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

D. S. Alekseev

DOI 10.46418/2079-8199_2023_3_1

METHOD FOR ORGANIZING AND ENSURING INFORMATION SECURITY OF CYBER-PHYSICAL SYSTEMS ON THE BASIS OF DETECTING SEASONALITY IN DATA FLOWS

At the conceptual level, a model for ensuring information security of a complex cyber-physical system is proposed. For complex data protection, the model is a system that is invariant to any point of its connection in the architecture of the cyber-physical system. The basic requirements for the information security model are formulated from a system standpoint. The model is implemented in the form of a computer system that analyzes data flows from end devices and an impersonal flow in the information environment of a cyber-physical system. The main parameters are disclosed that allow adjusting and adapting the information security system of a complex cyber-physical system to detect unusual data behavior. The computer system implements data processing algorithms that give signals about the presence of information threats in the devices and data transmission channels of the cyber-physical system. Based on indirect indicators of information flows and the operation of a computer system, security threats are assessed and anomalies are detected. The universal methods of data processing in the response system are considered, which allow, according to the signs in their behavior, to generate control signals corresponding to the current state of the information security system and aimed at bringing the state of a complex system to a stable, normal state. For the first time, a model was developed and the architecture of the information security system of a complex cyber-physical system was proposed. On the basis of the model, a prototype of an invariant information security system was developed, which can be embedded, depending on the needs, at any level of the cyber-physical system architecture.

Keywords: cyber-physical system, Information Security, architecture of the cyber-physical system, data protection, information security system.

V. I. Wagner, A. A. Kozlov, N. S. Klimova, M. A. Egorova

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CONDUCTING A SYSTEM ANALYSIS OF THE DEFORMATION PROPERTIES OF POLYPROPYLENE AND POLYVINYLIDENE FLUORIDE MEDICAL MATERIALS

The article provides a systematic analysis of the deformation properties of polypropylene and polyvinylidene fluoride threads for surgical purposes used for the manufacture of endoprostheses. The degree of influence of the properties of threads on the characteristics of mesh endoprostheses based on them has been established, which makes it possible to purposefully find ways to improve the quality of mesh endoprostheses. It has been shown that the elasticity of endoprostheses is mainly determined by their mesh structure, while remaining proportional to the elasticity of the thread.

Keywords: medical materials, system analysis, deformation, elasticity, mechanical properties, mesh endoprostheses, polypropylene threads, polyvinylidene fluoride threads.

A. M. Gelfand, V. V. Sigacheva, A. V. Arkhipov, L. K. Sirotina

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ANALYSIS AND MANAGEMENT OF INFORMATION SECURITY RISKS OF A CRITICAL INFORMATION INFRASTRUCTURE FACILITY

Ensuring the security of critical information infrastructure information systems remains an important task. But in addition to ensuring security itself, it is also necessary to understand and accept the possible risks of potential threats. To categorize objects of critical information infrastructure of the Russian Federation, a List of indicators of criteria for the significance of objects of critical information infrastructure was approved, but when using the List in its current form, some questions may arise regarding the unambiguity of assigning an object to a specific category. This article discusses options for improving the list using mathematical tools.

Keywords: Information Security, critical information infrastructure, critical information infrastructure facility, risk, threat.

A. V. Demidov, A. G. Makarov

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SOLUTION TO THE PROBLEM OF DIGITAL PREDICTION OF OPERATING PROCESSES OF UNIAXIALLY ORIENTED POLYMER MATERIALS

Traditionally, predicting the operational processes of uniaxially oriented polymer materials faces certain objective difficulties caused by the heterogeneity of the rheological structure of these materials. The widespread use of uniaxially oriented polymer materials in various fields of technology - from household polymers to the lining of space rockets and deep-sea vehicles - dictates the need to develop modern methods for predicting increased accuracy of their functional properties, including various deformation-relaxation processes. The development of new methods for predicting the functional properties of polymer materials is justified by the need to design new innovative products based on these materials that have the required functionality and increased competitiveness.

Keywords: polymer materials, deformation processes, forecasting, performance properties, competitiveness.

I. M. Egorov, S. V. Kiselev, A. A. Kozlov

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METHODS FOR QUALITATIVE ANALYSIS OF CREEP OF POLYPROPYLENE AND POLYVINYLIDENE FLUORIDE MEDICAL THREADS

The article presents the results of research and modeling of short-term creep of polypropylene and polyvinylidene fluoride threads for medical purposes, and a physical analysis of such creep of these threads is carried out.

Keywords: medical threads, modeling, mechanical properties, deformation, elasticity, creep, polypropylene threads, polyvinylidene fluoride threads.

K. N. Zhernova, A. A. Chechulin

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SEARCHING FOR ANOMALIES IN SECURITY DATA VISUALIZATION USING ARTIFICIAL NEURAL NETWORKS

Huge amounts of data are currently being transferred, and many security incidents are occurring. The safety data is visualized and then analyzed by the operator. In order to automate the visual analysis of information security data, in this paper, an artificial neural network model for image classification was presented. The proposed model will allow processing a large number of images with security data visualization and detecting anomalies in these images with high accuracy. Experiments performed show that this model is able to accurately recognize the anomalous behavior of security data from an image. In addition, experiments involving subjects

have shown that in some cases, a neural network can recognize anomalies even with higher accuracy than a human operator.

Keywords: Artificial neural networks; Machine learning; Computer vision, Information security; Visual analysis; Data visualization.

S. V. Kiselev, A. G. Makarov

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DEVELOPMENT OF A METHODOLOGY FOR COMPARATIVE ANALYSIS OF DEFORMATION PROPERTIES OF ARAMID TEXTILE MATERIALS

The article develops a methodology for comparative analysis of the deformation properties of aramid textile threads and products based on them. The deformation properties of these materials are studied in the area of non-destructive loads close to their operating conditions.

Keywords: aramid materials, mathematical modeling, computer forecasting, deformation, plasticity, relaxation, creep.

M. M. Kovtsur, A. A. Minyaev, V. E. Drepa, V. V. Sigacheva, L. K. Sirotina

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DETERMINING A WIRELESS CLIENT LOCATION USING THE FINGERPRINTING METHOD IN THE IEEE 802.11 NETWORK FAMILY. PART 1. RESEARCH

Wi-Fi networks are a popular way for organize communication, offering high mobility and the ability to connect many different devices. However, as wireless networks become more widespread and the value of transmitted data increases, cyber-attacks on these systems are becoming more common. Since data is transmitted through a radio channel, it is not possible to determine the location of an intruder based on his physical connection to a wired interface. This means that special methods are necessary to locate intruders in the territory, this information must then be transferred to the information security department. This article describes a technique for determining the location of an IEEE 802.11 wireless client using frames intercepted by passive scanning devices such as microcomputers, in order to ensure information security.

Keywords: Wi-Fi, IEEE 802.11, positioning, trilateration, fingerprinting.

M. M. Kovtsur, A. A. Minyaev, V. E. Drepa, V. V. Sigacheva, L. K. Sirotina

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DETERMINING A WIRELESS CLIENT LOCATION USING THE FINGERPRINTING METHOD IN THE IEEE 802.11 NETWORK FAMILY. PART 2. IMPLEMENTATION

Wi-Fi networks are a popular way for organize communication, offering high mobility and the ability to connect many different devices. However, as wireless networks become more widespread and the value of transmitted data increases, cyber-attacks on these systems are becoming more common. Since data is transmitted through a radio channel, it is not possible to determine the location of an intruder based on his physical connection to a wired interface. This means that special methods are necessary to locate intruders in the territory, this information must then be transferred to the information security department. This article describes a technique for determining the location of an IEEE 802.11 wireless client using frames intercepted by passive scanning devices such as microcomputers, in order to ensure information security.

Keywords: Wi-Fi, IEEE 802.11, positioning, trilateration, fingerprinting.

A. V. Meleshko, V. A. Desnitsky

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MODELING A SELF-ORGANIZING DECENTRALIZED WIRELESS SENSOR NETWORK WITH ROLE-FUNCTIONING FOR ATTACK DETECTION

The article discusses the process of creating a model of a self-organizing decentralized wireless sensor network (WSN). The model represents the formalization of the processes of functioning of a network of this type, as well as the conditions and limitations of self-organization and decentralization of the network. The model differs in the description of WSN functioning processes using the proposed role functioning of network nodes and a set of their states. An analysis was made of current work on the use of WSN in crisis response systems, as well as articles on existing alternative ways of WSN role-based functioning. Based on the analysis of works in the subject area of the study, the proposed system of roles of WSN nodes was refined, which can be used in various areas of WSN application. The practical implementation of the proposed WSN model with role-based functioning has shown its correctness and promise for solving the problems of attack detection.

Keywords: wireless sensor networks, role- functioning, model, attack detection.

M. A. Mozgushin, A. V. Epifanov

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DEVELOPMENT OF AN ALGORITHM FOR CALCULATING THE RATIO OF DILUTION OF WASTEWATER

An analysis of methods for calculating the multiplicity of dilution of wastewater in watercourses is given. It is shown that in the current methodology for calculating the standards for permissible discharges of pollutants, there are no methods for calculating the dilution ratio for many hydrological and meteorological regimes, and in a number of the above methods the limits of applicability are incorrectly indicated, which leads to environmentally unjustified values of the standards for permissible discharges. Universal methods for calculating the multiplicity of dilution of wastewater are proposed.

Keywords: dilution ratio, wastewater, algorithm for calculating the dilution ratio, limits of applicability, permissible discharge standard, mathematical models, transport of contaminants.

N. V. Pereborova

DOI 10.46418/2079-8199_2023_3_12

DEVELOPMENT AND IMPLEMENTATION OF CRITERIA FOR QUALITATIVE EVALUATION OF RELAXATION PROCESSES OF POLYMER TEXTILE MATERIALS

A method for calculating the relaxation characteristics of polymer textile materials, developed using mathematical models, makes it possible to conduct a qualitative assessment of the performance properties of these materials.

Keywords: criteria for qualitative assessment, relaxation, functional properties, optimization, polymer textile materials.

N. V. Pereborova, A. G. Makarov

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CHECKING CRITERIA FOR CONFIDENT PREDICTION OF RELAXATION OF POLYMER TEXTILE MATERIALS

The issues of adequacy of mathematical modeling of relaxation processes of polymer textile materials are considered. The developed integral criteria for confident prediction of relaxation processes of polymer textile materials are based on minimizing the integral convolution functional corresponding to the defining equation of state. The introduction of the developed

criteria for confidence prediction of relaxation processes of polymer textile materials is possible thanks to their computerization.

Keywords: relaxation, polymer textile materials, mathematical modeling, forecasting, optimization criteria.

V. I. Pimenov, E. O. Tihostup, I. V. Pimenov

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DATA MINING IN INVESTMENT PLANNING

Data analysis methods to identify patterns and trends reflecting the impact on stock prices, choosing the investment sector and diversifying the investment portfolio are considered. The methodology of an intellectual system for developing an investment strategy building is described.

Keywords: expected profitability, risk minimization, investment diversification, retrospective selection, machine learning, recurrent neural network.

D. N. Smirnov, I. V. Chumakov, A. I. Katasonov, A. V. Arkhipov, V. V. Maksimov

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ANALYSIS OF THE SECURITY OF THE FREEIPA TRUST RELATIONSHIP SYSTEM AGAINST ATTACKS SUCH AS CERTIFICATE SUBSTITUTION, INCLUDING THE ATTACK OF CONCEALING MALICIOUS ACTIVITY THROUGH TIMESTAMP MANIPULATION

This article includes a description of an experimental setup for conducting a security analysis of the FreeIPA trust relationship system. Purpose: This study focuses on the security analysis of the FreeIPA trust relationship system, addressing attacks involving certificate substitution and concealing malicious actions through timestamp manipulation. The research aims to identify vulnerabilities and security threats, as well as to develop effective measures and protection methods to ensure the reliability and security of the FreeIPA trust relationship system. Practical relevance: The analysis of the security of the FreeIPA trusted relationship system against attacks such as certificate substitution and the attacker's attempt to conceal actions through manipulation of timestamps holds significant practical importance within the context of modern information security. This study provides valuable insights and practical recommendations that can be directly applied by administrators and information security specialists. Understanding attack scenarios related to certificate substitution and manipulation of timestamps enables the development of effective defense strategies and ensures the continuous operation of the FreeIPA system amidst threats. The results of the analysis help uncover vulnerabilities and weaknesses in the system, contributing to its enhanced security.

Keywords: certificates, timestamps, security, FreeIPA.

N. R. Turkina, A. V. Soshnikov, N. G. Butkareva

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FINITE ELEMENT ANALYSIS OF TILT-SWIVEL TV MOUNT

In this paper, a strength calculation of a tilt-swivel bracket for a TV is carried out. Calculations under the influence of static loading, as well as 3D design of the model, were performed using the SolidWorks finite element complex. The results of the performed calculations confirmed the possibility of using this structure with the given parameters.

Keywords: computer simulation, tilt-swivel bracket, SolidWorks, finite element method, strength calculation, static loading, equivalent stresses.

I. A. Ushakov, V. V. Maksimov, L. K. Sirotina, A. V. Arkhipov

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METHODOLOGY FOR STUDYING THE DETECTION OF STEGANOGRAPHIC CHANNELS BASED ON EMBEDDING IN PACKET HEADER FIELDS

This work provides an analysis of the field headers of IPv4, UDP, TCP protocols for the hidden transmission of information. The paper examines the possibility of identifying steganographic channels based on a statistical method using a program developed by the author in the Python programming language.

Keywords: steganography, network steganography, information security, network threats, hidden communication channels.

O. I. Sheluhin, D. I. Rakovsky

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INFLUENCE OF MULTI-LABEL DATABASES ON THE RESULTS OF MULTI-CLASS CLASSIFICATION OF COMPUTER ATTACKS

The evaluation of the effectiveness of multi-class classification algorithms in the conditions of multi-label data sets is considered using the UNSW-NB15 database as an example. It is shown that in the UNSW-NB15 database there are about 0.1% of records that can be used for multi-label. The presence of such objects has a significant impact on the quality of the final classification. It is shown that such records are objects of malicious traffic and simultaneously belong to several categories of attacks, which reduces the quality of multi-class classification. Recommendations for the correction of multi-class classification algorithms in the conditions of multi-label processed data have been developed.

Keywords: information security, computer attacks, classification algorithms, multi-label, multi-class classification.

O. M. Shterenberg, V. I. Andrianov, A. Y. Khoromskaya, V. V. Maksimov, V. V. Sigacheva

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WAYS TO PROTECT AN ORGANIZATION FROM ATTACKS USING SOCIAL ENGINEERING

Since information and communication technologies have become an integral part of various spheres of human activity in our time: from entertainment and communication to the labor process, the problem of protection from cyber threats is very relevant. To prevent leaks of important information, various methods have been developed to find and eliminate technical vulnerabilities of networks. Cybercriminals, in turn, are coming up with increasingly sophisticated ways to gain access to data, so the development of special systems to ensure security remains relevant. Organizations are actively implementing new generation firewalls (MESPS) and security event management systems (SIEM), and build information security incident monitoring and response centers, deploy data backup and recovery systems. Of course, this is all important to ensure the stable protection of the organization from intrusion, but do not forget that the most vulnerable link in the entire system.

Keywords: social engineering, phishing, trojan, bait, quid pro quo.

S. I. Shterenberg, A. V. Krasov, V. V. Maksimov, A. V. Arkhipov

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THE IDEA AND GENERAL CONCEPT OF APPLYING A MULTI-AGENT APPROACH TO THE CREATION OF LARGE-SCALE INTELLIGENT INTRUSION DETECTION SYSTEMS

For almost decades now, a series of disputes about the advantages and disadvantages of using multi-agent systems as components for various software products has not subsided. In this

article, the author defines the terms what are multi-agent systems, software agents, agents, hidden codes and other tiny particles that will smoothly form the basis for the formation of nanocomponents of large intelligent intrusion detection systems. The paper will identify not only concepts, but also principles, problems that "draft" neural networks can face at an early stage of their formation, before being designated as a component of a quasi-biological information security system.

Keywords: software agent, multi-agent systems, artificial intelligence, neural networks, quasi-biological paradigm.

CHEMICAL SCIENCES

K. A. Antonova, K. I. Shikolenko, A. P. Mikhailovskaya

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N-ALKYLATION OF TERTIARY AMINES UNDER DIFFERENT CONDITIONS

The article is devoted to the development of technology for the production of quaternary ammonium salts such as triethyloctadecylammonium halide. The influence of catalysts and organic solvents on the reaction mechanism and the yield of quaternary ammonium salt as a result of alkylation of a tertiary amine was studied. Identification of reaction products was carried out by IR spectroscopy.

Keywords: triethyldodecylammonium bromide, triethyloctadecylammonium bromide, organic solvent, electrophilic catalysis, substitution reactions.

I. N. Ganiev, Abuali Elmurod, R. S. Shonazarov, U. N. Faizulloev

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EFFECT OF LITHIUM ADDITIVES ON THE HEAT CAPACITY AND CHANGES IN THE THERMODYNAMIC FUNCTIONS OF AN AlCu4.5Mg1 ALLOY OF THE DURALUMIN TYPE

Heat capacity is the most important physical property of aluminum alloys. The paper presents the results of a study of the temperature dependence of the specific heat and changes in the thermodynamic functions of the aluminum alloy AlCu4.5Mg1 of the duralumin type with lithium in the "cooling" mode in the range of 300–800K. For this purpose, by processing the curves of the cooling rates of samples from aluminum alloy AlCu4.5Mg1 of the duralumin type with lithium and the standard, polynomials were obtained that describe their cooling rates. Further, according to the experimentally found values of the cooling rates of the standard and samples of alloys, knowing their masses, the polynomials of the temperature dependence of the heat capacity of the alloys and the standard were established, which are described by a four-term equation. Using integrals of specific heat capacity, polynomials of the temperature dependence of changes in enthalpy, entropy and Gibbs energy for alloys were established. The dependences obtained show that with increasing temperature and lithium concentration, the heat capacity, enthalpy, and entropy of the alloys increase, while the values of the Gibbs energy decrease.

Keywords: aluminum alloy AlCu4.5Mg1 of the duralumin type, lithium, "cooling" mode, heat capacity, enthalpy, entropy, Gibbs energy, temperature dependence.

N. A. Ivanov

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PREPARATION AND USE OF FAST COLOUR SALTS FROM AROMATIC AMINE TO THE SYNTHESIS OF INSOLUBLE AZO DYES ON THE MIXED TEXTILE MATERIALS

In the present work the possibility is investigated of production stabilized fast base from aromatic amine contained vinylsulphone reactive group. In-Use stability and storage stability of fast base are evaluated. It has been shown that stabilized fast bases are of perspective in dyeing of mixed fabrics by synthesis of azo dyes on the substrate with covalent fixation.

Keywords: aromatic amine, stabilized fast base, reactive group, fiber, covalent fixation, dyeing, fastness, dyeing, quality.

AUTOMATION AND CONTROL OF TECHNOLOGICAL PROCESSES AND PRODUCTION

M. A. Kanevskiy

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PECULIARITIES OF IMPLEMENTATION POPULAR NEURAL NETWORKS IN RECOMMENDATION SYSTEMS FOR THE FASHION INDUSTRY

The use of artificial intelligence (AI) technologies in the development of recommendation systems for the fashion industry has become a trend. However, each tool has its own features that should be taken into account during implementation. Otherwise, AI remains more a toy for a press release than a tool for effective work. Moreover, the incorrect implementation will cause the opposite effect and lead to a drop of sales. The article discusses the advantages and limitations of their use of popular neural networks in online retail for the fashion industry.

Keywords: artificial intelligence, neural networks, e-commerce, fashion.

O. I. Sheluhin, V. V. Barkov, F. A. Matorin

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IMPROVING THE CLASSIFICATION OF ILLEGAL AND UNWANTED APPLICATIONS UNDER BACKGROUND TRAFFIC CONDITIONS USING AUTOENCODERS

Mobile illegal and unwanted applications traffic classification using machine learning methods in the presence of background traffic (BT) is considered. As a result of processing the experimentally obtained data, it was shown that the quality of classification in the presence of BT decreases for all the considered classification algorithms. To improve the efficiency of classification under background traffic conditions, it is proposed to use a neural network - an autoencoder. The effect of introducing such a neural network on the quality of mobile applications classification is shown. It is also shown that the use of the proposed approaches based on neural networks will make it possible to classify, analyze and filter network traffic of malicious and illegal applications with high efficiency.

Keywords: classification, neural network, autoencoder, data mining, attributes, Random Forest, metrics, protocol, flow, packet, application, content, efficiency.

M. A. Kanevskiy

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THE APPLICATION OF AN ENSEMBLE OF MODELS IN A HYBRID NEURAL NETWORK TO FORM A SET OF PRODUCTS (LOOK) IN ONLINE CLOTHING STORE

Hybrid neural networks combine the advantages of humans and the power of artificial intelligence to achieve higher performance and efficiency in solving complex problems. The application of hybrid neural networks in the fashion industry is required to combine individual preferences, experience and creativity with the computational abilities of a trained neural

network. The article presents the concept of creating an ensemble of neural network models in a single hybrid neural network for a recommender system based on the recommendations of experts (stylists), purchase history and product popularity.

Keywords: artificial intelligence, neural network, e-commerce, fashion.

AUTHORS LIST

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