitations / implications: current research is used for detection of patterns of crystal structures of biological fluids.

Originality / value: The ability to use of the offered approach for automation of method based on analysis of crystal structures of biological fluids.

Key words: convolutional neural network, computer vision, crystal structure, biological-LIC fluid.

I.A. Shemarulin, V.Y. Karpychev
RECOGNITION OF ROAD SIGNS ON THE BASIS OF COLOR CONTOURS

Purpose The alternative traffic sign recognition algorithm on the basis of color contours is described. The general algorithm of detection of road signs on the image is proposed.

Design/methodology/approach A theoretical framework is proposed based on the analysis of RGB and HSV color models and the use of mathematical morphology to improve the quality of the analyzed image.

Findings The assertion that the use of the RGB color model is most applicable solution of the problem of recognition of road signs confirmed by practical experiments. Detailed results are presented. The general algorithm of detection of road signs on the image is proposed as well.

Research limitations/implications Measurements of threshold values of red color at different times and in different weather conditions are given. It is necessary to consider the results obtained in the software development of the original problem.

Originality/value Moreover, the proposed algorithm is successfully implemented in practice in the scope of Traffic Sign Recognition system and has a number of technical advantages in terms of low resource consumption, highperformance computing and accuracy.

Key works: computer vision, neural network, color space, morphological operations, video signal.

**A.A. Basov, A.V. Kainova, M.M. Kuzma, M.A. Sybarev, I.V. Mineev,
I.S. Khudyakov, A.N. Yashina**

MODELLING OF A QUANTUM OSCILLATOR TASK

Purpose: The task of calculating a wave function describing the state of quantum oscillator poses considerable mathematic difficulties.

Design/ methodology/ approach: The authors developed a computer programme for counting Chebyshev-Hermite polynomials, which are the solution to Schrodinger equation for quantum oscillator.

Findings: The programme enables to represent the wave function and its squared absolute value (distribution in frequency) by a diagram.

Key words: Schrodinger equation, computer simulation, quantum harmonic oscillator, wave function, probability density, black-body radiation.

Gordeev B. A., Okhulkov S. N., Plekhov A. S., Titov D.Yu.

BEATS OCCURRING AT UNSTABLE SYNCHRONIZATION OF THE TWO ENGINES MOUNTED ON A COMMON VISCOELASTIC BASE

The object of study: In the article considered two main options of synchronization of two motors: synchronization on a fixed elastic base and synchronization with a vibrating base.

Objective: The article presents the results of experimental studies of the effects occurring at synchronization the two engines mounted on elastic foundation.

Results: Carry out spectral analysis and identify informative harmonic components that allow defining main harmonics generated by the vibration process.

Application field: in the system of shock damping of power electrical installations and mechanical equipment.

Key words: transitional process; synchronization; vibration; hydraulic support; experiment; low frequency beats; spectrum of vibrating processes.

G.I. Korobko, V.V. Lebedev, P.V. Akhlestin

DISTORTION COMPENSATION VOLTAGE IN SHIP NETWORKS WHEN POWERED SHIP RESPONSIBLE CONSUMERS

Conclusion: The above equivalent circuits of a ship uniform electropower system, allowed us to receive expression for calculation of the factor of nonlinear distortions of tension. An increasing the factor of the voltage booster equal to 6 and more, the factor of nonlinear distortion of tension is less than 2%.

Design/methodology/approach: Analytical computation.

Findings: The analysis shows that ship uniform electro power systems work at maximum permissible level of the highest harmonicas of tension. Use of the active compensator on the basis of the voltage booster allows to compensate effectively nonlinear distortions on the pure tire.

Key words: active compensator, the highest harmonicas, unified power system, «the pure tire», responsible consumers.

S.Y. Panfilov, A.I. Chivenkov, I.S. Panfilov, N.N. Vikhorev
**REQUIREMENTS FOR THE PARAMETERS OF
ELECTROMAGNETIC COMPONENTS DC CONVERTERS**

Purpose: This work aims to cover preliminary design problems of components of electromagnetic pulse voltage converters for electronic devices.

Design/methodology/approach: Synthesis of analytical expressions, allowing to make an indicative calculation of the DC/DC converters.

Findings: Analytical expressions adjusting characteristics for various modes of converters DC and expression, allowing to define the parameters of single-ended converters of various types corresponding to the boundaries of operating modes.

Research limitations/implications: The design of the power unit with a power supply of electronic equipment.

Originality/value: A selection method for electromagnetic components of magnetic circuits in the required volume subject private hysteresis cycles of their work, are given the necessary mathematical expressions.

Key words: inductor, transformer, single-ended converter, magnetization and demagnetization of the core transistor, residual induction, magnetization loop, the volume of the core.

S.V. Khorkov

THE DEVIATION FROM THE LINEAR CURRENT FLOW IN AN ORDERED TWO-DIMENSIONAL ENVIRONMENT

We investigate the impact of specific areas of periodic two-dimensional environment on its nonlinear effective conductivity. It is shown that the distribution of local currents and fields substantially depends on the ratio of the linear conductivities of the components. This dependence leads to the divergence of the correlator to the fourth power of the field and, hence, to divergence of the response function associated with the correlator. Defined value of the ratio of the linear conductivities of the component at which the effective nonlinear conductivity of the studied environment detects a peculiarity in the behavior.

Key words: inhomogeneous conducting structures, percolation, conductivity, nonlinear conductivity.

I.K. Kozlov, A.S. Trofimov

RESEARCH AND OPTIMIZATION OF THE HEATING PROCESS RESISTANCE BUTT WELDING

Purpose: The study of metal heating and deformation process when forming a join by the butt resistance welding method.

Approach: The results of the welding process monitoring are introduced, including registration and measuring of the actual welding current data and the sequence diagram, also the results of the study of metal heating and plastic deformation process.

Findings: Heat penetration zone uprising over the limit values leads to a shift of the intensive plastic deformation area away from the butt, in the butt area a braking area is formed, and no quality weld join is formed by solid phase.

Research implications: The obtained research results demonstrate the new optimization method of butt resistance welding technological process. The method is based on the thermal deformation state of the thermal-mechanic effect area modeling.

Value: A mathematic model of the components thermal deformation state in the resistance butt welding process was designed, that made the modeling process possible.

Key words: resistance welding, registration processes, thermal deformation, welding chains.

L. Yu. Kondratieva

DETERMINATION OF THE MAIN CHARACTERISTICS FOR PATROL SWATH AT THE EARLY DESIGN STAGES

Purpose: The specific dependents for determination of the main characteristics of patrol ships with small waterline area have been developed in this article.

Design/methodology/approach: The regression formulas were derived by using the statistical method in this paper. The investigation on the basis of statistical data 1999-2015 years have been conducted .

Findings : The vessel with a small area of the waterline has an atypical relations of the main dimensions, and regression formulas, obtained in this article, can help at the early stages of design to determine the geometrical characteristics of ships designed for patrolling of sea borders The derived formulas significantly reduce the time to work with vessels prototypes early in the design.

Originality/value: Regression dependence for the passenger SWATH have been proposed in and the similar formulas for traditional patrol ships have been developed. In published some statistics data about patrol SWATH, but the dependence for calculating of the the main dimensions was not done there. Consequently the investigation of obtaining of regression relationships are actuality.

Key words: statistical data patrol vessel, vessel with small waterline area, main dimensions.

**Z.A. Kostrova, A.V. Miheev, D.V. Zeziulin, V.S. Makarov,
E.V. Kolotilin, M.E. Bushueva, V.V. Belyakov
THE EVOLUTION OF THE WHEEL**

This article describes the evolution of the wheel - from the first wooden roller to nowadays developments - non-pneumatic (airless) tires. The aim of researching of evolution of the wheel is systematization of all available information about appearance of the first wheel, the wheel stages of development; consideration of the wheel as a means of technological progress and as a result of the development of society; compilation of conditional classification of all existing types of wheels.

Key words: wheel, evolution of the wheel , first car pneumatic wheel , Robert Thompson, J. Dunlop, metallelastic wheels , sprung wheel , airless tire , granulated wheels , radial and bias tires, spherical wheel, custom wheels, wheel rovers, spherical mono - wheel robot, square wheel, wheel ellipsoidal, non-pneumatic (airless) tire, wheel classification.

**Z.A. Kostrova, A.V. Miheev, D.V. Zeziulin, V.S. Makarov,
E.V. Kolotilin, M.E. Bushueva, V.V. Belyakov
HISTORICAL ENGINEERING CHANGE OF THE WHEEL
AS A PROP – TRACTIVE SYSTEM OF ELEMENTS OF A VEHICLES MOVER
IN THE ASPECT OF USING MATERIALS**

This article describes the engineering change of the wheel as a system of elements - from the first wooden rinks to the developments of polymers chemistry - non-pneumatic (airless) tires, and changes of each component of the wheels in a historical context also. The aim of this reserch is systematization of the information about the causes and preconditions of changing of the material elements of the wheel depending on the changing requirements of the external environment, depending on the technological progress and the impact of these changes on technological progress.

Key words: the wheel, the engineering change of the elements of the wheel, disc wheel, spoke wheel, the first pneumatic tire, wooden wheel, pair of wheels, a vehicle wheel pair, a steam machine Cuneo, Richard Tretvik, pneumatic tyre, metal tyre, hub, disc, treadmill, metallelastic wheels, sprung wheel, Fordson, granulated wheels, airless tire, Lambert's tire, radial and diagonal tyres, spherical wheel, magnetic suspension, wheel Rovers, the Rovers wheel, nonpneumatic (airless) tires.

**V.V. Lomakin, A.A. Shabanov
SELECTION CRITERIA OF THE MAIN PARAMETERS OF HYBRID
CARS POWERTRAIN IN THE DESIGN**

The selection criteria of the powertrain parameters and problems faced by foreign and domestic manufacturers of hybrid cars were considered.

Key words: powertrain, hybrid car, static coefficient.

S. N. Нагорных, E. V. Нагорных
RANDOM COMPONENT OF THE SPEED OF ROTATION OF THE SHAFT
INTERNAL COMBUSTION ENGINE WITH THE SPARK PLUGS

A random component of crankshaft engine rotation velocity is measured. The probability density of rotation velocity is found. It is approximated by the stationary solution of Fokker-Plank equation. The critical parameters of noise-induced transitions of a spark plug and an engine under operating conditions are given. A random component of rotation velocity is characterized by the statistic delay of a spark plug ignition by stimulated (exoelectron) emission of the cathode. The measurements are made for VAZ 11183 engine performed in the stationary idle running. The standard spark plug ignition is used. The measurement error of the engine rotation velocity by aboard computer comes to ± 5 revolutions per minutes. The measurement results of a random component of crankshaft rotation velocity may be used for construction and control of the engine operating conditions with primary idle running. Another application of the results is construction a new spark plug ignition.

Key words: crankshaft engine, rotation velocity, probability density, statistic time delay, spark plug ignition, exoelectron emission.

A.C. Pavlov, N.M. Vanushkin
MULTILAYER WELD FORMATION WITH DIRECTIONAL GAS JET
BY WELDING IN THE SLOTTED EDGE PREPARATION

Purpose: To study the possibility of obtaining the quality welded joint of thick-walled pipes with the slotted edge preparation by the new process providing the multilayer weld formation weld necessary form.

Approach: An experimental study of the process of obtaining the quality welded joint with the slotted edge preparation using automatic argon-arc welding with additional directional gas jet has been performed.

Findings: The welding torch for this welding method has been developed. Processing of the experimental results by means of metallographic studies has been carried out also mathematical models based on relation between size weld and the parameters of the welding method have been made.

Research implications: This study has shown the influence the main parameters of the welding conditions as well as changes of size and positions of the gas nozzle on the layer formation of the joint.

Value: The proposed welding method provides obtaining of higher quality indicators of welded joint and is easier to implement than current welding methods.

Key words: slit edge preparation, directional gas nozzle, depth of penetration, thickness of interlayer liquid metal, automatic welding in shielding gases.