MATH MODELING. METHODS AND SYSTEMS OF INFORMATION SECURITY

I. A. Ushakov, A. V. Krasov, D. D. ugli Mulladzhanov
TECHNIQUE FOR DETECTING ANOMALIES IN NETWORK TRAFFIC USING IPS BASED ON SECURITY ONION

The purpose of this work is to find incidents in computer networks using the Linux Security Onion distribution. In addition, in the course of the work, methods for carrying out network attacks on computer networks and means of countering them will be considered. During the practical part, a network attack will be carried out using the following tools: Nmap, hping3, Hydra and Metasploit. The result of the work is to find and study incidents in the computer environment.
Keywords: *Security Onion, SNORT, SQL, IDS, Pentest.*

V. I. Andrianov, E. V. Maiorova, V. V. Nefedov, A. D. Lebedeva
METHODOLOGY FOR USING STEGANOGRAPHIC SOFTWARE AGENTS IN A TRUSTED LINUX ENVIRONMENT

Currently, work organizations are increasingly introducing software that records the working time of employees. At the same time, there are threats associated with the appearance of an insider of the offender who can harm the personal data of users or use it for personal purposes. This article will consider the use of hidden steganographed software agents in the secure control of employee time attendance, built in a trusted Linux environment.
Keywords: *Linux operating system, secure control of employee time tracking, steganography, information security, integrity.*

V. S. Zurakhov, M. D. Shabala, A. A. Dyatchenko, A. V. Kostryukov
MATHEMATICAL MODELING OF SECURITY SYSTEMS AT AN ENTERPRISE USING THE FEATURES OF MODERN INSTANT MESSENGERS

According to the Competence Center for Import Substitution in the field of infocommunication technologies, the level of technological dependence in 2019 in Russia in different categories averaged 84 %. In this regard, changes were made to the state policy of import substitution, according to which state bodies, local authorities and organizations should switch to using mainly domestic (office) software and ensure information security based on domestic developments in the transfer, processing and storage of data guaranteeing the protection of the interests of the individual, business and the state.

In particular, these orders concern the owners of critical information infrastructure facilities, who must fulfill these transition requirements by January 1. 2021. Since the transition period has already passed, this article will consider the possibilities of ensuring information protection based on domestic software in structures that use messengers in their work.
Keywords: *DLP systems, instant messaging services, instant messengers, information leakage channels, data confidentiality, information protection tools, data leakage statistics, InfoWatch, DeviceLock, SearchInform, encryption.*

S. I. Shterenberg, I. E. Pestov, D. B. Kazakov, M. V. Ilyn
TOP TIPS FOR ORGANIZATIONS BEFORE MIGRATING THEIR DATA TO THE CLOUD. ANALYSIS OF EFFECTIVENESS ON THE EXAMPLE OF THE ZKU RVS

The authors discuss the main recommendations that must be considered when transferring information to cloud resources. A few factors have been selected to comply with the requirements of information security laws and standards, as well as a few factors taken from the experiences of other companies that have passed this path. All this is applied in practice in the development of cloud services technology for the secure control of employee time tracking.
Keywords: *infrastructure, cloud provider, information security, ZKU RVS, quality control.*

K. Akhrameeva, M. Fedosenko
COMPARATIVE ANALYSIS OF THE USE OF STEGANOGRAPHIC SOFTWARE FOR HIDDEN DATA EXCHANGE ON THE INTERNET

The article presents a comparative analysis of software products for data hiding. The work considered a model of the behavior of an attacker, reflecting the motives of actions and the necessary tools. An analysis of the functional capabilities of the products under study is given, and an assessment of the ease of use is made. As a result, a classification is derived, depending on the used stegane nesting algorithms. Based on the literature review of earlier studies, a study was carried out on the possibility of using steganographic programs for exchanging data on the Internet. The advantages and disadvantages of using software steganography are shown, the prospects for its use by malefactors are formulated, and their assessment is available. As a result of the work, promising directions of steganalysis were formulated for the investigated type of data hiding with the help of free software.

Keywords: *steganography, internet, hidden exchange, nesting programs, LSB nesting, intruder model.*

D. Yu. Yurkin, G. E. Voroshnin, M. M. Kovtsur, B. S. Mislivsky
INVESTIGATION OF THE IMPACT OF ARPINJECT AND ASSOCIATIONFLOOD ATTACKS ON WIRELESS NETWORKS BASED ON MIKROTIK EQUIPMENT

Attacks on wireless networks of the IEEE 802.11 family are becoming increasingly popular, which is partly why the study is relevant. Most often, attacks are carried out on equipment that is used everywhere. In particular, this is the equipment of MikroTik. In this paper, we investigated the impact of two types of attacks on wireless networks based on MikroTik equipment — ARP inject and association flood. During the study, we identified anomalies in wireless traffic, the behavior of equipment and customers. Based on the obtained anomaly analysis results, methods for detecting and mitigating/countering attacks were proposed.
Keywords: *information security, IEEE 802.11, MikroTik, attacks on wireless networks ARP inject, association flood.*

A. G. Makarov, D. O. Redkin
MATHEMATICAL MODELING OF CREEP PROCESSES OF NON-WOVEN MATERIALS MANUFACTURED USING THE «SPUNBOND» TECHNOLOGY

The authors consider a technique for constructing a mathematical model of creep with a minimum set of parameters and having a physical justification. The resulting mathematical model is adequate, which is proved graphically.
Keywords: *Mathematical model, plasticity, nonwoven materials, polymeric materials, material compliance, Geotex.*

A. V. Meleshko
MODELS AND METHODS FOR PROACTIVE MONITORING OF THE STATE OF WIRELESS SENSOR NETWORKS

The author discusses methods and models of proactive monitoring of the state of complex objects, in particular wireless sensor networks (WSNs). The concepts of monitoring, system, complex system and object are analyzed. A number of articles devoted to the methods and models of proactive monitoring in information systems in general and in relation to WSN are analyzed. The analysis showed that promising methods for proactive monitoring of the state of the WSN are machine learning methods, in particular, deep learning methods and neural networks, as well as methods for simulating the actions of an attacker or failures in the WSN. An analysis was also made of the limitations of the applicability of these methods, namely the resource limitations of the WSN, as well as limitations on the types of attacks that can be recognized proactively (primarily multi-step attacks).
Keywords: *wireless sensor networks, proactive monitoring, review of methods, complex objects.*

D. V. Kushnir, O. M. Shterenberg (Vinogradova), A. Y. Khoromskaya
DEVELOPMENT OF A SYSTEM FOR PROCESSING FUZZY MODELS OF THE RESULTS OF MASTERING EDUCATIONAL PROGRAMS IN THE FIELD OF INFORMATION SECURITY

In the article, a methodology for evaluating the results of mastering educational programs in the field of information security has been developed and introduced into the software package of the EAIS system. It is based on the theory of fuzzy sets. The method allows for integral accounting of both quantitative and qualitative factors of adaptive testing as part of the intermediate certification of the student's mastering of the discipline of the educational program in the field of information security. Within the framework of the cumulative point-rating system, the use of fuzzy set theory allows you to accumulate points on a 100-point scale for all types of academic work and form a final score for each discipline of the educational program in the field of information security, depending on the maximum possible points set for each volume of work performed.
Keywords: *fuzzy model, educational program, linguistic variable, membership function.*

P. I. Sharikov
A TECHNIQUE FOR OBFUSCATING THE BYTECODE OF A JAVA APPLICATION IN ORDER TO PROTECT IT FROM DECOMPILATION ATTACKS

In this paper, the obfuscation technique is consided, which protects the classes-files of the java-application of the information system from decompilation attacks, both java-modules and individual classes-files. The rationale for the choice of the obfuscation area is given, examples are given. The results of obfuscation of class files according to the proposed method are presented, conclusions are drawn.
Keywords: *bytecode, obfuscation, digital watermark, decompilation, java.*

A. S. Gorshkov, A. S. Stepashkina
ENUMERATOR METHOD FOR SOLVING HEAT CONDUCTION PROBLEMS

The paper proposes a new method for solving the problem of heat conduction using a generating function, an enumerator. The enumerator method allows solving problems in one-dimensional and quasi one-dimensional structures. The analysis of thermal interaction for a chain of particles of the

same type with and without a defect, for a chain of particles of two types is given.

B. E. Malyugin, S. N. Sakhnov, L. E. Aksenova, K. D. Aksenov, A. V. Krasov, V. V. Myasnikova
APPLICATION OF MACHINE LEARNING METHODS IN THE DEVELOPMENT OF AN ALGORITHM FOR THE DIAGNOSIS OF KERATOCONUS

Currently, medical diagnostics is mainly focused on the use of instrumental research methods. Various devices collect a large amount of data, which, together with the development of mathematical methods that optimize learning algorithms, leads to the emergence of automated patient screening systems (Abdelmotaal et al. 2020, Gatinel 2018, Ruiz Hidalgo et al. 2017). The result of using such systems as an additional tool in the arsenal of clinicians is to improve the diagnostic process.

A. V. Epifanov, N. Yu. Abramov, M. A. Epifanova, V. I. Klyazmin, G. Ya. Frolov
DEVELOPMENT OF SOFTWARE FOR CALCULATING THE MODEL OF WIND CURRENTS

The theoretical foundations for calculating wind currents for shallow water bodies are presented, an algorithm for calculating the depth field for each calculation cell using the available discrete data is developed, an automatic function for constructing a 3D bottom model is implemented, the optimal number of iterations for calculating total flows is determined, modern software for calculating wind currents, allowing you to work with modern mapping services and office applications.

CHEMICAL SCIENCES

E. V. Kudriavtseva, A. A. Burinskaya, Yu. A. Sergutina
OBTAINING OF COLLOIDAL SOLUTIONS OF METALLIC IRON AND IRON-SILVER NANOPARTICLES

The authors discuss the issues of obtaining the stable colloidal solutions containing bimetallic iron-silver nanoparticles Ag-Fe and monometallic iron nanoparticles Fe using environmentally friendly reducing agents.

I. N. Ganiev, L. Z. Alieva, A. E. Berdiev, S. J. Alikhonova
KINETICS OF OXIDATION OF ZINC ALLOY TSAMSv4-1-2.5 WITH SODIUM IN THE SOLID STATE

The kinetics of oxidation of zinc alloy TsAMSv4-1-2.5 with sodium was investigated by thermogravimetric method. It was found that the weight gain of alloys during the first 15–20 minutes. oxidation increases rapidly, and then acquires an almost constant value. Oxide films formed at the beginning of the oxidation process do not possess protective properties, which indicates an increase in the rate of oxidation of alloys with temperature in the initial period. An increase in the rate of oxidation of alloy samples with temperature is noted. It was found that sodium at concentrations of 0.05–1.0 wt% increases the oxidizability of the initial alloy, which is accompanied by a decrease in the apparent activation energy from 136.8 to 109.5 kJ / mol. By mathematical processing of the quadratic kinetic curves of the oxidation of alloys, it is shown that the oxidation process is described by the hyperbola equation.

Kh. Z. Karambakhshov, M. Bobomulloev, Sh. R. Samikhov, S. Sh. Safarov
PVA-BASED FILM-FORMING CLEANING SYSTEMS FOR REMOVING CORROSION PRODUCTS FROM ARCHAEOLOGICAL COPPER PRODUCTS FOUND AT ARCHEOLOGICAL EXCAVATIONS MES AYNAK

This article presents an innovative polyvinyl alcohol based film forming system specially designed for the controlled and selective cleaning of copper based artifacts. Traditional cleaning procedures are usually performed using mechanical and chemical methods. The innovative system proposed in this work allows to combine the advantages of chemical and mechanical processing, due to the retention of the complexing agent (EDTA) in a liquid polymer matrix, which is capable of forming a solid thin film upon drying. After processing, the plastic film can be completely removed from the artwork by gentle exfoliation. In this article, the mechanism of film formation has been investigated using thermal analysis and rheology; the role of plasticizers, the volatile solvent fraction, and the amount of EDTA charged are also discussed. Finally, the results of cleaning tests performed on artificially aged samples and on a real example of copper products found from the archaeological excavation of Mes Ainak (Afghanistan) are presented.

S. A. Yakimov, A. V. Koksharov
THE USE OF VARIOUS ACIDS TO IMPROVE THE WASHING OF UNBLEACHED SULFATE SOFTWOOD

Under laboratory conditions, the use of various acids to improve the washing of unbleached sulfate softwood pulp was studied. The addition of acids during the washing of unbleached softwood sulfate pulp in the amount of 3 kg/t of absolutely dry pulp allowed to reduce the content of water-soluble organic substances in the pulp mass after washing the pulp compared with washing without the addition of acids.
Keywords: *water-soluble organic substances, acids, washing of pulp, foaming.*

I. N. Ganiev, P. N. Abdukhalikova, A. E. Berdiev, S. J. Alihanova
EFFECT OF TALLIUM ADDITIVES ON HEAT CAPACITY AND THERMODYNAMIC FUNCTIONS OF ZINC ALLOY TSAMSv4-1-2.5

Modern scientific and technological progress ensures high rates of development of non-ferrous metallurgy. In the total volume of production of non-ferrous metals for industrial use, zinc ranks fourth. Due to its specific properties, zinc and zinc-based alloys are widely used for structural and non-structural purposes due to their specific properties. In recent years, zinc-based alloys have also found application in the manufacture of cast projectors designed to protect marine vessels and metal structures from corrosion. The expansion of the range of zinc products puts forward new requirements for their thermal and thermophysical properties. The paper presents the results of a study of the influence of thallium additives on the heat capacity, heat transfer coefficient and thermodynamic functions of the zinc alloy TsAMSv4-1-2.5. The studies were carried out in the «cooling» mode in the interval 300–500 K. It is shown that thallium decreases the heat capacity, heat transfer coefficient, enthalpy and entropy of the initial alloy, while the Gibbs energy value increases. An increase in the thermophysical properties of alloys and their thermodynamic functions, with the exception of the Gibbs energy, was established with respect to temperature.
Keywords: *zinc alloy TsAMSv4-1-2.5, thallium, «cooling» mode, heat capacity, heat transfer coefficient, thermodynamic functions.*

AUTOMATION AND MANAGEMENT OF TECHNOLOGICAL PROCESSES AND PRODUCTION

D. A. Kovalev, V. A. Sharyakov, O. L. Sharyakova
MODELING OF THE SYSTEM OF AUTOMATIC CONTROL OF POWER UNIT CAPACITY WITH NONUNIFORMITY UNDER CHANGES IN THE TOTAL LOAD OF THE POWER SYSTEM

The questions of application of simulation modeling system for the study of automatic control system of power unit capacity with non-uniformity at change of general load of power system for control of power unit capacity and steam pressure are considered. For the developed simulation models the results of simulation are given, the analysis of which makes it possible to demonstrate the correct operation of the power unit capacity and steam pressure control system.
Keywords: *simulation modeling system, control object, heat source, increase of operation efficiency, automatic control system, power unit capacity, superheated steam pressure control, cascade control scheme.*

E. V. Korsa-Vavilova, E. V. Naumenko, A. Ya. Shmelev, V. L. Gibalov, V. L. Bozhko
ALGORITHM FOR FUZZY CONTROL OF WATER OZONATION DOSE AT WATER SUPPLY STATIONS

The article considers the synthesis of an algorithm for fuzzy control of the dose of ozonation of drinking water at a water supply station based on the classical principle of deviation control and fuzzy control methods. At the same time, the complexity of constructing algorithms for controlling the ozonation process based on an analytical model of the processes occurring in the module of the ozonation generator is shown. To obtain a mathematical model of the fuzzy control algorithm, basic term sets of input and output variables of linguistic variables are introduced, and a fuzzy inference system based on fuzzy linguistic statements in the form «βi is $\tau T j$». is used. The base of the ozone dose control rules in the ozonation generator module is written in the form of a multidimensional matrix $Liklr$. The developed fuzzy control algorithm will ensure the efficiency and flexibility of the process of controlling the ozone dose in the ozonation generator module.
Keywords: *control, ozone, dose, fuzzy set, fuzzy control, linguistic variables, basic term sets, membership function, fuzzy inference system, fuzzy linguistic statements, rule base.*

Gorobchenko S. L., Kovalev D. A.
DEVELOPMENT OF AUTOMATED PROCESS CONTROL SYSTEMS BASED ON THE LAWS OF DEVELOPMENT OF TECHNICAL SYSTEMS

Although automated process control systems (automated process control systems) are technical systems, however, with the application of the laws of the development of technical systems (SRTS) to them, some features are revealed. Among them, one of the important places is occupied by the need for an integrated approach to various subsystems of the automated control system and a large

proportion of the «virtuality» of subsystems in the automated control system. The article is devoted to the disclosure of the issues of the use of SRTS in the automated control system and the ways of developing automated control systems based on them.

Keywords: *automated control system, technical systems (TS), laws of development of technical systems (SRTS), difference of automated process control systems from a technical system, integrated approach, mathematical effects, resources of automated process control systems, specifics of the action of SRTS in automated process control systems, adapted lines of evolution of automated process control systems, modeling of the development of automated process control systems.*

E. P. Dyatlova, I. V. Remizova
OPTIMIZATION OF THE PROCESS OF BLEACHING THERMOMECHANICAL MASS
The question of finding the optimal bleaching conditions, providing the maximum increase in TMM whiteness. Developed an algorithm for selecting the optimal conditions of the TMM bleaching process.
Keywords: *thermomechanical mass, whiteness, mathematical model, regulatory system.*

V. Yu. Ivanov, D. A. Shurygin
ABOUT DIGITAL REGULATION OF AIR FLOW TEMPERATURE
A scheme of digital regulation of the air flow temperature has been developed. On the basis of the experimental stand, the need to clarify the structure and software of the automatic temperature control system was determined.
Keywords: *digital controller, temperature, regulation law, test bench*

K. G. Pugin, I. E. Shayakbarov
IMPROVING THE RELIABILITY OF HYDRAULIC SYSTEMS OF CONSTRUCTION AND ROAD VEHICLES OPERATED IN WINTER IN THE ARCTIC ZONE OF THE RUSSIAN FEDERATION
According to the observations of experts, when operating machines at low temperatures, it is associated with problems, and first of all, these are problems with hydraulic fluid. Its properties change with a decrease in temperature, the oil becomes thick, which makes it difficult to pump it through hydraulic lines. The solution to this problem was the installation of heaters in hydraulic tanks, however, this method is not devoid of negative aspects, namely in technology where the executive body (hydraulic cylinder or hydraulic motor) is at a significant distance from the tank, the heating of the body itself is not carried out. At the moment of a sharp supply of hot oil to the cold body, an uneven temperature expansion of the elements of the executive body occurs, as a result of which the process of jamming and failure of the machine is possible. Thus, improving the reliability of hydraulic equipment of equipment operated in areas with low temperatures by minimizing the influence of uneven thermal expansion of hydraulic system elements, which may result in increased wear or failure of components due to jamming of elements, is an urgent task.
Keywords: *hydraulic drive, construction and road vehicles, heat stroke, computer modeling.*