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MATH MODELING. METHODS AND SYSTEMS OF INFORMATION PROTECTION, INFORMATION SECURITY

A. M. Gelfand

DOI 10.46418/2079-8199_2023_2_1

CONFIDENTIALITY, INTEGRITY, AND AVAILABILITY THREAT MODEL IN MESSAGE TRANSMISSION

Ensuring the security of information systems is a very important and urgent task. Nowadays cybercrime is constantly growing. Particular attention should be paid to the security of using information infrastructures. Up-to-date data on vulnerabilities and threats is often updated on the website of the FSTEC of the Russian Federation, but at the same time, each identified system has its own local vulnerabilities. Therefore, it is required to determine the model of violation of international security and the threat model. Basic models were found on the website of the FSTEC of the Russian Federation, but typical models are performed to ensure security and prevent successful attacks.

Keywords: information security, critical information infrastructure, object of critical information infrastructure, threat model.

E. N. Drozdova, D. V. Sopov

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DEVELOPING A HIGH QUALITY ANIMATION ALGORITHM WITH MINIMAL RENDER TIME

The article discusses the features of the algorithm for creating high-quality animations with minimal render time. The algorithm is based on the following set of techniques: slowing down video with drawing additional frames, suppressing noise and flickering in the image and increasing video resolution using neural network models. The features of each step of the algorithm are considered: a render with lowered parameters, reconstruction of missed frames, minimization of flickering, improvement with the help of neuroalgorithms. The results of the algorithm are discussed.

Keywords: video processing, render, animation, neuroalgorithms, noise suppression.

I. M. Egorov, E. N. Maksimov

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A VARIANT OF MATHEMATICAL SIMULATION OF RELAXATION OPERATIONAL PROCESSES OF MEDICAL TEXTILE ELASTOMERS

The article presents the most popular variant of mathematical modeling of the relaxation of textile elastomers used in implantology. On the basis of the proposed version of the mathematical model of relaxation, the corresponding parameters of this mathematical model were determined, which are essential for a qualitative assessment of the relaxation properties of the materials under study and for determining their functionality.

Keywords: research, mathematical modeling, elastomers, textile materials, relaxation properties, relaxation.

M. A. Egorova, S. V. Kiselev

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DEVELOPMENT OF METHODS FOR SYSTEMIC AND QUALITATIVE ANALYSIS OF OPERATIONAL PROCESSES OF ARAMID TEXTILE MATERIALS

The article discusses the methods of systematic and qualitative analysis of the operational processes of aramid textile materials. Knowledge of the viscoelastic characteristics of aramid textile materials for the intended purpose helps to make the best choice of materials with certain deformation properties. To determine the deformation characteristics of aramid textile materials, computer methods for the system analysis of their deformation properties are being developed.

Keywords: system analysis, mathematical modeling, textile materials, operational properties, aramids.

S. V. Kiselev

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THEORETICAL AND EXPERIMENTAL STUDIES OF OPERATION PROCESSES OF MEDICAL TEXTILE ELASTOMERS

The article deals with the issues of theoretical and experimental studies of the operation processes of medical textile elastomers, which are important for determining the functionality of these materials. A detailed step-by-step plan for conducting such studies is proposed and the technical characteristics of a representative group of polymeric textile materials used for the manufacture of medical elastomers for implantology are given.

Keywords: research, mathematical modeling, elastomers, textile materials, deformation properties, relaxation, creep.

N. S. Klimova

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CONDUCTING A QUALITATIVE ASSESSMENT OF THE PERFORMANCE PROPERTIES OF POLYMERIC TEXTILE YARNS

The article deals with the issues of conducting a qualitative assessment of the operational properties of polymer threads in order to produce products with increased competitiveness. A qualitative assessment of the operational properties of polymer threads is carried out on the basis of mathematical modeling, prediction and system analysis of the elastic, viscoelastic and plastic properties of these threads. To solve this problem, methods are also proposed for separating the total deformation and the mechanical work of deformation of polymer filaments into elastic, viscoelastic, and plastic components that are essential in determining their functionality.

Keywords: qualitative assessment, mathematical modeling, numerical prediction, textile materials, polymer threads, elasticity, viscoelasticity, plasticity.

A. A. Kozlov

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DEVELOPMENT OF METHODS FOR INVESTIGATION OF DEFORMATION PROCESSES OF MEDICAL TEXTILE ELASTOMERS

The article developed methods for studying the deformation processes of medical elastomers used in implantology. The fundamental relaxation processes and creep deformation processes are chosen as the main deformation processes of medical elastomers.

Keywords: mathematical modeling, elastomers, textile materials, deformation properties, relaxation, creep.

A. V. Mayorov

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ARCHITECTURE AND SOFTWARE IMPLEMENTATION OF THE SPACECRAFT DETECTION SYSTEM IN CORPORATE AND GOVERNMENT INFORMATION SYSTEMS BASED ON INTELLECTUAL ANALYSIS METHODS

The architecture generally consists of three levels of information processing: (1) the network and data layer, where data is collected and sent from multiple sources using specialized agents; (2) the level of pre-processing of information and security events, which includes components of correlation and indexing (MapReduce), data storage (NoSQL database) and their analysis; (3) the level of analytical processing of information and security events, where the search for anomalies and security incidents is performed.

Keywords: MapReduce, NoSQL, machine learning, deep learning, cloud technologies.

A. V. Maiorov, A. V. Krasov, I. A. Ushakov

DOI 10.46418/2079-8199_2023_2_9

A MODEL FOR REPRESENTING BIG DATA ABOUT COMPUTER ATTACKS IN NOSQL FORMAT

In this article, the initial design stage has been carried out, namely, the first scientific result has been performed - modeling of an intelligent intrusion detection system based on machine and deep learning. At the initial stage of modeling, threat models for RIS and threat models for the protected AI were compiled. Various mathematical methods and intellectual tools were used to formally describe and simulate the processes of detecting and countering unauthorized actions in computer systems.

Keywords: Intrusion detection systems, NoSQL, Machine learning, Deep learning, distributed information systems.

A. G. Makarov, A. V. Demidov, N. V. Pereborova

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SOLUTION OF THE PROBLEM OF INCREASING THE ACCURACY OF MATHEMATICAL MODELING OF THE OPERATIONAL PROCESSES OF POLYMERIC TEXTILE MATERIALS

The article considers the solution of the problem of improving the accuracy of mathematical modeling of the operational processes of polymer textile materials. This problem is solved on the basis of the proposed integral criteria for the adequacy of modeling the viscoelasticity of these materials. The criteria represent an estimate of the magnitude of the deviations of the values of the integral convolutions of the nuclei of relaxation and creep of polymeric textile materials from the theoretically substantiated single value. The less the value of the specified integral convolution differs from a single value, the more adequate the developed models of relaxation and creep, and, therefore, the corresponding numerical prediction of viscoelastic-plastic processes of the studied polymeric textile materials will be more accurate.

Keywords: degree of reliability, mathematical modeling, forecasting, textile materials, polymers, viscoelastic-plastic processes, accuracy criteria.

N. V. Pereborova

DOI 10.46418/2079-8199_2023_2_11

DESIGN OF MEDICAL TEXTILE MATERIALS WITH RECOMMENDATIONS BASED ON THE CRITERIA FOR QUALITATIVE ASSESSMENT OF THEIR PERFORMANCE PROPERTIES

The article is devoted to the development of recommendations for the design of textile materials for medical purposes. Recommendations are obtained on the basis of a qualitative analysis of the

performance properties of the studied materials, carried out in accordance with the developed criteria for evaluating their functionality.

Keywords: design, mathematical modeling, polymers, textile materials, implants.

N. V. Pereborova, Ya. S. Tomashevich, A. A. Kolodin

DOI 10.46418/2079-8199_2023_2_12

DEVELOPMENT OF METHODS FOR PREDICTION OF VISCOELASTIC MODES OF OPERATION OF POLYMERIC TEXTILE MATERIALS

The article deals with the issues of predicting the prediction of viscoelastic modes of operation of polymer textile materials. The mathematical models of viscoelasticity, the main of which are relaxation and deformation processes, are based on the spectral-time theory. The practical use of methods for confident prediction of viscoelastic processes of polymeric textile materials is simplified due to digitalization.

Keywords: digitalization, forecasting, polymeric textile materials, deformation properties, viscoelasticity.

E. N. Perevoznikov, E. V. Orlova

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DYNAMICS OF FINANCIAL PROCESSES OF DEVELOPMENT "MARKET BUBBLES" ON THE EXAMPLE OF MATHEMATICAL MODELS

Based on the mathematical model of Shcherbakov's monetary and financial system, the paper examines the dynamics of processes in the formation of "financial bubbles". The stability of the system is investigated. The conditions of instabilities leading to the formation of bubbles are obtained.

Keywords: modeling of financial processes, market bubbles, dynamics and instability.

A. S. Shakhova, T. A. Kravec

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MODELING OF THE ORGANIZATION OF THE MOVEMENT OF BUSES ALONG THE ROUTE

The article is discussed the organization of bus traffic along the route by the simulation modeling method. The model was developed and the simulation of the bus movement along the circular route of the city of Yuzhno-Sakhalinsk was carried out. The purpose of the simulation is to maximize profit by varying the number of buses on the route and the time between the arrival of buses.

Keywords: simulation modeling, effective solution, bus traffic management, circular route, time between arrivals.

N. V. Pereborova, A. I. Eremin, K. Yu. Shilov, A. V. Kosenko, E. Yu. Kochkin, A. F. Grebnev

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PLASTIC DEFORMATION INCLUDED IN PREDICTION OF DEFORMATION PROCESSES OF POLYMER MATERIALS

Methods for predicting the deformation processes of polymeric materials are based on the numerical solution of the integral constitutive equations of viscoelasticity of polymers of the Boltzmann-Volterra type, which do not take into account corrections for the irreversibility of the plastic deformation component and, therefore, can lead to significant prediction errors. To improve the accuracy of predicting the deformation processes of polymeric materials, it is proposed to introduce a correction to take into account the plastic component of deformation.

Keywords: polymeric materials, deformation processes, irreversible deformation, plasticity, prediction.

V. I. Wagner, V. D. Katushkin, E. O. Gretchenko, D. Avezov, A. V. Repsha, A. V. Parfenova

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SEPARATION OF THE DEFORMATION OF POLYMER MATERIALS INTO VISCOELASTIC-PLASTIC COMPONENTS

The deformation that occurs in polymeric materials can be conventionally divided into three components: elastic, highly elastic and plastic. The division of the total strain into components is considered a difficult task, due to their simultaneous occurrence and further development. Only by means of a physically substantiated analytical description of the studied rheology of polymeric materials in combination with the measurement of various deformation processes can one obtain information about the complex pattern of the distribution of material particles over relaxation times and delay times.

Keywords: polymeric materials, rheology, relaxation, creep, viscoelasticity, deformation.

A. G. Makarov, V. V. Evdokimov, K. S. Churkin, F. S. Ryzhov, M. G. Dobryakova, V. S. Matveev

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RELAXATION PROCESSES OF POLYMER MATERIALS FROM THE POSITION OF SPECTRAL THEORY

The relaxation times characterize the times of transition of "relaxing" particles of polymer macromolecules from one stable energy state to another. The nature of such transitions can be different. It is determined both by the rheology of the polymer material and by the magnitude of the applied strain or load. It can be explained, on the one hand, by conformational energy transitions inside the macromolecules of the material, when their shape changes during rearrangement, and on the other hand, there are shifts of macromolecules relative to each other or other changes generated by energy changes.

Keywords: polymeric materials, spectrum of relaxation times, relaxation.

CHEMICAL SCIENCES

M. S. Zavadskaya, Yu. M. Kachina, S. M. Kosolapova, I. N. Pyagai

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PROSPECTS FOR PURIFICATION OF ALKALINE MIXTURES OF FATTY ACID ESTERS BY CARBON DIOXIDE

In this work the main methods of purification of fatty acid esters from homogeneous alkaline catalyst used in their synthesis have been studied. The method of purification using carbon dioxide barbotage is considered in detail. Experimental study of the process of carbonization of the catalyst contained in FAEs for its subsequent removal was carried out. As a result of processing of the obtained data the optimum conditions for carbon dioxide barbotage of biofuel have been determined.

Keywords: biofuel, carbonization, barbotage, carbon dioxide, purification, fatty acid esters.

A. A. Kudinova, D. I. Gapaniuk, L. S. Rode, T. E. Litvinova, M. E. Poltoratskaya

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INFLUENCE OF THE POROUS STRUCTURE OF A CARBON SORBENT ON THE SORPTION OF ETHYL ALCOHOL FROM AN AQUEOUS SOLUTION

The sorption properties of highly porous activated petroleum coke and low-porous hydroanthracite have been studied using water-alcohol solution. The ultimate sorption capacity of ethanol for the two carbon materials is close and is 14 mol/kg. However the sorption efficiency at ethanol concentration less than 6 mol/L for hydroanthracite is lower than for activated petroleum coke. Ethanol sorption on hydroanthracite is better described by Freundlich model, and on activated petroleum coke by Temkin model. The sorption of ethanol on the carbon surface is physical process, and the Gibbs energy values are in the range from 5 to 3 kJ/mol.

Keywords: petroleum coke, hydroanthracite, Gibbs energy, Langmuir model, Freundlich model, Temkin model, Dubinin–Radushkevich model, specific surface area, sorption.

Sh. D. Nabotov, I. N. Ganiev, A. G. Safarov, H. A. Asimov

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ANODE BEHAVIOR OF ALUMINUM ALLOY AlZr0.1% ALLOYED WITH LITHIUM

The potentiostatic method in the potentiodynamic mode at a potential sweep rate of 2 mV/s was used to study the corrosion-electrochemical behavior of the lithium-doped AlZr0.1% aluminum alloy in the NaCl electrolyte medium. The dependence of the change in the potential of free corrosion on time for the initial alloy AlZr0.1%, and alloys with lithium show a mixing of the potential in the region of positive values. It is noted that an increase in the lithium concentration leads to a shift in the potentials of free corrosion, repassivation, and pitting formation to the region of positive values.

With an increase in the concentration of the chloride-ion in the NaCl electrolyte, a mixture is observed in the negative region of the values of the indicated electrochemical potentials of the AlZr0.1% alloy with lithium additives. An increase in the concentration of chloride-ion contributes to an increase in the corrosion rate of alloys, regardless of their composition. It is shown that lithium additives reduce the corrosion rate of AlZr0.1% aluminum alloy by 10% in NaCl electrolyte medium.

Keywords: aluminum alloy AlZr0.1%, bismuth, potentiostatic method, electrolyte NaCl, corrosion potential, pitting potential, corrosion rate.

S. A. Yakimov, A. V. Koksharov, E. V. Belykh

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THE EFFECT OF THE COOKING CONDITIONS ON THE RESIN CONTENT IN HARDWOOD SULFATE PULP

In laboratory conditions, the influence of the sulphate cooking conditions of hardwood chips from aspen, birch and mixture of aspen and birch (70:30) on the resin content in unbleached hardwood pulp was studied. Based on the results of laboratory experiments, it was found that the content of extractives in unbleached hardwood pulp correlates with aspen in chip mixture. Unbleached hardwood pulp from aspen have resin content less than unbleached hardwood pulp from birch.

Keywords: hardwood sulfate pulp, kappa number, white liquor consumption, content of extractives, birch, aspen.

AUTOMATION AND CONTROL OF TECHNOLOGICAL PROCESSES AND PRODUCTION

S. L. Gorobchenko, D.A. Kovalev

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METHODOLOGY FOR ASSESSING THE RELIABILITY OF SAFETY VALVES BY THE CRITERION OF EXPLOSION RESISTANCE

The problems of increasing the reliability of safety valves when working in conditions of accident development and post-accident condition are considered. It is shown that a new criterion for evaluating the operability of valves in these conditions should be introduced - the criterion of explosion resistance with an analysis of the mechanical model of safety valves installed on the pipeline. An algorithm for calculating the explosion resistance of safety valves using the maximum values of seismic resistance of the valves possible for these conditions of explosive pressure development is given. An example of calculating the destruction of various elements of a sodoregeneration boiler is shown and ways to improve the assessment of the explosion resistance of various valves are presented. The principles of the development of technical conditions for valves according to the criterion of explosion resistance are presented and the main points of the technical and economic efficiency of the application of the above methodology are shown.

Keywords: Safety valves. Explosion resistance. The criterion of explosion resistance. The algorithm for calculating explosion resistance. Mechanical model of the valve. Sodoregeneration boiler. Technical conditions for the selection of safety valves. Technical and economic efficiency of the application of the explosion resistance criterion.

V. S. Zurakhov, A. G. Makarov, K. N. Busygin

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PROBLEM STAGES OF DATA MODEL DESIGN

To manage information, information systems must:

- ✓ *know what information they have and its content,*
- ✓ *know that the information retrieved from the database fully satisfies the request,*
- ✓ *be able to exchange data between organizations and other information systems,*
- ✓ *integrate information from various sources, independently deciding which information is already contained and which is new,*
- ✓ *share the same data between applications and users with different data presentation,*
- ✓ *manage data, include history of changes and logging.*

This means that standards are needed to ensure that data has the same representation across organizations and systems. Currently, due to the lack of standards, information systems and interfaces often cost much more than they should due to the stages of their development, operation and maintenance.

Keywords: data, databases, corporate databases, database roles, database standardization, database design mistakes.

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