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CONTENT

HEAT AND POWER ENGINEERING

B.L. Shelygin, A.V. Moshkarin, E.S. Malkov. Detecting Use Conditions of Exhausted Gases from Recovery Boiler as Oxidizer for Additional Fuel Burning.....**4**

A.V. Moshkarin, E.V. Barochkin, V.P. Zhukov, G.V. Leduhovsky, A.A. Korotkov. Development of Empirical Support for Matrix Model of Water Heating and Deaeration in Spray Sections of Atmospheric Deaerators....**8**

A.A. Mityushov, D.I. Korovin, S.I. Shuvalov. Dependence of Microdamages of Steel Steam Pipeline on Residual Deformation Magnitude.....**12**

A.A. Genvarev. Identification of Elevator and Pumping Element of Melange.....**16**

ELECTRICAL POWER ENGINEERING

Yu.A. Mit'kin, O.S. Mel'nikova. Detection of Statistical Performances of Transformer Oil Electrical Strength with Account of its Volume in Transformers.....**21**

S.Yu. Tokarev. Influence of Ground Finite Conductivity on Multiwire Lines of Electric Power Transmission.....**25**

ELECTROMECHANICS

I.M. Arefyev, T.A. Arefyeva, YU.B. Kazakov. Research of Colloidal Stability and Thermostability of Magnetic Liquids for Vacuum High-Temperature Magnetic Liquid Seals of Power Engineering Devices.....**32**

S.M. Perminov, B.A. Poletaev, T.A. Pakholkova. Research of Magnetic Field in Working Gap with Rugged Magnetically Conductive Surface of Friction of Electromechanical Device.....**36**

M.Yu. Kulikov, M.A. Larionov. Improving Accuracy of Deep Apertures Console Boring in Details for Power Engineering Machine Building.....**39**

D.A. Bektashov, A.A. Krapostin. Research of Reliability Level of Mechanical Systems of Finishing Detail Shaping of Power Engineering Devices.....**42**

A.I. Tikhonov, Yu.B. Kazakov, K.M. Pirogov, A.S. Martynov. Model of Viscous Friction in Magnetic Liquid Sealer on the Basis of Monte Carlo Method.....**44**

AUTOMATION CONTROL SYSTEMS

V.V. Tutikov, A.I. Voronin. Influence Analysis of Zeros of Object Transfer Function on Parametric Sensitivity of the Systems Synthesized by Using Adar Method.....**48**

A.N. Golubev, V.A. Martynov. Synchronous Electrical Drive with Improved Characteristics and its Mathematical Simulation.....**51**

A.S. Ushkov, A.R. Kolganov. Research of Modern Methods of Energy-Efficient Control by Asynchronous Electric Drive.....**56**

E.V. Krasilnikyants, A.P. Burkov, A.A. Smirnov, G.A. Buldukyan. Adjustment Peculiarities of Rotor Magnetic Flux Observer.....**62**

METHODS OF MATHEMATICAL SIMULATION

F.N. Yasinskiy, N.B. Il'ichev, A.I. Kuleshov, D.P. Kharitonov. Calculation of Steady Mode of Electrical Network with means of GPU.....**68**

S.N. Chadov. Integration of Rigid Model of Electromechanical System with Explicit Methods.....**73**

D.O. Moskvina, V.V. Sotsky, N.V. Usol'tseva. Productivity Investigation of Different Algorithms for Calculating van der Waals Interactions in Molecular Dynamics Problems on Graphics Units.....**75**

COMPUTER SCIENCE AND INFORMATION TECHNOLOGIES

A.A. Belov, E.S. Soldatov. Common Structure of Universal Knowledge Store of Organization.....**80**

ECONOMICS

I.O. Volkova, D.G. Shuvalova, A.A. Boglay. Optimization of Organizational Structure of Power Engineering Holding Company.....**86**

D.M. Maslov, Yu.V. Vylgina, Yu.V. Grubova. Strategic Development of University with EFQM Model.....**91**

R.A. Fadeev. ERP-system Implementation as a Mean for Increasing Investment Attractiveness of Enterprise.....**94**

G.V. Leduhovskiy, E.V. Barochkin. Moshkarin Andrey Vasilyevich – Scientist, Organizer, Teacher, Human.....**97**

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HEAT AND POWER ENGINEERING

UDK 621.311.22

DETECTING USE CONDITIONS OF EXHAUSTED GASES FROM RECOVERY BOILER AS OXIDIZER FOR ADDITIONAL FUEL BURNING

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Abstract

Background: Exhausted gases from heat recovery boilers contain large amounts of oxygen. In order to increase energy efficiency of a power unit they should be used as an oxidizer to burn additional fuel.

Materials and methods: Development of dependency was carried out on the basis of the technical documentation for combined-cycle gas turbine and the boilers calculation.

Results: The authors determined conditions of fuel combustion in the combustion chamber of additional fuel, set the permissible values of the relative consumption of additional fuel burned. The authors obtained multiple-factor dependence, allowing to analyze the effective operation of gas turbine.

Conclusions: The results show the possibility of using exhausted gases from heat recovery boilers as an oxidant to burn additional fuel. The authors have found out that it is possible to combust up to 55 % of the fuel additionally at the air ratio of 4.0 into the flow of exhausted gases.

Key words: combustion chamber of additional fuel, oxygen concentration, excess air ratio, relative consumption of additional fuel.

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UDK 621.321

DEVELOPMENT OF EMPIRICAL SUPPORT FOR MATRIX MODEL OF WATER HEATING AND DEAERATION IN SPRAY SECTIONS OF ATMOSPHERIC DEAERATORS

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Abstract

Background: The authors describe universality of the existing matrix mathematical models of heat-mass exchange processes in multistage systems with complex stream configuration as their advantage. Their usage in specific conditions requires only identification parameters. The lack of empirical support prevents from applying these models for calculation of process characteristics of thermal water deaeration in spray sections of deaerators of atmospheric pressure. The authors have the aim to develop such an empirical support in the article.

Materials and methods: Model identification is made according to the results of experimental researches of deaeration processes in two devices, which include four distinguished in construction and operation conditions spray sections. Empirical support includes the determination method of effective area of phase contact surface in spray stream as well as written equalizations in non-dimensional aspect for calculating the coefficient of heat and mass transfers.

Results: The authors provide the values of identification parameters of the matrix mathematical models of thermal water deaeration in spray sections of deaerators of atmospheric pressure. This mathematical model describes the processes of water heating in spray stream with the water vapour condensation from the moving gas-vapor mixture and desorption of dissolved oxygen. The authors prove that the matrix model combined with the received parameters of its identification allows to calculate the water temperature and concentration of dissolved oxygen outside the spray sections of deaerators of atmospheric pressure with accuracy of 10,8 % of heat exchange calculation, and 17,2% of oxygen desorption calculation.

Conclusions: The developed model can be used for calculating heat-mass exchange processes with thermal water deaeration in designing problems of spray deaerators of atmospheric pressure and security adjustment of operated devices of this type.

Key words: thermal deaerators, spray section, heat transfer in condensation process, oxygen desorption.

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UDK 621.311.22

DEPENDENCE OF MICRODAMAGES OF STEEL STEAM PIPELINE ON RESIDUAL DEFORMATION MAGNITUDE

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Abstract

Background: One of the most dangerous possible accidents that could happen at a thermal station is the destruction of a steam pipeline that works in creep conditions with high steam temperature. Metal condition is controlled with the help of different methods, including research of metal structure on clippings and models and measurement of residual deformation. Structure research is time-consuming and usually conducted after economic life depletion. Residual deformation measurement is easier and more common. Evaluation of metal structure condition is assumed to be taken in time period between measurements of structure based on magnitude of residual deformation.

Materials and methods: Evaluation of connection between structure damage and residual deformation is based on statistical processing of Ryazanskaya GRES jet steam and hot reheat pipelines (made of 15H1M1F steel) condition diagnostic results. Probability of specific microdamage classes appearing is defined using the Bayesian method.

Results: The correlation assessment of the damage of steel 15H1M1F microstructure is completed from the magnitude of residual deformation. The authors show normal distribution function logarithmically gives the best correlation of observed and theoretical frequencies. The magnitudes of the distribution function parameters are presented for the structure microdamage classes.

Conclusions: The obtained dependences are recommended for damage prediction of the metal of steam pipeline bends which are operated in creep conditions.

Key words: steam pipeline bends, creeping, residual deformation, damage, prediction of condition.

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UDK 532.542

IDENTIFICATION OF ELEVATOR AND PUMPING ELEMENT OF MELANGE

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Abstract

Background: Applicable computer programs of hydraulic calculation are founded on network calculation methods, which are constructed from active and passive two-terminal devices. Being used in heat networks water-jet pumps are elevators and at the same time three-terminal devices that limit the research of hydraulic modes of users, connected to the elevators.

Materials and methods: Applied in thermal networks of the centralized heat supply systems the water-jet pumps are three-terminal devices which are also elevators according to the theory of circuits. Identification of the elevator by means of pumping element of mixture that is three-thermal device constructed from two-thermal ones, is carried out by the method of conditional optimization.

Results: The author develops the algorithm and the computer program on Maple to identify the given elevator for the scheme of the pumping element of mixture, consisting of two-thermal devices.

Conclusions: Identification of the elevator to pumping element of mixture provides the possibility for hydraulic calculation of heat networks with elevator joining of users and open water pumping for them.

Key words: three-terminal device, elevator, pumping element of melange, identification, optimization with restrictions.

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ELECTRICAL POWER ENGINEERING

UDK 621.321

DETECTION OF STATISTICAL PERFORMANCES OF TRANSFORMER OIL ELECTRICAL STRENGTH WITH ACCOUNT OF ITS VOLUME IN TRANSFORMERS

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Abstract

Background: Nowadays the basic insulation of transformer is chosen without taking into account the influence of transformer oil volume. In order to take this factor into account the authors have to study statistical performances of oil electrical strength and develop the methodology for their evaluation.

Materials and methods: The authors used the statistical model of transformer oil fault. The research about the influence of oil volume on statistical performances of strength was carried out with the usage of the Gnedenko - Weibull three-parameter distribution, which indicates physical processes in oil breakdown.

Results: The authors suggest the evaluation method of statistical performances of transformer oil electrical strength. This method takes into consideration the influence of oil volume and quality on their variation. The comparison of experimental data and calculation results is carried out.

Conclusions: The authors prove that the suggested method allows to determine characteristics of electrical oil strength, including the lower point of fault tension and may be used for choosing the basic insulation of transformer taking into account the evaluation of transformer oil volume influence on it.

Key words: transformer, transformer oil, electrical strength, statistical performances.

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UDK 621.3

INFLUENCE OF GROUND FINITE CONDUCTIVITY ON MULTIWIRES LINES OF ELECTRIC POWER TRANSMISSION

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Abstract

Background: Practical engineering approaches for calculating parameters of multiwire transmission lines at high frequency area do not pay much attention to the influence of ground finite conductivity. It may cause an error in calculations of wave processes.

Materials and methods: The author researches the parameters of electric power lines with the usage of the method of Bessel analytical functions, approximation of Carson's integral and others including the finite conductivity and dielectric capacity of ground.

Results: The author carries out the analytical and numerical comparison of results with the influence of electric induction currents in ground as well as without them. The parameters of lines in wide frequency range in different values of conductivity and dielectric penetration of ground are considered.

Conclusions: In the article it is recommended to use the expressions of accurate approximation of ground influence for calculating in wide range of frequencies.

Key words: return through ground, ground resistance, displacement current in the ground, high frequency dependence, asymptotic nature, multiconductor overhead circuits, multiwire lines, ground mode, zero sequence, soil parameters, relaying protection, wave process, verification of model, weather conditions, finite element method.

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ELECTROMECHANICS

UDK 621.321

RESEARCH OF COLLOIDAL STABILITY AND THERMOSTABILITY OF MAGNETIC LIQUIDS FOR VACUUM HIGH-TEMPERATURE MAGNETIC LIQUID SEALS OF POWER ENGINEERING DEVICES

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Abstract

Background: The main indicators of magnetic liquids quality are their colloidal stability and thermostability. These indicators define the period of operation time for magnetic liquid in vacuum high-temperature magnetic liquid seals. Because of the absence of the techniques to define these values it is necessary to develop them and research the characteristics of specific magnetic liquids.

Materials and methods: Magnetic liquids MLK 001-60, MLS 350-40 and MLC 030-40 were researched by means of the method of a liquid-carrier replacement.

Results: Techniques for detection of colloidal stability and thermostability of magnetic liquids are developed. On the basis of the developed techniques colloidal stability of MLK 001-60, MLS 350-40 and MLC 030-40 and thermostability of MLS 350-40 and MLC 030-40 were researched.

Conclusions: Magnetic liquids MLS 350-40 and MLC 030-40 can be successfully used in magnetic fluid seals in engineering devices.

Key words: magnetic liquid, colloidal stability, thermostability, magnetic liquid seal.

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UDK 621.538

RESEARCH OF MAGNETIC FIELD IN WORKING GAP WITH RUGGED MAGNETICALLY CONDUCTIVE SURFACE OF FRICTION OF ELECTROMECHANICAL DEVICE

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Abstract

Background: Redistribution of magnetic field near the rugged magnetically conductive surface can seriously influence the device parameters or technological processes in electromechanical devices where the fine-dispersed magnetic environments are used in working gaps.

Materials and methods: The authors use the method of mathematical simulation based on the method of finite elements, and they research the magnetic field near the rugged magnetically conductive surface which is formed while turning works of details with section of lugs like equiangular triangles.

Results: The results of numerical calculations demonstrate that the field strength near the lug edge of surface exceeds average tension of the field in several times. The field strength between lugs of rugged surface is below the basic level of the field strength, and it decreases up to zero at the foundation of concavity formed with the adjacent lugs.

Conclusions: The calculation of magnetic field near a flat surface shows that nonuniformity of a field near the rugged surface brings appreciably down. The maximum value of the field strength above the surface is no more that 15 % H_{cp} , and minimum value is 20 % H_{cp} . Therefore, the negative effects connected with the losses in devices noticeably go down.

Key words: rugged surface, magnetic field near the rugged surface, mathematical simulation, fine-dispersed magnetic liquids.

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UDK 621.9

IMPROVING ACCURACY OF DEEP APERTURES CONSOLE BORING IN DETAILS FOR POWER ENGINEERING MACHINE BUILDING

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Abstract

Background: Circular accuracy is one of the main quality characteristics treated by boring the body apertures in electrical machines. While deep console boring the appearing loads can lead to resilient deformation of spindle of boring machine. It substantially deteriorates the accuracy of the apertur. As a result, it is necessary to develop the new construction of device to increase the quality of apertures treatment.

Material and methods: The authors used the method of the finite elements and the empirical data obtained during production testing in this research work.

Results: The results of the computer simulation showed that the spindle stiffness decreases with increasing its length. The production testing results proved the effectiveness of the proposed method of its use in boring deep apertures.

Conclusions: The proposed method greatly improves the rigidity of the spindle when the console boring deep apertures, and this in turn increases the precision of form and arrangement processed apertures of power engineering machine building.

Key words: deep aperture, console boring, rigidity, spindle unit, deformation.

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UDK 621.9

RESEARCH OF RELIABILITY LEVEL OF MECHANICAL SYSTEMS OF FINISHING DETAIL SHAPING OF POWER ENGINEERING DEVICES

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Abstract

Background: The fault absence of electrotechnical steel plates between each other and fault of aluminum windings with electrotechnical steel plates because of the aluminum galling on the surface are the one of the main quality characteristics of mechanical treatment of

rotors in electrical machines. The authors consider necessary to develop the way of mechanical treatment of rotors with the usage of new cutting tools in order to improve its reliability.

Materials and methods: The developing model is based on the theory of reliability and mathematical statistics.

Results: The technology of rotor treatment with the cutting tool made from mineral ceramics BOK-71 is developed. The law of distribution is found out; the main indicators of mechanical systems reliability of power engineering devices are calculated; the graphical dependences are made.

Conclusions: Mechanical treatment of rotors with the cutting tool made from mineral ceramics BOK-71 does not lead to the fault of electrotechnical steel plates between each other and fault of aluminum windings with electrotechnical steel plates.

Key words: reliability, mineral ceramics, the law of distribution, power engineering device.

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UDK 621.321

MODEL OF VISCOUS FRICTION IN MAGNETIC LIQUID SEALER ON THE BASIS OF MONTE CARLO METHOD

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Abstract

Background: The main drawback of analytical and numerical methods for calculating the processes of viscous friction is the complexity of the mathematical apparatus. At present, the Monte Carlo method becomes more and more popular in solving such problems. It is simple in algorithmization, including the implementation of these algorithms in parallel computing technology.

Materials and methods: For the calculation of the magnetic fluid finite element method is used. The Monte Carlo method is also applied when the velocity field of fluid is calculated.

Results: The method for calculating the moment of viscous friction of magnetic liquid sealer is developed. The conclusions about the prospects of using the Monte Carlo method for solving hydrodynamics problems are made.

Conclusions: The usage of the combined method allows substantially to simplify the mathematical apparatus of viscous friction calculation.

Key words: magnetic fluid, finite element method, Monte Carlo method, viscous friction, magnetic liquid sealer.

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AUTOMATION CONTROL SYSTEMS

UDK 62-50-83

INFLUENCE ANALYSIS OF ZEROS OF OBJECT TRANSFER FUNCTION ON PARAMETRIC SENSITIVITY OF THE SYSTEMS SYNTHESIZED BY USING ADAR METHOD

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Abstract

Background: The usage of the modern methods of regulators synthesis often strikes on the difficulties relating to the production of automatic control systems with high parametric sensitivity.

Materials and methods: The method of the analytical design of aggregated regulators for synthesis of automatic control systems by different objects is used.

Results: Contrastive analysis of the results of using the methods of modal control and analytical design of aggregated regulators is carried out to produce parametric rough systems.

Conclusions: Using the method of the analytical design of aggregated regulators allows to provide great areas of parametric roughness for synthesized systems.

Key words: analytical design of aggregated regulators (ADAR), parametric roughness, transfer function.

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SYNCHRONOUS ELECTRICAL DRIVE WITH IMPROVED CHARACTERISTICS AND ITS MATHEMATICAL SIMULATION

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Abstract

Background: One of the ways to build an advanced electrical drive with improved technical and economical characteristics is to use it on the basis of the actuating motor with the increased number of phases. However, the existing mathematical models of synchronous motor and well-known approaches to the synthesis of electromechanical system do not take into account the specificity of m-phase machine ($m > 3$) as the object of control.

Materials and methods: The mathematical apparatus of spectral vectors given to spatial harmonic field is used to simulate a polyphase synchronous electric drive and thy synthesis of automatic control system.

Results: Efficient methods of building the synchronous m-phase electrical drives are considered. Advanced synchronous electrical drive structure with improved performance characteristics is suggested. The Results of its simulating modeling are given.

Conclusions: It is shown that intentional shaping of electromagnetic condition of m-phase synchronous electrical drive in general case for all electrical channels is necessary to improve its performance.

Key words: synchronous electrical drive, multiphase drive, power engineering characteristics.

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UDK 621.3.004.18

RESEARCH OF MODERN METHODS OF ENERGY-EFFICIENT CONTROL BY ASYNCHRONOUS ELECTRIC DRIVE

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Abstract

Background: The modern control systems of asynchronous electric drive allow to organise the regulation of electric drive coordinates in a wide range, with the high accuracy and fast speed. However, not every control system provides functioning of the electric drive with the maximum power efficiency.

Materials and methods: Research of the modern energy optimal control methods for asynchronous electric drive is executed on the basis of the analysis of the scientific and technical information presented in domestic and foreign popular editions, collections of conferences reports, and in the Internet.

Results: Modern energy optimal control methods for asynchronous electric drive are considered. Classification of the modern energy optimal control methods for asynchronous electric drives was created. Two main approaches for considering modern methods of power efficiency in the asynchronous electric drive are found out. The first approach is connected with updating the structure of the electric drive; the second one is connected with application of energy-effective control strategies.

Conclusions: It is shown that the complex application of both mentioned approaches will provide the maximum effective usage of the power for the electric drive, as well as to minimize the losses at electromechanical transformation of energy.

Key words: asynchronous electric drive, methods of power saving, corrector of power coefficient, power efficient control strategy.

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ADJUSTMENT PECULIARITIES OF ROTOR MAGNETIC FLUX OBSERVER

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Abstract

Background: The authors consider the problem of using the maximum power of asynchronous motors according to the moment and speed to be very urgent because of the wide usage of drives based on asynchronous motors. The fine adjustment of rotor magnetic flux observer is one of the important stages in the research.

Materials and Methods: The given results were received by means of simulation and field modellings.

Results: The technique of observer adjustment is put forward. The criterion of optimality is a constancy of acceleration providing magnitude constancy of active and magnetizing components of stator current.

Conclusions: Implementation of rotor magnetic flux observer fine adjustment is of critical importance for asynchronous motor torque and velocity maximum utilization.

Key words: electric drive, asynchronous motor, magnetic flux observer tuning approach.

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METHODS OF MATHEMATICAL SIMULATION

UDK 519.683.8

CALCULATION OF STEADY MODE OF ELECTRICAL NETWORK WITH MEANS OF GPU

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Abstract

Background: At present the problem of getting the steady mode is solved, and the result can be received for the short period of time. However, for big volumes of networks and mass calculation of steady mode it is necessary to decrease the calculation time.

Materials and methods: The nodal-voltage method is used for calculation of steady mode. The authors carry out the linearization of equations by means of finding the matrix of Jacobi while solving the system of nonlinear equations with the Newton method. The linearization of equations helps to solve linearized equations with GPU.

Results: The article considers the calculation algorithm of steady mode of electrical network. The description of the graphical card general structure is given. The analysis of the given algorithm paralleling is carried out.

Conclusions: It is shown that it is possible to get calculation acceleration of steady mode of electrical network.

Key words: steady mode, GPU, parallel algorithm.

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UDK 519.622.2

INTEGRATION OF RIGID MODEL OF ELECTROMECHANICAL SYSTEM WITH EXPLICIT METHODS

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Abstract

Background: The model of electromechanical systems with centrifugal regulator has been studied since the 19th century. Nevertheless, the issues of numerical integration of the equations system in case of its high rigidity are rarely described. Many effective integration methods of rigid systems have been developed for the last 20 years, and their application to the classical model has not only theoretical but also practical significance.

Materials and methods: For the numerical integration of the simple differential equations system the author uses both a variety of classical methods (Runge-Kutta 4, implicit Euler method) and a set of modern ones for integration of moderate rigidity system (methods with automatic determination of rigidity, projection method).

Results: The author researches the efficiency of solving the rigid system with different methods. The results indicate that the specific methods indeed have a much greater efficiency on the system than classical ones.

Conclusions: It is shown that at least in some cases the special methods provide a great efficiency boost for the model system.

Key words: centrifugal regulator, rigid system ODE, numerical analysis, projective methods of ODE solving.

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UDK 532.783 : 519.63

PRODUCTIVITY INVESTIGATION OF DIFFERENT ALGORITHMS FOR CALCULATING VAN DER WAALS INTERACTIONS IN MOLECULAR DYNAMICS PROBLEMS ON GRAPHICS UNITS

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Abstract

Background: The researches consider the actual synthesis problem of the liquid crystals with the given characteristics because of the fact that the liquid crystals are widely used in a lot of human spheres. The chemical synthesis is premised on the computer simulation because of the several reasons. The usage of the algorithms which work on graphical units allows to accelerate the simulation process significantly. At the present time, the issue of graphical units application for accelerating the computer simulation in chemistry is not studied well.

Materials and methods: The Lennard-Jones potential is used for calculating the van-der-waals interactions. The fact that van-der-Waals forces diminish proportionally to the sixth degree of interatomic spacing allows to use the calculation methods based on finding the space area where van-der-waals interactions are substantial and the area where it can be left out of account. The authors consider the cell method and Verlet method of lists which realize the mentioned approach. The method of full surplus is also observed. During the research process the graphic device GeForce 580GTX and the CPU Intel core i7 are used.

Results: Three calculation algorithms of the van-der-waals interactions on GPU graphic units are tested. For each algorithm two operation strategies with GPU memory are considered. In the first instance the data reading is realized from the lobar memory, in the second instance it is made from the texture memory.

Conclusions: During a number of calculation experiments it is revealed that the cell method and the Verlet method of lists reading data from texture memory have the equivalent productivity on a system composed of a large amount of atoms and work faster than algorithms reading from the global memory. On the contrary the algorithm of full surplus has less productivity during the work with texture memory (half as less in comparison with global one).

Key words: van-der-waals interactions, molecular dynamics, Verlet lists, cell method, graphical units, texture memory.

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COMPUTER SCIENCE AND INFORMATION TECHNOLOGIES

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COMMON STRUCTURE OF UNIVERSAL KNOWLEDGE STORE OF ORGANIZATION

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Abstract

Background: The problem to organize the store of knowledge has been considered very often for the last several years while the different problems in companies are solved. Nowadays there are not any general known methods for organizing the knowledge stores.

Materials and methods: The present research was founded on the system theory and specific decisions of the knowledge stores organization described in special literature on this theme.

Results: The authors suggest the structure of knowledge stores and the list of tools to manage them. The description of software tool for the structure is given.

Conclusions: The authors conclude that the development of universal structure of knowledge stores is possible according to the results of the topic field of study, however, its implementation requires more organizational knowledge.

Key words: knowledge store, knowledge management, management based on knowledge.

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ECONOMICS

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OPTIMIZATION OF ORGANIZATIONAL STRUCTURE OF POWER ENGINEERING HOLDING COMPANY

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Abstract

Background: The reformation of industrial structures and diversity of external conditions of distribution networks have created the necessity to develop a model of organizational structures for enterprises of a holding, which will reduce the costs on the managerial staff and increase the manageability of the holding.

Materials and methods: The authors used the following documents: operating typical organizational structure, functional responsibility matrix, the functional cards, the internal regulatory documents. The statistical methods (correlation and regression analysis), methods of expert estimates, valuation methods, structural analysis are applied.

Results: The algorithm for transforming the organizational structure has been developed. The reserves of optimizing the organizational structure by standardizing units and avoiding duplication of functions have been identified. The type functional has been obtained. Three types of organizational structures have been developed.

Conclusions: The implementation of the developed algorithm works on the transformation of organizational structures based on the analysis of the matrix of functional responsibility and functional maps has allowed to develop new model unit structure of the energy holding company. The introduction of model structures will solve the problem of increasing the effectiveness of management units.

Key words: organizational structure, algorithm for transforming; three-tiered management scheme (a classic), two-level operational management scheme, a two-level control scheme.

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STRATEGIC DEVELOPMENT OF UNIVERSITY WITH EFQM MODEL

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Abstract

Background: The application of the EFQM model assumes implementation of the serious diagnostic research of organization's managerial potential efficiency, management system maturity assessment and benchmarking, revelation of strengths and areas for improvement.

Materials and methods: During the self-assessment using EFQM model criteria, a combination of the following methods is used: questionnaire polls, blank forms, conference meetings, elements of RADAR assessment logic.

Results: The opportunities to apply the EFQM model in a state-financed sector are presented, model application practices in ISPU are described.

Conclusions: Systematic improvement of using different EFQM model methods and tools allows ISPU management to continually improve the quality in all directions of its activities in the context of the nine EFQM model criteria.

Key words: Quality Management System, University, Perfection Model, Self-assessment.

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ERP-SYSTEM IMPLEMENTATION AS A MEAN FOR INCREASING INVESTMENT ATTRACTIVENESS OF ENTERPRISE

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Abstract

Background: There are a large number of foreign companies which develop and implement the management systems on the enterprises of different levels and in different fields. However, it is worth noticing that the given systems are not practically implemented at the companies of Russian medium-size and small segments of business.

Materials and Methods: The research is carried out and based on scientific research of well-known Western experts. In addition, the main advantages and disadvantages of the implementation of optimized enterprise resource management systems, involving all key performance indicators are researched.

Results: The authors show the main advantages and disadvantages, as well as the possibility of introducing the system in terms of investments, and technical feasibility of the system for the enterprise, taking into account the specifics of the market.

Conclusions: The research results showed that the automation of administrative processes at the enterprise can improve its level of investment attractiveness through the implementation of communication flows within the company, which ultimately allows to increase customer loyalty provided by the company goods and services.

Key words: automation of administrative processes in a company, company's resources, ERP-system, customer.

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