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MATH MODELING. METHODS AND SYSTEMS OF INFORMATION SECURITY

Al-Khafaji Israa M. Abdalameer
AUTONOMOUS MOBILE ROBOTS BASED ON PERMANENT FEDERATED LEARNING

Deep learning (DL) in robotics is very important and has a major role in this development of artificial intelligence. Therefore, robotic systems that use (DL) are considered smart systems today, and autonomous tasks). Autonomous robots are distributed in groups, and it is necessary to have cooperation between robots. Through collaborative learning, federated learning (FL) enables continuous and continuous training of models in a way that is distributed to robots as well as privacy. The purpose of this paper is to avoid vision-based obstacles for mobile robotic navigation. Through it, we explore the capabilities of FL for systems that are distributed on mobile robots that make continuous learning by engaging robots in both simulation systems and in the real world. We advance previous work by studying the performance of FL's multiple image classifiers, and benchmarking it against cloud-based central avoid vision-based obstacles for mobile robotic navigation. Through it, we explore the capabilities of FL for systems that are distributed on mobile robots that make continuous learning by engaging robots in both simulation systems and in the real world. We advance previous work by studying the performance of FL's multiple image classifiers, and benchmarking it against cloud-based central learning using previously collected data. We are also giving a continuous learning system on mobile bots with sensors that can automatically provide classified data as they complete other tasks. We were able to achieve higher accuracy by training the models in both simulation and reality, allowing continuous updates to the published models.
Keywords: federated learning, robot navigation, continuous learning

Mayorova E. V., Sokolovskaya S. A., Koshkina N. V., Shirshikova M. S.
INFORMATION SECURITY MANAGEMENT OF SOFTWARE DEVELOPMENT WITHIN THE FRAMEWORK OF THE APPROACH DEVSECOPS

The article describes the processes of information security of software development in the framework of flexible Agile methodology and DevSecOps approach. The techniques and tactics of the knowledge graph of cybersecurity countermeasures DEF3ND.
Keywords: information security, software, agile software development methodology, information security system

Vitkova L. A., Zrelova A. L., Spitsin M. A.
REVIEW AND SYSTEMATIZATION OF LICENSES, RESTRICTIONS ON DISTRIBUTION AND COPYING

Over the past decade, the level of digitalization of society has increased. The rules for the dissemination and protection of intellectual property rights have been appearing and becoming part of the global world for decades. In 2022, we are faced with limitations. It has become difficult to conclude contracts and pay for commercial licenses of foreign vendors. But, the communities, the community, the developers of the open source software «open source» on their own initiative restricted access to the repositories to companies located in Russia. In the article, the authors consider well-known approaches to licensing digital products, to their distribution and methods of protection. The work is an overview, but in the course of the study, 2 types of licenses for open source products were identified, which are most acceptable for use in import substitution processes today.
Keywords: intellectual property, licenses, protection methods, import substitution

Pavlov A. S.1, Ryabtsev S. S., Mandritsa I. V., Linets G. I., Mochalov V. P.1, Chernyshev A. B.
DETECTION OF NETWORK TRAFFIC ANOMALIES USING AN ENSEMBLE OF CLASSIFIERS

Modern information systems are characterized by growing volumes of information being

transmitted. During the transmission, information is exposed to confidentiality, integrity, and availability threats. In this regard, there is a need for continuous monitoring of network traffic to detect intrusions and take countermeasures. Thus, the purpose of this work is to improve the efficiency of network traffic anomaly detection in information systems. To achieve the goal of the study, a method for detecting network traffic anomalies based on an ensemble of classifiers is proposed. The scientific novelty of the presented solution lies in the use of blending to create a meta-classifier, which helps to increase the accuracy of detecting traffic anomalies in comparison with the individual classifiers it is based on. A distinctive feature of the method is the ability to use various classifiers that can detect previously unknown attacks. The effectiveness of the developed method was confirmed by the results of computer simulation carried out in Python.
Keywords: intrusion detection system, artificial neural network, anomaly detection, network security

APPLICATION OF GAMIFICATION TECHNOLOGIES IN TRAINING
The authors discuss the peculiarities of the use of gamification technologies in training. The development of interactive materials by the JavaScript programming language and graphic editors (Adobe Photoshop, Figma) for training the managing controllers of the Zenit-Arena LLC Temporary Staff Training Center, a subsidiary of FC Zenit JSC, was presented.
Keywords: distance learning, gamification, interactive materials, development, graphics, typing, styling, scripts, programming

MODEL FOR ASSESSING THE PROBABILITY OF INTERNAL INCIDENTS IN THE INFORMATION SECURITY OF THE ENTERPRISE
According to the statistics of leading analytical companies in the field of information security, the frequency and volume of «leaks» of commercial, production, administrative and financial information are growing every year. At the same time, the source of «holes» (leakage channels) are not always third-party attackers. Often the reason for information leakage is its availability or the «interest» of individual employees of the organization itself (enterprise). The purpose of this work is to increase the information security of an enterprise's trade secret by timely assessing and identifying the likelihood of internal incidents and quickly clarifying (changing) the adopted regulations (level of security policy) to protect an enterprise's trade secret from the threat of its leakage. To achieve this goal, a model for assessing the probability of internal information security incidents of an enterprise is proposed. An element of the scientific novelty of the proposed model is the use of two streams of evaluated information: externally resonant and internally emotional. A distinctive feature of the model is the ability to calculate the probability of internal incidents individually for each employee of the enterprise. The effectiveness of the developed model is confirmed by the experimental calculations performed.
Keywords: internal violator, information security incidents, probability of employee dissatisfaction

A SYSTEMATIC APPROACH TO ASSESSING THE CORONAVIRUS PANDEMIC
The issues of applying a systematic approach to assessing the development of coronavirus and the pandemic situation as a whole are considered. The applicability of the system model of the S-shaped life cycle curve to the tasks of analyzing the development of a pandemic is shown. An algorithm for modeling changes in the pandemic situation based on the analysis of the triad «Virus - Organism - Population» is proposed. The forecast is demonstrated on the basis of the proposed model generalizing the development of the pandemic situation on the basis of various viruses that obey the development model based on the life cycle.
Keywords: systemic approach, coronavirus, pandemic situation, life cycle model, s-shaped curve, virus-organism-population triad, algorithm for the development of a pandemic situation,

assessment and forecast of a pandemic situation

METHOD OF SPECTRAL EVALUATION OF DEFORMATION PROCESSES OF NONWOVEN MATERIALS
The article discusses the method of spectral estimation of deformation processes of nonwoven materials based on the numerical calculation of the delay spectra of these materials. The substantiation of the smallness of the values of the average statistical delay times of the indicated nonwoven materials is given.
Keywords: spectral analysis, geotextile nonwoven materials, deformation processes, mathematical modeling

RESEARCH OF DEFORMATION PROCESSES OF FABRICS FOR PARACHUTE DOMES
The issues of research of deformation processes of polyamide fabrics used for the manufacture of parachute domes are considered. Computational forecasting is carried out taking into account the specifics of the transience of processes and on the basis of mathematical modeling of relaxation and creep, as well as the Boltzmann - Volterra integral constitutive relations.
Keywords: PARACHUTE CANOPIES, POLYAMIDE FABRICS, MATHEMATICAL MODELING, OPERATIONAL PROPERTIES

DIGITAL PREDICTION OF DEFORMATION PROCESSES OF TEXTILE MATERIALS WITH INCREASED ACCURACY
The article discusses the issues of improving the accuracy of digital prediction of deformation processes of textile materials, which are important both from the scientific and practical side, as this allows you to get recommendations for creating new promising materials with desired functional properties. A method for optimizing mathematical modeling of the fundamental operating conditions of textile materials is also considered.
Keywords: mathematical modeling, optimization criteria, polymeric textile materials, deformation properties, relaxation, creep

ORGANIC CHEMISTRY, PHYSICAL CHEMISTRY. HIGH MOLECULAR COMPOUNDS

ADSORPTION OF ALUMINUM (III) IONS ON RESINEX KP AND RESINEX KW-8 CATIONITE
The physical, physico-chemical and chemical properties of imported Resinex KP and Resinex KW-8 cationites, which are analogues of domestic KU-2-8 and KU-23 cationites, have been studied. It is established that cationites have high values of exchange capacity in a wide range of pH values. The adsorption of aluminum (III) ions from model solutions on Resinex KW-8 and Resinex KR cationites was studied under static conditions. It was found that at pH = 3.0 and pH = 5.5, adsorption proceeds by the mechanism of ion exchange. Adsorption isotherms are constructed, the type of which shows that at pH = 7.6 and pH= 9.5, localized adsorption of aluminum from aqueous solutions on a homogeneous surface of cationites is observed. This made it possible to apply the Langmuir equation and calculate the adsorption equilibrium constants and the maximum adsorption of aluminum. The adsorption of aluminum (III) ions from model solutions on Resinex KW-8 and Resinex KR cationites at pH=5.17 was studied under dynamic conditions. The values of DEC and FDEC for the studied conditions are calculated. The analysis of the output curves showed that the adsorption process under dynamic conditions is mixed-diffusion. Using an analytical solution for a mixed-diffusion model of adsorption dynamics for the

parallel transfer mode, kinetic constants of adsorption dynamics are determined by the Shilov equation.
Keywords: adsorption, resinex kr, langmuir equation, shilov equation, kinetic adsorption constants

Lipin V. A., Medvedev V. V., Akhmedov S. N., Gorbachev E. V., Shapot D. M.
OBTAINING HYDROGARNET-CONTAINING PIGMENTS FROM RED MUD
Red mud, which is a waste in the production of alumina from bauxite, was considered as a raw material for obtaining various pigment materials. Technical solutions for the processing of red mud with the production of iron oxide pigments through the stage of formation of iron hydrogarnets are proposed using the example of red pigment. The study of hydrogarnet-containing pigments included the determination of granulometric, chemical and mineralogical compositions, physicochemical and physico-mechanical properties. The main phases in the pigment are andradite-type hydrogarnet, katoite, and cancrinite. It is shown that the resulting pigments consist of separate spherical particles and their aggregates up to 20-30 μm in size, the ratio of α-Fe2O3 and δ-FeOOH in the red pigment is 7:3, which gives it this color. The properties of the resulting pigment in terms of the main parameters - granulometric characteristics, light resistance, oil absorption, hiding power, coloring ability, dispersibility - are not inferior to existing analogues. The resulting pigment can be used to color various building materials - concrete, paving slabs, tiles, etc. The effectiveness of the proposed technical solutions lies in the ability to obtain pigments with desired physical and chemical properties from alumina production waste, including adjustable color characteristics. These technical solutions, taking into account the chemical composition and physical properties of the initial components, make it possible to create such a production in which various types of pigments can be produced on one unified line of chemical equipment.
Keywords: red mud, pigments, hydrogarnets, hiding power, light fastness, oil absorption

Mishina N. M., Zykova I. V., Abramova E. S., Novoselov N. P.
STRUCTURAL AND FUNCTIONAL GROUPS OF CARBON-MINERAL SORBENTS BASED ON SAPROPEL
The structural and functional composition of the sorbents makes it possible to characterize the possibility of the adsorption process. The main properties of sorbents are associated with the presence of surface groups. Boehm's method quantitatively determined the sums of carboxyl, hydroxyl and lactone groups on the surface of sapropels thermally oxidized at different temperatures. In the studied sapropel, carboxyl (2.3 mmol/g) and hydroxyl groups (1.8 mmol/g) predominate, and lactone groups (0.8 mmol/g) in a smaller amount, which disappear in thermally oxidized sapropel at an oxidation temperature of 400 ℃, which is in good agreement with the infrared spectra of sapropels thermally oxidized at different temperatures. Determination of the main elemental composition and hydrogen-carbon and nitrogen-carbon ratios made it possible to establish the presence of predominantly aromatic compounds, and the hydrogen-nitrogen ratio - the presence of nitrogen in the composition of proteins and protein-like compounds.
Keywords: thermooxidized sapropel, adsorption, functional groups, elemental analysis

Mirmukhamedov M. M., Jobirov U. R., Ganiev I. N., Obidov Z. R.
A POTENTIODYNAMIC INVESTIGATION OF THE ANODIC BEHAVIOR OF ZN22AL ALLOY WITH ERBIUM IN VARIOUS CORROSIVE ENVIRONMENTS
The article presents the results of a potentiodynamic study of the anodic behavior of the Zn22Al alloy with erbium dopants in various corrosive media of HCl, NaCl and NaOH electrolytes. It has been established that erbium alloying additions in amounts of 0.01÷1.0 wt.% somewhat increase the anode resistance of the Zn22Al alloy by reducing the corrosion rate in various corrosive environments.
Keywords: zn22al alloy, erbium, potentiodynamic study, corrosive media, corrosion rate, anodic behavior

Mishina N. M., Zykova I. V., Abramova E. S., Novoselov N. P.
STUDY OF THE LIQUID-PHASE ADSORPTION OF LEAD IONS (℃) ON THE THERMALLY OXIDATED SAPROELS

The adsorption kinetics of lead ions (℃) on model solutions with concentrations of 5; ten; twenty; thirty; 50 mg/dm3. It has been established that the optimum temperature for thermal oxidation of sapropel for the adsorption of lead ions (℃) is 600 ℃. The degree of purification from lead ions (℃) with concentrations in model solutions from 5 to 50 mg/dm3 at a given thermal oxidation tem- perature is 92-99 %. The kinetics of adsorption of lead ions (℃) by thermally oxidized sapropel is close to the pseudo-second order model, therefore, chemical adsorption is the limiting stage of the process. To describe the adsorption of lead ions (℃) by thermally oxidized sapropel at a temperature of 600 ℃, the equations of Langmuir monomolecular adsorption, BET polymolecular adsorption, Dubinin-Radushkevich and Dubinin-Astakhov's theory of volumetric filling of micropores were used. The process of adsorption of lead ions (℃) from model solutions is satisfactorily described by all the considered adsorption theories, the data on the basis of which the main parameters of adsorption of lead ions (℃) are calculated: the value of the maximum adsorption value $\Gamma\_max=0.23$ mmol/g, the specific surface of the sorbent $S\_sp=69,93$ m2/g, the value of the characteristic adsorption energy of lead ions $E=20.65$ kJ/mol.
Keywords: thermally oxidized sapropel, liquid-phase adsorption kinetics, heavy metals

Sharipov J. Kh., Khakimov I. B., Ganiev I. N., Obidov Z. R.
OXIDATION OF ZN22AL ALLOY DOPED WITH THALLIUM

The article presents the results of a study of the kinetics of oxidation of the Zn22Al alloy with thallium. In the temperature range of 473-623 K, the kinetic and energy parameters of the oxidation of alloys have been established. Additives of thallium in amounts of 0.01-1.0 wt.% contribute to a decrease in the oxidizability of the Zn22Al alloy, and the oxidation products are mixtures of ZnO, Al2O3, ZnAl2O4, Al2O3 Tl2O3 oxides.
Keywords: zn22al alloy, thallium, thermogravimetric method, oxidation rate, activation energy

Olimov R. A.
SYNTHESIS AND PHYSICO-CHEMICAL PROPERTIES OF ETER DERIVATIVES BASED ON GLYCEROL

The article presents the results of the synthesis and physicochemical properties of new compounds of 3-alkoxy-1,2-propanediols and1,3-dialkoxy-2-propanol with acetic acid. Used α-monoethers of glycerol and 1,3-dialkoxy-2-propanols with active hydroxyl groups. Ethers, heterocyclic derivatives of the 1,3-dioxolane series, diacyloxy derivatives of glycerol monoesters, 3-alkoxypropyl-1,2-diacetate, 1,3-diethoxy-2-acyloxypropanes, 1,3-di(alkoxy) - 2-phenylacetoxypropane and 1,3-diethoxy-2-butyryloxypropanes. Based on these synthesized esters, drugs with pharmacological properties can be obtained.
Keywords: synthesis of glycerol, acetic acid, 3-alkoxypropyl-1,2-diacetate, 1,3-dialkoxy-2-propanol, 3-alkoxy-1,2-propanediol, 1,3-diethoxy-2-acyloxypropanoate, 1,3-diethoxy-2-butyryloxypropane, acyloxypropane

Olimov R. A.
SYNTHESIS AND CONVERSIONS OF DERIVATIVES OF OXYGEN-CONTAINING HETEROCYCLES BASED ON α-GLYCERIN MONOESTERS

The article presents the results of the synthesis of new compounds of α-monoesters of glycerol with furfurals. 2-Furyl- 4-alkoxymethyl-1,3-dioxolanes were used as the diene component in the Diels-Alder reaction. A number of 1,3-dioxolanes have been synthesized based on monoalkyl esters of glycerol. Ethers, heterocyclic derivatives of the 1,3-dioxolane series, 5-propoxymethyl-2 (1',2',3',6'-tetrahydro-3,6-endoxyphthalic anhydride-3'-yl)-1,3-dioxolanes and 5-alkoxymethyl-2 (1',4'-dihydroxy-5',8',9',10'-tetrahydro-5',8'-endoxyphthalazin-8'-yl)-1,3-dioxolanes.

AUTOMATION AND CONTROL OF TECHNOLOGICAL PROCESSES AND PRODUCTION

Kovalev D. A., Sharyakov V. A., Sharyakova O. L., Lebedeva V. A.
ANALYTICAL ADJUSTMENT OF REGULATORS IN A CASCADE AUTOMATIC CONTROL SYSTEM
When synthesizing automatic control systems, there is a problem with complex definition of controller parameters, and the main criterion becomes the achievement of stable operation, and the quality of the transient becomes of secondary importance. Such problems may arise in the presence of two or more nested loops in the initial system. The correct synthesis of such systems is possible by using a slave control structure that allows us to replace the inner loop with an equivalent aperiodic link of the first order. By the example of an automatic temperature control system for superheated steam, the principle of building a slave control structure and the synthesis of such a system are shown in the paper.

Surikov N. V., Kovalev D. A., Tayanchina A. V., Mirny A. P.
RESEARCH OF THE HOT WATER CIRCULATION SYSTEM AS A CONTROL OBJECT
This paper considers the problem of instability of the temperature of hot water supplied to consumers in the circulating hot water supply system under conditions of peak loads. The article presents the results of a study of the circulating hot water supply system (DHW) as a control object. Residential buildings with a closed circulation system were taken as the base for the study. A mathematical model of the hot water supply system is presented. The work is aimed at improving the efficiency of managing the hot water supply of residential buildings and ensuring regulatory requirements under conditions of peak loads and random disturbances.

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