

18. SIMPOZIJ „MATERIJALI I METALURGIJA“ „Zbornika sažetaka“

18th SYMPOSIUM „MATERIALS AND METALLURGY“ “Book of Abstracts”

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Review – Prikaz

Summaries

1. B. Zhang, Q. Liu, Z. Li, Y. H. Zhong, Y. Q. Cao, L. D. Jiang, Q. H. Xiao

Study on the influence of nozzle brick structure on the tail coil of molded steel ingot. Mold casting has unique advantages in the production of complex shape, large single weight and small batch steel ingot. In the field of special steel, continuous casting still can not be replaced, but the quality problem of steel ingot is still the key bottleneck problem restricting the high-end of its products. At present, the industrial production often focuses on how to control the loose hole defects inside the ingot, generally ignoring the ingot surface and subcutaneous slag rolling problem. In view of this, with the study of 2,8 t octagonal ingot on the edge of arc, the influence of the nozzle brick structure in the average diameter of the nozzle is 40 mm and the cone of the nozzle is above 0,20.

2. B. H. Wang, Z. J. Wei, Y. Q. Yan, X. C. Meng, J. J. Wang

Effect of tempering temperature on microstructure and properties of high nitrogen stainless steel skates. The results show that when the tempering temperature is 180 ~ 550 °C, the hardness, tensile strength and yield strength decrease first, then increase and then decrease rapidly. The test steel reduces carbon and increases nitrogen, and there is no coarse eutectic carbide in the structure. When the tempering temperature is 500 °C, the matrix structure is tempered sorbite, carbide M₂₃C₆ and nitride Cr₂N are finely dispersed and evenly distributed on the matrix. Secondary hardening occurs when tempering at 500 °C, and the strength and hardness reach the peak, which is related to the dispersion strengthening of carbonitride. The experimental results provide theoretical guidance for high carbon steel in the process of making skates.

3. B. H. Wang, J. Y. Zhang, X. Zhao, G. Q. Zhang, J. J. Wang

Effect of annealing temperature on microstructure and properties of ti-3al-1,5fe-1cr titanium alloy golf club. Titanium alloy is a common material of golf clubs. Ti-3Al-1,5Fe-1Cr titanium alloy is a relatively successful golf club material because it enhances the anti-elasticity of golf clubs. The Ti-3Al-1,5Fe-1Cr dual phase titanium alloy was studied. The microstructure and mechanical properties of the alloy after annealing treatment were studied. The effects of annealing treatment on the microstructure, hardness, strength, plasticity and toughness of the alloy were clarified. After annealing treatment, the microstructure of the alloy is composed of cluster-like staggered lamellar α phase and β phase. When the annealing temperature is 850 °C, the hardness of the alloy is the highest 447 HV, the tensile strength is the highest 958 MPa, and the elongation after fracture is 16 %.

4. M. Trehub, Yu. Trehub, I. Mamuzić

Land management for the metallurgy industry. Land management in the metallurgical industry involves spatial planning, organisation and regulation of land resources to support metallurgical activities and ensure sustainable development of territories. This process includes various aspects that meet the specific needs and objectives of metallurgical enterprises. The main components of land management for metallurgy are: site selection and acquisition, zoning and land use planning, environmental impact assessment, land reclamation, and infrastructure development. Effective land management in the metals industry involves a multidisciplinary approach that integrates technical expertise, environmental considerations, social responsibility and regulatory compliance to support sustainable development and responsible use of resources.

5. V. Nazarenko, H. Brui, O. Kuchin, I. Mamuzić

Surveying instrumental observations of displacement of mine workings contours. Maintenance and accident-free operation of underground mine workings in difficult mining and geological conditions, which are characterized by unstable, watered rocks, is provided by the use of anchor and frame-anchor supports. Periodic leveling of the reference points and anchors of the support provides information about displacements in separate sections of mine workings at different time intervals and in different areas. Measurements were made in the pumping drift at a depth of 300 m. Mine length is 2550 m, average inclination angle is 4 °, excavation cross-section S=14,6 m². The excavation is secured by rows of anchors with a step of 0,6-0,8 m.

6. O. Yankin, A. Zuska, A. Hoichuk, I. Mamuzić

Geodetic determination of geometrical parameters of overhead cranes in metallurgical enterprises. Metallurgical plants use special overhead cranes. When the main actual parameters of crane tracks deviate from the designed ones, the load-bearing elements of the metal structures of the cranes are under additional loads, which leads to their deformation, and the elements of the crane structures fray and collapse. Research has been carried out to determine the magnitude and nature of changes in the spatial position of crane tracks depending on their service life, external and internal parameters. A technique has been developed for geodetic control of crane tracks using a robotic electronic total station, which allows measurements to be taken from points located on a rigid base, which is more reliable and safe.

7. V. Kamenets, V. Piliuhyn, Y. Gavrytskov, I. Mamuzić

Use of low-alloy steels in production of mine frame supports. At coal mines of Ukraine at carrying out of mine workings frame metal fasteners from a profile of SVP type are universally used. They are made of steel grade 5PS by its hot rolling. Widespread use of these supports is due to relatively good physical and mechanical properties of the material and its relative cheapness. Currently, during mining operations there is a tendency to complicate geological conditions, which leads to an increase in the metal intensity of fasteners. The way out of this situation is the use of stronger and more “enduring” types of steel in the production of mine profile.

8. N. Vozna, I. Mamuzić

Theory of structuring multifunctional elements of complex information and measurement systems. This report clarifies with the problem of formalizing elements and binary relations multifunctional data. The concept of free and active element of a complex system and their classes relatively interaction with the environment resources and consumer information messages. The aim is to formalize elements and binary relations multifunctional data in complex systems. Proved the concept of free and active element of a complex system. Classified six attributes of binary relations elements such as: information, material, energy, optical, management. Outlined the fundamentals of the theory to solve the problem of structuring multifunctional data defined and the concept of an element of a complex system.

9. A. I. Segin, I. Mamuzić

Construction of correlation models of periodic processes in the polar coordinate system. A large number of investigated processes in nature and technology have a cyclic or rotational nature. When studying the mutual influence of such processes on the basis of correlation analysis, it is suggested to use a polar coordinate system. Since most periodic processes in the polar coordinate system have a much simpler mathematical description, it allows to significantly simplify calculations and provides a clearer graphical representation of the results. In addition, the construction of correlation models of such processes in the polar coordinate system allows one to take into account the cumulative effect of multiple repetitions of weak relationships, which in the end may have a significant value.

10. A. I. Segin, Y. I. Popyk, I. Mamuzić

System of automatic translation of verbal audio streams in real time. With the development of information technologies, the exchange of information between people and organizations of different countries of the world has accelerated. However, the problem of fast, reliable, simultaneous translation of the speaker's speech in real time into several other languages remains. The proposed system of simultaneous automatic translation in real time allows to solve this problem when it is used in various international conferences and events. This system solves the task of dividing verbal flows into separate phrases, their automatic translation from one language to the selected languages of other participants using artificial intelligence with preservation of context and an acceptable time delay.

11. C. Kolmasiak

Selected aspects of decarbonization of production systems in the metallurgical industry. This paper discusses the growing importance of decarbonising production systems in the metallurgical industry as a response to climate challenges and increasing sustainability requirements. Many solutions are currently being implemented and tested in the metallurgical industry, but the problem of meeting the carbon emissions target remains complex and difficult. The metallurgical industry is one of the branches of industry that generates significant amounts of carbon dioxide emissions due to the energy consumption during the metal melting and forming process. The paper presents several possible decarbonisation strategies available to smelters, such as the use of renewable energy, the utilisation of more efficient melting technologies, or the implementation of low-energy technologies throughout the production process. Application examples from different countries illustrate how these strategies are already being applied in practice, as well as potential obstacles and challenges on the road to full decarbonisation.

12. C. Li, X. G. Li

Fourier series method for function synthesis of space rccc mechanism. Metallurgical equipment needs to use a large number of linkage mechanism to achieve the given movement requirements, compared with the plane four-bar mechanism, the movement of the spatial mechanism is more stable, this paper through the study of the spatial RCCC mechanism, to establish a new method to realize the function synthesis of the mechanism of the algebraic solution, for the spatial mechanism in the metallurgical equipment in a wide range of applications to lay a theoretical foundation.

13. C. F. Wang, J. J. Wang

Effect of quenching temperature on microstructure and properties of 0Cr13Ni8Mo2Al stainless steel for piano stringer. T Stainless steel, as a common material for piano stringer, has the advantages of high strength and good toughness. 0Cr13Ni8Mo2Al stainless steel meets the strength and enhances the toughness of the piano string machine, so it is a relatively successful golf club material. A new type of 0Cr13Ni8Mo2Al stainless steel was studied. The microstructure, hardness and tensile properties of the stainless steel after quenching treatment were studied. The effects of quenching treatment on the microstructure, hardness, strength, plasticity and toughness of the alloy were clarified. The experimental results show that the best quenching process of stainless steel is 515 °C, the hardness is the highest 45.7 HRC, the tensile strength is the highest 145 MPa and the elongation is 13.8 %. This study has a certain guiding role in the development of piano stringing machine materials.

14. N. Vozna, O. Zastavnyy, I. Mamuzić

Information and measurement system of microclimate control based on wireless sensor networks. With the development of automation systems and wireless technology, information and measurement systems are widely developing. In particular, the spread and development of wireless systems, which have better characteristics regarding the deployment and modification of the system, is gaining popularity. The work deals with wireless systems based on modern sensor networks and their features regarding energy consumption and deployment. The use of wireless systems makes it possible to change the system configuration. This is especially relevant in experimental systems and provides an opportunity to improve system performance with minimal costs.

15. I. Pitukh., A. Sydor, N. Vozna, I. Mamuzić

Peculiarities of the influence of external dynamic factors on the functional characteristics of high-voltage electrical networks. The work investigated the characteristics of interactive information and measurement systems based on the criterion of emergency. A study of the dynamics of impacts on power grids was conducted. The probabilistic characteristics of the effects on the operation of working substations are given. It is shown that in order to determine the level of degradation of the energy system, it is advisable to use logical-statistical information models based on the calculation of the matrix of correlation-Hamming and Euclidean distances between technological and structural parameters of high-voltage networks under the conditions of the influence of external factors on the operation of the network.

16. I. Mamuzić, G. G. Shvachych, P. O. Shcherbyna

Study of neural network topologies of network sensor cluster data analysis. Research reveals the problem of creating a neural network for analyzing data from a cluster of sensors. The modeling process can be divided into such stages as data collection, topology selection, pre-processing, training, and evaluation of its effectiveness. Clusters transmit data, such as temperature or movement speed, which are distributed among the nodes of the system. Recurrent neural networks (RNN) are most applicable in one area of the heat treatment process, and multilayer perceptrons (MLP) in several areas, depending on the nature of the analysis task. The above makes it possible to significantly increase the efficiency of the heat treatment process.

17. I. Mamuzić, G. G. Shvachych, P. O. Shcherbyna

Improvement of the cluster structure of network sensors with connection to a distributed system. The studies are devoted to the analysis of promising directions for the improvement of sensor clusters in metallurgy, namely, increasing the accuracy and reliability of the system. To increase accuracy, you can apply information reduction technologies and filtering algorithms. It is also possible to apply grouping with the selection of a master node that will be responsible for data collection, transmission and redundancy, installation of redundant sensors to increase resistance to failures, application of multi-route protocols and autonomous power supply systems. Which will increase the overall efficiency and reliability of the cluster of network sensors.

18. I. Mamuzić, G. G. Shvachych, P. O. Shcherbyna

Multiprocessor system and cluster of network sensors in the problem of metal heat treatment. The research is devoted to revealing the features of the development of a multiprocessor computing system together with a cluster of network sensors for simulating heat treatment conditions of metal workpieces. A special feature of the approach is the combination of sensors for continuous monitoring of metal temperature conditions. It is proposed to connect a cluster of sensors to a distributed system for effective management of technological operations. Cluster data is used to control the temperature conditions of the metal. The proposed system allows for parallelization of data collection and processing, which leads to an increase in overall performance.

19. I. Mamuzić, G. G. Shvachych, P. O. Shcherbyna

Features of using a cluster of network sensors in the problem of heat treatment of metal. To effectively analyze production data at industrial sites during metal heat treatment, the most important elements of collecting information for basic calculations are processing time, temperature parameters, accuracy and system reliability. It is obvious that improving existing technological metal processing processes and creating new ones is possible through the cluster organization of industrial sensors. Under such conditions, a cluster of network sensors is used for distributed control of the technological process of metal heat treatment. Merged sensors can send pre-processed data as needed, reducing network load and reducing latency in data transmission.

20. I. Mamuzić, G. G. Shvachych, P. O. Shcherbyna

Modified technological process for heat treatment of long products. The research is devoted to the modernization of the system for analyzing and controlling temperature processes in the heat treatment section of long products using a distributed multiprocessor computing system. The use of a distributed system based on a cluster network connection of sensors is aimed at improving the technological properties of the product by ensuring high dispersion and uniformity of the sample structure over the entire cross-sectional area. This modernization is focused on obtaining more accurate data on temperature conditions, adds scalability, reduces the load on equipment, increases fault tolerance, ensuring more efficient use of computing resources and electricity.

21. C. F. Zhang, J. J. Wang, M. L. Xu, Q. Liu

Effect of normalizing temperature on microstructure and properties of ductile iron for piano iron plate. Piano iron plate is one of the components that play a decisive role in the quality of piano. In this paper, the effects of normalizing temperature on the microstructure and mechanical properties of nodular cast iron for piano iron plate were studied by normalizing at different temperatures and tempering at the same temperature. The microstructure observation, tensile test and impact test were used to study the effect of normalizing temperature on the microstructure and mechanical properties. The results show that after normalizing at 840 ~ 1 040 °C and tempering at the same temperature, the microstructure of ductile iron is mainly pearlite. In the normalizing temperature range of 840 ~ 1 040 °C, with the increase of normalizing temperature, the impact toughness and elongation of ductile iron increase, while the tensile strength and Brinell hardness show the opposite trend. When the normalizing temperature is 930 °C, the comprehensive mechanical properties of ductile iron are the best. At this time, the tensile strength is 815 MPa, the Brinell hardness is 328 HBW, the elongation is 3,79 %, and the impact toughness is 3.04 J / cm².

22. C. Q. Hu, K. Zhao, X. Q. Hu, J. Ji, Y. Li, W. Jiang, P. Deng

Research on conical plug valve piezoelectric pump applied to metallurgical equipment cooling. In this paper, a valve piezoelectric pump structure is proposed, which provides a method for the cooling of metallurgical equipment and avoids the hidden danger of damage to key components due to long-term exposure to high temperatures. In this paper, the research results of simulated flow rate and test flow rate of valved piezoelectric pump are introduced. The results show that the flow rate of the pump is sensitive to the influence of driving voltage, and it has certain feasibility for the cooling of metallurgical equipment.

23. C. X. Li, X. Meng, Y. Zhang, P. Zhao, H. J. Shen, Z.K. Feng, Z. H. Ji

Study on the participation of blowing co2 in steelmaking reaction of fe-c binary alloy. Based on the concept of green low-carbon and high-efficiency smelting, Fe-C alloys were prepared using industrial pure iron and high-purity graphite powder, and thermal experiments were carried out using a high-temperature tube furnace, and it was found that with the increase of blowing time, the carbon content in the molten pool was reduced subsequently; The reaction rates of CO₂ with (C) were 11,03 %, 12,94 %, 16,51 %, and 18,75 % at blowing flow rates of 10, 20, 30, and 40/ml·min⁻¹, respectively; The decarburization rate increased from 0,0172 %/min to 0,0289 %/min, and the decarburization reaction rate is subsequently increased 1,68 times.

24. N. Vozna, I. Mamuzić

The theory of structuring multifunctional data. The assessment of structural complexity is based on the modern theory of structuring multifunctional data. According to this theory, graphic components are classified and their importance is expertly evaluated to determine the structural complexity of graphic images. The developed classification allows for an integral assessment of the structural complexity and information value of alphanumeric, graphic information, schematic solutions of microelectronics and computer equipment components, computer system architectures and their models, methods of presenting algorithms, mathematical figures and functions. This theory can be effectively used for any graphic document. This allows solving the task of comparing the structural complexity of different classes of multifunctional data in order to optimize the system characteristics of the data.

25. N. Vozna, I. Mamuzić

Application of structuring theory to estimate amino acid structures. The theory of structuring multifunctional data is useful for evaluating the structural complexity of amino acids and nucleotides A, T, G, C, which are chemical components of DNA structures. This approach makes it possible to determine the peculiarities of their structure. The synthesis and analysis of these structures require a clear definition of the system of criteria, on the basis of which the comparison and optimization of system characteristics is carried out. Substantiation of the theory based on a system of criteria for assessing the structural complexity of biologically active substances allows solving the task of comparing structural complexity and structural organization, optimizing characteristics for the purpose of their further improvement.

26. N. Vozna, I. Mamuzić

A method of statistical processing of RGB pixel data of color images. The paper analyzes the system characteristics of Charge Coupled Device RGB-pixels of color images and their scope of application in scientific, industrial and military fields. The volumes and rates of formation of data streams represented by byte-oriented codes of RGB pixels by the codes of the Rademacher and Crestenson counting systems are determined. The proposed method of statistical processing of RGB pixel data, which is used in the construction of cumulative histograms in image recognition algorithms. A structural diagram of a high-performance processor for determining selective mathematical expectation was developed. Compared to known devices of this class, the achieved calculation speed is increased by 1-2 orders of magnitude.

27. N. Vozna, A. Dunets, V. Shevchuk, V. Vozniak, I. Mamuzić

Automation of technological processes in the oil and gas industry. Oil and gas extraction takes place in difficult meteorological and environmental conditions, therefore, for the normal functioning of an oil and gas production enterprise, it is necessary to ensure the reliable operation of automated equipment, remote monitoring of the operation of technological facilities and their condition. The efficiency of oil and gas production facilities can be achieved with automatic management of technological processes in the optimal mode. To solve the problem of designing a system of optimal automatic control of technological processes, the degree of influence of its parameters on the output indicators is determined.

28. T. A. Zheldak, I. Mamuzić

Mathematical model of an order implementation plan construction of a metallurgical enterprise with a wide range of finished products. A new model, considering the time of equipment reconfiguration, is proposed in the article. The model is based on an equilibrium convolution of four criteria: maximum revenue from orders implemented in accordance with the established terms; the minimum cost of work in progress during the planning period; minimum equipment downtime and minimum losses from orders which are not implemented. The optimization problem is solved as a traveling salesman problem in the maximum metric. The application of the described model enabled to build plans for real flows of weekly and monthly orders of metallurgical enterprises of Dnipro region, which are better which were obtained by traditional methods.

29. T. A. Zheldak, I. Mamuzić

Mathematical model of the metal amount minimization used to produce a certain order in two-stage rolling production. A mathematical model of minimizing the amount of metal for the order fulfillment for rolled products, the size of which does not exceed the volume of one melt, is considered. The model is based on the previously known optimal size of the repartitioning blank, its cross-section and the desired cutting of the finished product. The constraints of the problem are the maximum and minimum weight of the discharge and the length of the dividing blank of a certain cross-section. Application of the developed model as part of the decision-making support system in two-stage rolling production made it possible to reduce the metal consumption ratio.

30. T. A. Zheldak, I. Mamuzić

Application of inverse dependencies in mathematical models of complex objects and systems. The principle of restoring the mathematical dependence of the control functions of deoxidation and mechanical characteristics of finished products on the chemical and physical parameters of steel production in the oxygen converter is proposed. The novelty of the author's approach is the use of negative degrees of predictors in regression models and the application of a penalty function on the dimension of the approximation polynomial. The described approach enabled to increase the physical correspondence of models of the essence of processes in steel. The scientific result of the work is the possibility of obtaining forecasting models of optimal complexity through self-organization.

31. D. H. Li, Y. Q. Cai, Q. Q. Yin, H. L. Wang

Active disturbance rejection control of electro-hydraulic servo system. LADRC (Linear Active Disturbance Rejection Control) is a control method based on real-time estimation and compensation of internal and external disturbance of the system. The basic idea is to set up a dynamic and real-time interference observer to estimate all kinds of interference to the system, and use these estimates to adjust the output of the controller in real time, so as to suppress the ability of the system to be affected by interference and realize the accurate control of the system.

32. G. Shvachych, B. Moroz, P. Shcherbyna, D. Moroz, N. Vozna

Metal heat treatment system based on the use of a cluster of networked industrial sensors. The features of the development and use of a multiprocessor computing system together with a cluster of network sensors for modeling heat treatment conditions of metal workpieces are considered. The main goal of the study is the cluster integration of industrial sensors for continuous monitoring and control of metal temperature conditions in various areas of the production process. It is proposed to connect a cluster of sensors to a modular multiprocessor system in order to increase the speed and performance of calculations, which helps to increase the efficiency of managing technological operations. In this case, the data from a network of sensors combined into a cluster are used to monitor the temperature conditions of the metal.

33. H. C. Ji, R. Zhang, N. Z. Kang, J. H. Huang

Simulation analysis of wheel bearing forging process based on deform. Aiming at the complex structure of wheel hub bearing parts, which is difficult to form, an upsetting-pre-forging-final forging forming process is adopted after process analysis. A three-dimensional finite element model is established by Deform software to study the process of wheel hub bearing forging, and the distribution law of temperature field, equivalent stress field and other important fields in the forging process are systematically analyzed. The influence of forging process parameters on the forming quality of wheel hub bearings is studied. Based on the results of Deform simulation, the optimal forging process parameters are used in the actual forging production, and the forging parts obtained have clear hierarchical levels in each region and good forming quality. The experiment verifies that the forging is complete and meets the product requirements under the optimized process parameters, which provides theoretical and technological guidance for the hot die forging of wheel hub bearing parts.

34. T. A. Zheldak, I. Mamuzić

A hybrid optimization method based on artificial immune systems modelling with adaptation. The author proposed a hybrid adaptive optimization method, which uses the operators of selection, information exchange, mutation and population compression. The clonal selection operator uses Saati's principle of pairwise comparisons. Adaptive crossover selects the degree and type of data exchange between search agents. The adaptive mutation operator simultaneously implements the mechanisms of search diversification and intensification. The population compression operator prevents premature convergence and ensures variability of solutions. The author justified the restrictions on the numerical parameters of the mentioned operators. The application of the proposed method for obtaining optimal solutions of planning, management and control problems as part of the metallurgical production control system.

35. T. A. Zheldak, I. Mamuzić

Recommendation systems of the converter operator in the processes of steel refining and deoxidation. The methods of self-learning of the converter production operator recommendation system, based on the analysis of previous activities, were further developed. For the steel refining process, it is proposed to use a learning mechanism based on a constructed pattern of behavior based on the most successful previous actions. A self-learning method based on a naive Bayes network with correction for human behavior is proposed for the steel deoxidation process. The use of improved self-learning methods in the processes of refining and deoxidation of steel allows to significantly reduce the influence of the "human factor" on smelting and the use of ferroalloys.

36. N. Vozna, I. Mamuzić

A new look at structuring multifunctional elements composition. This article deals with the problem of formalizing elements and binary relations multifunctional data, which are components of cyber-physical systems. The free and active element of a complex system and their classes relatively interact with the environment resources and consumer information messages. Classified six attributes of binary relations elements: information, material, energy, optical, management, and general. Present table four classes of active interaction between elements of complex systems of signs: generating absorbing, transit, full-featured. Theoretical principles of assessment of structural complexity of binary and multi-level images. Outlined the fundamentals of the theory to solve the problem of structuring multifunctional data defined and the concept of an element of a complex system.

37. N. Vozna, B. Maslyak, I. Mamuzić

Ontological approach to creating subject-oriented technologies in the field of IoT. The work is devoted to the development of subject-oriented ontologies in the field of measurements and IoT technology in order to obtain new knowledge. A generalized method of ontology construction, its general components: concepts, relations, axiom derivation rules are proposed. In the knowledge base, it is proposed to include algorithms for measuring accuracy and reliability - determination of errors, prediction of their future values, laws of distribution of their random component, determination of periods of calibration and verification of measurement channels, prediction of the reliability of the operation of both the IoT system and its components.

38. N. Vozna, I. Mamuzić

Analysis of structures based on euclidean distance in 2D-hamming space. Structuring includes the interaction of the components of 2D images, therefore it is advisable to apply the theory of MFD structuring to assess the structural complexity of amino acids and the structures of nucleotides A, T, G, C, which are chemical components of DNA structures, in order to determine their structural properties and highlight structural features. In this article, the theory of the structuring of MFD was applied in the assessment of the structural complexity of amino acids. On the basis of the mathematical apparatus, in accordance with the determined weighting factors α_r , estimates of the Hamming distance (d) were calculated, which made it possible to determine the smallest and largest values.

39. O. Zastavnyy, A. Segin, I. Mamuzić

Promising communication protocols for IOT. The article discusses communication protocols for IoT and their characteristics. At the same time, emphasis is placed on consideration of protocols for low-power systems, since many modern devices operate on autonomous power, which simplifies the installation of such systems. The prospects of the 6LoWPan protocol are considered, which allows work on the IPv6 protocol, which allows devices to have a unique address, and provides easy integration into modern computer systems. Protocols that ensure the use of IoT technologies in smart city systems or agriculture, where the system itself is distributed over fairly large territories, are also considered. In particular, a comparative analysis of such protocols as: NB-IoT; Thread; Wi-Fi HaLow; Sigfox; UWB and others.

40. A. Davletova, I. Mamuzić

Research on methods to enhance security and reliability of information exchange in communication networks. The work is devoted to the research on integrating data encryption with error correction methods, enhancing secure and reliable information exchange in modern networks and communication systems. Proposed a comprehensive solution combining asymmetric encryption algorithm with error detection and correction codes. Encryption ensures cryptographic protection of information from unauthorized access, guarantees data confidentiality, integrity, and authenticity. Error correction mechanisms reduce the probability of information loss or corruption during transmission through unstable communication channels. Conducted an analysis of the advantages associated with integrating these two approaches, particularly in the context of information security. The research findings can improve data transmission quality, crucial for modern information technology development.

41. J. X. Zhu, X. Liu, Z. C. Xu, C. Y. Han, C. A. Dai, X. C. Qian

Signal-to-noise analysis of the elevator boosting performance of flat-tube-and-fin heat exchanger. In this work, after the elevators shaped by NACA 0012 were proposed for the Flat-tube-and-fin heat exchanger (FTFHE) with an experimental validation, a signal-to-noise (SNR) analysis was considered for the contribution rate (CR) of structural parameters. It is found that, for CR, chord length dominates with 43,44 % as the minimum 13,11 % escort orientation point. Besides those, the mounted angle of 0°, the chord length of 6,4 mm, the extruded length of 1 mm or Orientation point 6 might only benefit heat transfer, while 8°, 6 mm or 0,9 mm purely serves pressure loss disregarding orientation point.

42. Z. X. Li, Z. P. Liu, J. T. Yu

Prediction of carbon black/carbon nanotube reinforced polydimethylsiloxane properties based on bp neural network. Sensory structure integration is the future development trend of flexible robots. At present, polydimethylsiloxane (PDMS) is often used as the main structural material for flexible robots, in which the addition of conductive fillers can achieve the perception of external forces and temperature. Therefore, it is of great research value to explore the road-writing properties of doped PDMS. This paper focuses on the mechanical properties of carbon black (CB)/carbon nanotubes (CNTs) doped PDMS on the line, aiming to promote the development of flexible robot industry.

43. L. L. Meng, W. Dai

Research on motor overvoltage issues in metallurgical environments using three-level inverters. Industries such as nuclear power plants and underground mining are characterized by space constraints, forcing the use of long-wire cables to power motors. The impedance mismatch between long-wire cables and motors leads to overvoltage phenomena at motor terminals, especially when the cable length is long or the transmission frequency is high. In this paper by analyzing the expressions of the peak voltage at the motor terminal of the two-level and three-level inverters, we explain the mechanism of the three-level inverter to suppress the overvoltage at the motor terminal, and build the inverter-long-line cable-motor system for simulation to verify the correctness of the conclusion.

44. S. Kulyna, I. Mamuzić

The main tasks and principles of digital forensics in the conditions of war. The article examines the connection between digital forensics and cyber security in the context of a military invasion. The proposed algorithm for the digital forensics process includes the extraction, visualization and analysis of digital data, as well as the compilation of a report on the collected evidence. In wartime, the recovery phase is the most difficult, as digital evidence may be located outside the country's jurisdiction. After receiving relevant digital data, the researcher performs a keyword search in the digital media environment or restores damaged or extracted data. Extracted digital artifacts are analyzed and reconstructed to determine the involvement of the digital event in the cybercrime itself.

45. G.G. Shvachykh, M.V. Ievlanov, R.O. Havrilov, I. Mamuzić

Web-based platform developing features for software installation. Today, there is an increasing development of computer technologies, mobile systems, devices, and advanced operating systems that provide greater efficiency and quality of technical devices. The available variety of web resources and applications only ensures that some of the users' requirements to maintain efficient operation of devices are met due to imperfect and limited organization system of such resources and platforms. That leads to creating a better and advanced web platform for organizing technical support for users' devices and companies. The developed platform's peculiarity is that user's profile can view the history of software downloads and re-downloads. Besides, user profile will have a block with recommendations for OS: Windows, MacOS, Linux, Android, iOS, and iPadOS.

46. G.G. Shvachykh, B.I. Moroz, R.O. Havrilov, I. Mamuzić

Web-based platform development for optimizing the performance of desktop and mobile software. Developed web platform offers systematized software for the most existing desktop and mobile operating systems and provides a user-friendly interface that makes software selection and download a breeze. It allows selecting an individual package of licensed software depending on user's needs and ability to save selected individual software packages in their profile to optimize work and time. Key features of developed platform are that it can recommend software for specific personal activity areas like video recording, streaming, device maintenance, etc. It also provides a user-friendly interface to get the download page in Google Play or the AppStore, depending on the pages OS: Android, iOS, and iPadOS. The structure of such pages will also change slightly.

47. G. G. Shvachykh, A. L. Shyrin, T. P. Karpova, I. Mamuzić

Web application development is used to promote a company in the digital space. The research aims to create a web application for the company's marketing promotion in the digital space. The website is available around the clock, all year around, from anywhere in the world, making the business accessible even beyond working hours. All marketing efforts, regardless of whether the business is online or offline, should grow out of and lead to a custom, stunning, and informative webpage. So, a website is a priority and the first step to success. Apart from attracting new customers, a modern and well-designed website can build trust among existing customers and partners. It can also help establish the studio's professionalism and reputation in the industry, leading to larger and more profitable projects.

48. G. G. Shvachykh, I.G. Hulina, B.V. Kuznetsov, I. Mamuzić

Securing features of an enterprise website from cyber threats. Ensuring website security is not just a task, it's a mission-critical necessity to protect website and data from various cyber threats. The cyberattacks consequences can be severe, including revenue loss, recovery costs, brand reputation damage, trust loss, and heavy fines for failing to protect identifying information. Unprotected websites can negatively impact a company's online reputation and rankings on search engines like Google. By securing their websites, companies can improve their SEO and ensure that their websites are properly indexed, leading to increased visibility and traffic. There are several ways to secure a website, with best practices falling into four categories: technical measures, coding and design, access control and user management, and backup and recovery plans.

49. G. G. Shvachykh, M. V. Ievlanov, M. O. Aleksieiev, I. Mamuzić

Research on methods of protecting enterprise websites from cyberattacks. The analysis of best practices for protecting a website from cyberattacks showed that they can be divided into four categories: technical measures, coding and design, access control and user management, and backup and recovery plans. Technical measures include using SSL certificates to encrypt and block malicious traffic, security plug-ins, or threat-scanning software. The research reveals the specifics of using an SSL certificate to protect user data, verify website ownership, prevent attackers from creating a fake site version, and gain user trust. That is very important for a wide range of businesses. It is also shown that backup and recovery plans are another necessary aspect of website security.

50. L. L. Meng, Z. Y. Zhang, S. J. Liu, H. Z. Zhao, Y. L. Zhang

Rotational speed observation of a metallurgical lifting motor based on the delta operator. In metallurgical and mining applications, it is not easy to install speed sensors, so the speed of the lifting motor is usually obtained using a speed observer. To solve the instability problem of traditional speed observers in practical applications when the sampling period is reduced after discretization based on shift operators, a new type of speed observer for discrete-time systems is analyzed and designed. The speed observer introduces the Delta operator, which improves the problem of unstable observation data caused by high-frequency sampling in traditional speed observers. And by establishing a motor speed observation system through simulation, the correctness of the conclusion was verified.

51. L. Q. Zhao, L. C. Sun

Research on constitutive model of rheological behavior of 7050 aluminum alloy based on metal material of badminton racket frame. In order to improve people's experience of badminton and improve the performance of badminton rackets. The flow stress behavior of 7050 aluminum alloy for badminton racket frame metal material was studied under the conditions of strain rate range of $0,01 \sim 10 \text{ s}^{-1}$ and deformation temperature of $573 \sim 723 \text{ K}$. The true stress-strain curve of 7050 aluminum alloy was obtained. According to the real stress-strain curve, the Arrhenius constitutive model of 7050 aluminum alloy was constructed. The results show that obvious dynamic recovery and dynamic recrystallization occur in the hot compression deformation of 7050 aluminum alloy. The flow stress increases with the increase of strain rate and decreases with the increase of temperature. The theoretical stress value predicted by the constitutive model is fitted with the experimental value, and the correlation is 97,3 %. The constitutive model has high prediction accuracy.

52. M. Łągiewka

Mechanical properties of die-cast composites reinforced with natural and synthetic graphite. This paper presents the results of mechanical tests on AlSi10Mg alloy matrix composites reinforced with natural and synthetic graphite particles. The natural graphite used as reinforcement in the composite

was flake graphite of very high purity, chemically refined, while the synthetic graphite came from recycled graphite electrodes used in electric arc furnaces. Composite slurries containing 5, 10 and 15 % graphite particles were die-cast on a cold chamber die casting machine. Samples of pure AlSi10Mg alloy were also cast.

53. G. G. Shvachych, L. I. Meshcheriakov, I. A. Pobochii, I. Mamuzić

Features of using the Figma computer platform in website development to promote a company in the digital space. It is necessary to use modern computer technologies to develop a high-quality web application. This study used the Figma platform to prototype and design the website. It is a powerful cloud-based design tool similar to Sketch in terms of functionality and capabilities but offers several distinct advantages that make it particularly suitable for team collaboration. One of the key advantages of this platform is its compatibility with any operating system that can run a web browser, including Mac, Windows PC, and Linux OS. Due to its browser-based nature, Figma enables seamless collaboration between team members, similar to the collaboration features of Google Docs.

54. G. G. Shvachych, M. O. Aleksieiev, A. A. Martynenko, I. Mamuzić

The use of non-relational databases in processing hierarchical data structures. The research is devoted to the MongoDB database use. MongoDB, with its flexibility, performance, and scalability, empowers developers in various fields, from web development to data analytics. It is known for its flexibility in storing data in JSON format, which makes it ideal for rapid prototyping and easy scaling. Using MongoDB allowed us to store complex objects, which greatly simplified the development process and allowed us to change the data structure quickly. One of the main features of MongoDB is its document-oriented data structure. Unlike relational databases, which store data in tables with rigidly defined schemas, MongoDB stores data as documents in BSON (Binary JSON) format, giving developers the freedom and efficiency they need.

55. G. G. Shvachych, I. A. Pobochii, Y. M. Friman, I. Mamuzić

Integration features of web applications with payment systems. Research reveals the integrating web applications peculiarities with LiqPay payment system. One of the main features of LiqPay is its simplicity and integration ease with various payment systems. That application provides a well-documented API allowing developers to connect payment capabilities to applications quickly and easily. API supports multiple programming languages offering flexibility and ease for developers with different technological backgrounds. LiqPay supports many payment transactions, including one-time payments, recurring payments, user money transfers, invoicing, refunds, etc., to allow meeting various business models' needs, from simple online stores to complex financial services. One of the key features of LiqPay is multi-step authentication support to ensure a high security level for financial transactions and protect from fraud.

56. G. G. Shvachych, D. M. Moroz, A. A. Martynenko, I. Mamuzić

Gaming application development to improve reactionary skills and train coordination. The research is devoted to creating a game application that is more original than others on the market and combines multimedia elements created in different programs. The application aims to improve users' accuracy, speed, and reaction through exciting and interactive gameplay. The game encourages players to make strategic decisions, providing an adaptive environment and progressive difficulty, taking the right position, and overcoming obstacles in time to progress through the levels. The user can control a character with different mechanics, overcome platform and gravitational obstacles, monitor health resources, and replenish them quickly. The program includes enemies with simple artificial intelligence and uses Raycast technology to find the player's character.

57. G. G. Shvachych, B. I. Moroz, L. V. Kabak, I. Mamuzić

Computer technologies usage for game application simulation. When creating a gaming application to improve reactionary skills, train accuracy, speed, and actions coordination for effective strategic decision-making, software with the C# programming language on the Unity game engine in the Visual Studio Code development environment was used. This project main programming language is C#, a popular and effective cross-platform language for creating applications. The project is developed on the Unity game engine, which supports the above programming language and allows simplifying work with its add-ons. The engine is known for its ease of creating dynamic experiences and cross-platform compatibility. This project uses Visual Studio Code, an integrated development environment (IDE) that supports many languages, libraries, and plug-ins to write and modify the code.

58. G. G. Shvachych, B. I. Moroz, O. M. Aleksieiev, I. Mamuzić

Software development to automate the ordering of the enterprise components. The study is devoted to developing software to automate the ordering of enterprise components. The developed system's main functionality includes managing users and their roles, order processing, and product management. Such a system provides automated data collection, processing, and manipulation, which can significantly improve the efficiency of the enterprise. The software was developed using modern technologies and programming languages, such as C# .NET 8 for the server side and React.js for the client side. These technologies were chosen based on their reliability, flexibility, and community support. The system's architecture uses ASP.NET Core Web API to build a scalable and reliable backend and React.js to create a dynamic and user-friendly interface.

59. M. H. Pang, B. Z. Wang

Effects of coolants on the properties of igt liquid cooled plates under different materials - a review. The thermal performance of Liquid-cooled plate (LCP) can be improved by using different kinds of materials and coolants. Suitable and effective coolant can bring better cooling capacity to cope with the impact of high temperature on IGBT chips, and improve the safety and service life of new energy metallurgical loaders. In this context, the recent progress of the effects of traditional coolants, nano-fluids, ethylene glycol and oil on the heat transfer capacity of the liquid cooling plate is reviewed in detail. Nanofluids have been identified as the most prominent cooling method at present because of their good thermal conductivity. In addition, the considerations and advantages and disadvantages of using different coolants are discussed in depth.

60. N. G. Zulu, M. J. Mvita, B. Thethwayo, M. Madiba

Exploring the application of *acidithiobacillus ferrooxidans* for the beneficiation of platinum group metals-bearing base metal sulphides. Biotechnology has emerged as a promising alternative to existing minerals processing methods, offering potential advantages in terms of cost-effectiveness and environmental sustainability. One area where microorganisms have shown significant promise is in the leaching of metals from medium and low-grade sulphide minerals thanks to the metabolites they produce. Extensive research has been conducted on the utilization of microorganisms for mineral beneficiation, with a specific focus on *Acidithiobacillus ferrooxidans*. This paper provides a comprehensive review of the application of *A. ferrooxidans* in bio-oxidation and biohydrometallurgy, highlighting its potential to replace inorganic reagents in the flotation of precious metals (PGMs) that are associated with sulphide ores.

61. Q. H. Wang, X. G. Wang, Y. K. Wen, B. X. Liu

Establishment of constitutive equation of medical AZ81 magnesium alloy. The hot deformation characteristics of deformed AZ81 magnesium alloy were studied by hot compression deformation on Gleeble-3800 thermal simulation test machine. The deformation temperatures were set at 300, 350, 400 and 450 °C, and the deformation rates were 0,01, 0,1 and 1s-1, respectively. Using the experimental data, the constitutive equation is obtained by friction correction and a series of formulas, and the constitutive equation is compared with the experimental data to verify its accuracy.

62. G. G. Shvachych, B. I. Moroz, L. V. Kabak, I. Mamuzić

Software development to optimize business processes. Studies show that business processes require constant innovation and operations optimization in today's highly competitive global business environment. Therefore, mobile technologies became vital, allowing enterprises to improve the internal processes efficiency. The development aims to implement a mobile application to optimize business processes. By choosing Ionic to develop the mobile interface and Spring Boot to write the backend, the researcher creates an integrated solution that meets the modern industry requirements. The application is considered an integrated tool designed to simplify the enterprise's routine operations and increase its efficiency. Developing a mobile application as a POS terminal reveals new opportunities for automating and optimizing workflows, improving service quality, and providing businesses with tools to compete effectively.

63. G. G. Shvachych, O. M. Aleksieiev, Y. M. Friman, I. Mamuzić

Features of using mobile applications to optimize business processes. The research aims to develop a mobile application to optimize business processes operation. At the present stage of technology development, mobile applications become an important tool for improving business processes and increasing efficiency. With fast and high-quality service in the manufacturing sector, mobile technologies can facilitate routine tasks like receiving and processing orders, managing inventory, and keeping records of production components and their categories. A mobile application with Ionic technology for the interface and Spring Boot for the backend was proposed to manage business processes efficiently. The project aims to use a convenient and innovative tool that will help reduce the time spent on routine operations and improve interaction with various parts of the enterprise.

64. G. G. Shvachych, L. I. Meshcheriakov, D. M. Moroz, I. Mamuzić

A mobile cross-platform application for computing the enterprise's main indicators. The cross-platform application aims to study and analyze software development processes to characterize enterprise's economic condition. The research is determined by the fact that, for the first time, a model for processing data on the company's economic activity was developed and substantiated allowing a mobile cross-platform solution for computing its main indicators. Development practical value lies in models and methods proposed in the research allowing the accumulation and use of expert knowledge to solve the problems of analyzing the company's economic activity. The research is useful for company's management, financial analysts, planning and strategic development managers, and risk management specialists. Proper methods and developed software tools allow analyzing and improving the company's financial condition effectively.

65. G. G. Shvachych, O. M. Shcherbina, D. O. Myronov, I. Mamuzić

Client-server library development for quoting access to ARI systems. With modern technologies people download certain software or find necessary information online using a smartphone. That leads to the load on a particular server or web application increasing with each new user. Hence, research aims to develop algorithms for quoting access to API systems to choose optimal algorithm and to ensure a limited number of requests. A comparative analysis of possible quota algorithms was carried out considering modern load requirements. Namely, such algorithms analysis as Leaky Bucket, Token Bucket, and Sliding Window. Research's result is a library with an implemented API access quota algorithm that prevents the user from making more than the certain number of requests to protect the server from an uncomfortable load.

66. G.G. Shvachych, O. M. Shcherbina, D. O. Myronov, I. Mamuzić

Research of access quota algorithms for API systems. Research revealed that access quota algorithms are a necessary element for almost any system or application. Those are to ensure high server reliability and monetization. Various access quota algorithms, like Leaky Bucket, Token Bucket, Fixed Window, and Sliding Window, were analyzed. These algorithms detailed analysis allowed identifying the advantages and disadvantages of each of them, and to establish that the Sliding Window algorithm is the most optimal. The researchers compared various possible solutions for quoting access to APIs of horizontally scalable systems, considering current trends. Comparing the advantages and capabilities of multiple options allowed developing a library in the Java programming language, using the microservice architecture and the Spring framework to build microservice business logic.

67. G. G. Shvachych, P. O. Ishchuk, I. Mamuzić

Software reliability estimates analysis. Reliability models are used, which are mathematical models built to assess the dependence of reliability on parameters known in advance or determined while performing a task to quantify software reliability indicators. It is necessary to consider their suitability for different life cycle stages, establishing the order of their joint use to determine the reliability of software throughout its life cycle. Most software reliability assessment models focus on the life cycle stages associated with the development phase. That is because achieving a given level of reliability as early as possible is necessary to incur lower costs in later phases of the life cycle, which will be required only to maintain the level of reliability already achieved.

68. R. B. Liu, A. Y. Jiao, S. Chen, E. Y. Lu

Failure analysis of 48MnV engine crankshaft. Investigation was conducted on the failure of the crankshaft made from 48MnV alloy steel used in automotive engines. Magnetic flaw defects were detected at the transition fillet between the third main journal and the counterweight of the crankshaft. Macroscopic examination, chemical composition analysis, metallographic analysis, and scanning electron microscopy observation were performed on the crankshaft samples. The testing results were summarized, and the causes of the crankshaft cracking were systematically analyzed. The results indicate that longitudinal cracks occurred on the surface of the crankshaft journal due to the combined effect of thermal stress and normal operating stress, exceeding its load-bearing capacity. These cracks propagated inward, forming magnetic flaw cracks, ultimately leading to crankshaft failure.

69. V. Lang, J. Wu

Surface defect detection algorithm of high temperature casting slab based on improved yolov5s. In order to improve the accuracy of surface defect detection of high temperature casting slab, an improved YOLOv5s surface defect detection algorithm is proposed. Firstly, Swin Transformer network structure is added to enhance the ability of feature extraction. Secondly, a coordinate attention mechanism is introduced to increase the sensitivity of position and direction information. Finally, a target detection layer is added to better realize feature fusion and enhance the generalization ability of the network. The improved algorithm has performed ablation experiments on the data set, which shows the effectiveness of the algorithm.

70. M. Walkowicz, E. Rudnik, P. Osuch, D. Pęczar

Superhydrophobic and superhydrophilic copper coatings electrodeposited on copper substrate. The aim of the paper was to determine electrochemical deposition conditions for superhydrophobic and superhydrophilic copper coatings on copper substrates. Through variable conditions of the two-stage electrodeposition process (cathode overpotential, process duration), copper layers with different wettability, i.e. high 150° and low contact angle 8°, were created. In particular, low wettability was achieved in the electrodeposition process involving low overpotential and long process time in the first stage, and high overpotential and short process time in the second stage. However, high wettability was obtained for stage I, including low overpotential and long time, and stage II, for low overpotential and long time. The morphology of the hierarchical layers was analyzed using a scanning electron microscope. The experiment suggests that the electrodeposited copper surface can exhibit stable wettability in real applications.

71. G. G. Shvachych, P. O. Ishchuk, I. Mamuzić

Basic mathematical models software analysis. Most researchers divide software reliability models into deterministic (static) and probabilistic (dynamic) broad classes. *Analytical models* allow quantitative reliability indicators computation based on data about program's behavior during testing (measurement and evaluation models). *Empirical models* are based on programs' structural features analysis. Those consider reliability indicators dependence on inter-module connections number, cycles number in modules, etc. Those models are used at software design stage when software is divided into modules and with known structure. Analytical models are represented by dynamic and static ones. Software behavior (failure occurrence) is considered over time in dynamic models. In static models, failure occurrence is not related to time; only considered the error number dependent on the test run number.

72. G. G. Shvachych, P. O. Ishchuk, I. Mamuzić

Software reliability forecasting features. Software reliability forecasting is performed by mathematical models based on the methods of probability theory and mathematical statistics. Those mathematical models search for the total number of errors in the program. Also, these models are used to find the program's reliability. There are also many well-known software reliability models. According to the main features, software reliability models can be classified: by the time errors are found in the software, program complexity itself, program's input data structure, and program text structure. The term «reliability model» usually refers to a mathematical model built to assess the software reliability dependence on some specific parameters, which values are either assumed to be known or can be measured during observations.

73. G. G. Shvachych, O. M. Aleksieiev, P. O. Shcherbina, I. Mamuzić

Principles analysis of address space allocation in TCP/IP networks. The Internet is based on the TCP/IP (Transmission Control Protocol/Internet Protocol) family of protocols. It is an industry-standard set of protocols designed for global computer networks. TCP/IP is a technology for interconnection between networks. The TCP/IP protocol stack is the most popular today, as it can interact with local and global networks. The most widely used protocol stack is TCP/IP version 4 (32 bits). With Internet rapid growth trend based on TCP/IP, the TCP/IP version 6 protocol stack (128 bits) was

developed, which has yet to be used on such a large scale. The new version of the protocol stack is based on the new generation of interconnection protocol (IP new generation, IPng, or IPv6).

74. G. G. Shvachych, P. O. Shcherbina, D. M. Moroz, I. Mamuzić

IP address assignment features in computer networks. The IP addressing scheme must ensure the uniqueness of network numbering, and node numbering uniqueness within each network. Therefore, assigning numbers procedures to both networks and nodes within networks must be *centralized*. With a network that is part of the Internet, the numbering uniqueness can only be ensured by the efforts of specially created central bodies. In a small, autonomous IP network, the network administrator can meet the uniqueness condition of network and node numbers. Here, the administrator has the entire address space since the coincidence of IP addresses in unrelated networks will cause no negative consequences. The administrator can choose addresses arbitrarily, following only syntactic rules and considering restrictions on special addresses.

75. G. G. Shvachych, P. O. Shcherbina, I. Mamuzić

Classless addressing features of computer networks. The problem of uneconomical classless addressing lies in the 32-bit address division into a prefix and a suffix along the octet boundary. Later, allocating an arbitrary number of bits to the prefix and suffix (with the suffix being at least 2 bits) was proposed. To know where the prefix (network address) and suffix (host address) are in a particular IP address, the so-called Subnet Mask was added to the address, which also consists of 32 bits; in place of the prefix (network address bits), there should be ones, and in place of the suffix, zeros; in the record, the mask is divided into octets with a decimal point format.

76. G. G. Shvachych, P. O. Ishchuk, I. Mamuzić

Harmful impurities transfer simulation by direct methods. Predicting changes in ecological systems influenced by natural and anthropogenic factors is pramaunt today. The mathematical expression of those models is a system of multidimensional nonlinear differential equations with several input parameters. With direct methods of mathematical simulation of harmful impurities transfer in atmosphere from pollution sources, these studies also consider formulations and methods for solving inverse problems to estimate input parameters considering actual information about the modeled system known from the experiment. When studying and assessing the impact of human activity on atmosphere, simulating the task of transferring harmful impurities process against the background of atmospheric processes plays an essential role. The study considers the mathematical formulation of this problem and its simulation processes.

77. W. T. Shen, Y. F. Zhao, Z. C. Xu, C. Y. Han, B. Z. Wang, X. C. Qian

Numerical analysis of the elevator boosting performance of flat-tube-and-fin heat exchanger. In this work, elevators shaped by NACA 0012 were deployed on the outer surfaces of tubes in a Flat-tube-and-fin heat exchanger, and their structural details were numerically investigated. Then, following an infrared experiment validation, heat transfer coefficient, pressure loss and JF factor were numerically compared to confirm performance enhancement. It is found that the maximum deviations between numerical and experimental data, 6,31 % of heat transfer coefficient and 3,84 % of pressure loss, secure the accuracy of the following comparison, and the maximum increases of heat transfer coefficient, pressure loss, and JF factor are 7,20 %, 0,07 %, and 7,09 % at 12 m/s, respectively.

78. W. T. Shen, Y. F. Zhao, Z. C. Xu, C. Y. Han, B. Z. Wang, X. C. Qian

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79. Y. Q. Gui

Effect of quenching temperature on microstructure and mechanical properties of 50CrVA spring steel for mountain bike shock absorber. In order to improve the quality of people 's cycling and improve the safety performance of mountain bikes. The effects of quenching temperature on the microstructure and mechanical properties of 50 CrVA spring steel for mountain bike shock absorber were studied by means of microstructure observation, tensile test and impact test. The results show that the microstructure of 50CrVA steel is tempered troostite after quenching at 860-940 °C and tempering at 450 °C. In the quenching temperature range of 860 ~ 940 °C, with the increase of quenching temperature, the yield strength, tensile strength and elongation of 50CrVA steel increase first and then decrease, and reach the maximum at 920 °C, while the impact energy shows the opposite trend. When the quenching temperature is 920 °C and the tempering temperature is 450 °C, the comprehensive mechanical properties of 50CrVA steel are the best. At this time, the yield strength is 1 419MPa, the tensile strength is 1 538MPa, the elongation is 12 %, and the impact energy is 20,2J.

80. I. H. Olishkevskiy, I. Mamuzić

Computer-integrated system of heat utilization. In this research, based on the analysis of available methods of heat utilization, allowing an increase in the energy efficiency of thermal operation of district heating enterprises, it is shown that the most promising but insufficiently developed method is the use of heat pumps with automation and computer-integrated equipment. As this method development, a generalized technology for analyzing and evaluating the energy efficiency of heat recovery processes was developed, allowing for studying the recovery processes in residential air conditioning systems, hot water supply systems, ventilation systems, computing parameters in systems of non-traditional heating and air conditioning technologies for buildings, and computing energy parameters and required characteristics for heat pumps operating in heat recovery systems.

81. I. H. Olishkevskiy, I. Mamuzić

A computer model of heat utilization. It is advisable to study the processes of heat energy utilization in complex industrial and domestic heat supply systems using simulation modeling and computer experiments. For this purpose, a universal generalized heat pump model was developed, and its adequacy was proved. Based on this model, a computer model of heat pump heating and air conditioning of a residential building with different ways of controlling the operation of heat pumps was created. The modeling experiment's results showed the proposed model's high versatility and scalability. As a follow-up to the modeling work, an original structure of a heat pump heating and air conditioning system with the use of a heat accumulator and solar collectors was proposed.

82. I. H. Olishkevskiy, I. Mamuzić

A computer-integrated method development for energy-efficient control of condensing power plants. The study aims to develop a computer-integrated method for energy-efficient control of condensing power plants. Introduction of an automated heat pump into heat recovery process scheme allowed achieving heat utilization rates of up to 78 % with a 41 %base cycle efficiency, provided that heat generation process does not affect qualitative and quantitative indicators of electricity production. A computer-integrated method for improving energy efficiency of hydroelectric power plants was also enhanced by introducing automated heat pump into heat recovery process scheme, allowing increasing energy conversion factor from 2.3 to 3.3 at permissible loads on heating system, saving up to 30% of conventional fuel for heating and hot water supply compared to boiler-based heating systems.

83. I. H. Olishkevskiy, I. Mamuzić

A computer-integrated method development for increasing the energy efficiency of the heat supply process. Research studies further development of a computer-integrated method for improving energy efficiency of heat supply process based on multi-stage heat pump systems with automated control. The proposed approach allows up to 12 % conventional fuel savings and increases energy conversion factor by 2 times compared to a single-stage system or boiler due to transition to a two-stage heat pump system architecture. Meanwhile, structural and algorithmic organization of automated systems for energy-efficient control of heat pump heating and air conditioning of private buildings was further developed with a heat accumulator and solar collectors to increase cooling coefficient for air conditioning system by 2 times and increase energy conversion factor of the heat pump by 1.5-2 times.

84. O. Dmitrieva, V. Huskova, I. Mamuzić

Construction of difference approximations with Legendre polynomials. When solving the Cauchy problem numerically for ordinary differential equations or their systems, increasing the accuracy requirements increases the computational load. A solution to the problem may be the use of highly parallel algorithms. The paper proposes an approach that allows one to increase the order of approximation of one-step block methods. To construct difference approximations, the use of orthogonal Legendre polynomials is proposed. Additional base points are introduced into the calculation block of the one-step method, which are the roots of an orthogonal polynomial of a given order. Thus, while maintaining the block dimension, a higher order of approximation of the difference scheme is ensured. The number of processors used remains constant.

85. O. Dmitrieva, V. Huskova, A. Khalyhov, I. Mamuzić

Parallel modeling of dynamic processes using deep neural networks. The paper presents a comparative analysis of modern approaches to modeling the behavior of dynamic objects with lumped parameters that can be described using ordinary differential equations and their systems. Algorithms for adapting the integration step are proposed. Verification of the step control parameters was carried out using deep machine learning approaches. A Bayesian approach was used to calibrate the model. All sources of uncertainty were taken into account. The inadequacy of the model was corrected by minimizing the discrepancy between the observed data and the model predictions. The obtained estimates of parallel implementation show high rates of acceleration and efficiency when parallelizing computational processes with balancing the computational load.

86. A. Selegej, M. Krekoten, V. Petrenko, I. Mamuzić

Formation of Effective Gas Load in a Blast Furnace. The gas load of a blast furnace is a value that characterizes the amount of reducing gas interacting with a unit mass of charge materials loaded into the charging hopper per unit of time. Therefore, the regulation of the gas load significantly affects the efficient operation of the blast furnace. It is proposed to adjust the blast furnace operation through a comprehensive analysis and regulation of the gas load, ore load, and blast. The regulation is suggested to be implemented by changing the furnace loading program and considering the specific charge conditions. The advantages of this methodology are its efficiency and ease of use.

87. Z. H. Romazanov, A. Aldabayeva, O. Silayeva, G. Turgumbayeva, L. Chepelyan

The feasibility study for the establishment of a wind power plant. The article studies the issues of the application of Renewable Energy Source (RES) technologies for power generation on the basis of wind resources of Kazakhstan. The primary objective of this study is to evaluate the technical and economic viability of establishing wind power plants for electricity production. Throughout the research process, we computed the production program based on the region's wind resources and developed a financial model to assess the project's feasibility. Our findings affirm the effectiveness of RES, particularly wind energy technologies, in Kazakhstan. We determined that the project becomes economically viable when the selling price without VAT exceeds 24,53 tenge per kWh. Thus, the project itself can be recommended for implementation when the price exceeds the threshold level.

88. J. H. Zhou, G. F. Cui, D. X. Gao

Command filter adaptive output feedback control based on steel structure robotic arm with prescribed performance. The paper proposes a command filtering adaptive output feedback control scheme with preset performance for a Robotic Arm Model (RAM) designed specifically for steel structures. Initially, a neural network observer is employed to approximate the nonlinear functions within the model and to estimate the unmeasured states of the system. Subsequently, within the backstepping framework, the integration of preset performance theory and command filtering technology addresses the differential complexity challenges commonly encountered in traditional backstepping methods. This approach ensures rapid convergence of the system's tracking error within predetermined boundaries. The efficacy of this strategy is demonstrated through simulation instances.

89. Z. X. Li, Q. Zhang, B. W. Huang, Y. X. Miao

Research on vision system of intelligent sorting robot based on deep learning. It is an important step to realize automatic and intelligent production of coal mine to use intelligent sorting robot instead of manual. The vision system, as the "eye" of the intelligent sorting robot, completes the rapid identification, positioning and grouping of the sorting target. Based on YOLOv5, the vision system uses GhostNet to carry out the lightweight design of the model, aiming to ensure the detection accuracy while making the entire model more lightweight, so as to improve the model recognition speed and reduce the operating cost. The model recognition speed of Ghost-YOLOv5 designed and developed is 33FPS, the MODEL size is only 4,2 Mb, and the average DETECTION accuracy is 96,7 %.

90. A. Selegej, M. Krekoten, V. Petrenko, I. Mamuzić

Concept of Automatic Control of Gas Load in a Blast Furnace. The automatic control of gas load is based on managing the distribution of burden materials across the cross-section of the blast furnace, utilizing automatic monitoring of the gas phase composition above the surface of the charging hopper zone. An axiom of the blast furnace process is the uniform distribution of reducing energy across the furnace cross-section. If the reducing energy is distributed evenly, it corresponds to the lowest consumption of reducing components in the blast furnace smelting process. The object of automated regulation of burden material distribution is the management of the parameters of the charging device.

91. A. Selegej, M. Krekoten, V. Petrenko, I. Mamuzić

Automated Control of the Granulometric Composition of Blast Furnace Burden Components. The gas permeability of the burden column in a blast furnace depends on the technological factors of loading and its distribution. Knowing the granulometric composition of the burden components being charged is crucial. The method of automated determination consists of controlling the mass of burden components and their passage speed through a standardized aperture. As a result, the automated system calculates, based on numerical analysis, the granulometric composition and its distribution along the height and cross-section of the blast furnace. Based on these data, the optimization of the burden and gas distribution is carried out to enhance the smelting intensity using the developed algorithm.

92. V. F. Mazorchuk, S. I. Repyakh, I. Mamuzić

Development of a high-temperature coating composition for ceramic molds. requirements for high-temperature coatings have been determined, such as the presence of the coating on the contact surface of the ceramic product and the coating at the time of pouring the mold with the melt. This is necessary to prevent the coating layer from peeling off from the ceramic during the heating process of the mold for pouring. the coating material must undergo a polymorphic transformation, accompanied by an increase in its volume; the temperature of the polymorphic transformation of the coating material must be higher than the liquidus temperature of the flux, but lower than the calcination temperature of the mold, etc.

93. Z. X. Li, J. B. Wang

Research on teaching robot based on servo motor dynamic balance. Aiming at the problems of complex teaching trajectory, many teaching points and long teaching period, a series robot with direct teaching was developed. The configuration, 3D model and balance scheme of the robot's mechanical structure are designed. The dynamics of the robot is analyzed by Lagrange method, and the Monte Carlo workspace of the robot is analyzed based on MATLAB platform.

94. A. B. P. Sutowijoyo, E. D. W. S. Putri, N. Muhyat, A. R. Prabowo, Y. P. D. S. Depari, Triyono

Microstructure and hardness of extrusion welding on hollow panel AA6061. Given the length of the structure, extruded products are occasionally joined to reach the desired length. To minimize production costs, this joint is achieved through extrusion welding, where it takes place while the work-piece is still a heated billet inside a chamber. As extrusion structures differ in complexity, this study seeks to identify the traits of extrusion welding outcomes across various structural designs. Research findings suggest that structural design significantly impacts both the physical and mechanical properties of the extruded plate and the extrusion joints.

95. N. Muhayat, S. Yasinta, A. R. Prabowo, Y. C. N. Saputro, Triyono

Effect of the post weld heat treatment on the microstructure of the underwater wet welding SS400 steel. The effects of the post weld heat treatment (PWHT) on the microstructure and hardness of the underwater wet welding (UWW) SS400 steel have been evaluated. The UWW was performed using Shielded Metal Arc Welding (SMAW) in water depth of 5.0 m, while PWHT was carried out on underwater welded specimen with temperature of 660 °C for 75 minutes. The result showed that the PWHT caused increasing the grain size of the microstructure and decreasing in hardness.

96. † F. Vodopivec, I. Mamuzić

The life and achievements of acad. Ilija Mamuzić. The goal of this article is to give an overview of his life and achievements. Rarely has an individual not only in Croatia but in the world had influence on his profession as I. Mamuzić his own – metallurgy. He was involved and worked in all metallurgical areas: science, profession, education, organising of Faculty or Institute, Symposiums, editing, popularisation and responsibility for the profession and he is an author of the history of metallurgy on the territory of Croatia, during 6000 years. In Croatian Bibliography base CROSBİ registration works. By the same conditions in foreign bibliography ORCID works. He participated even in the education of 47 generations students (1963–2010). He received 75 various acknowledgments etc. He is an exceptional personality as individual, scientist, pedagogue, and professional. Ilija Mamuzić has achieved plenty, not because he had or was obliged to, but because he wanted to. He didn't work to live, but to live to work.