ABSTRACTS

METHODS OF MATHEMATICAL MODELING

APPLICATION OF NONPARAMETRIC METHODS TO STATISTICAL EVALUATION OF THE CHARACTERISTICS OF THE SAMPLE

Stroyeva V.O., Nakopia M.

Abstract

Mathematical modeling has been widespread in various fields of science: mechanics, physics, statistics, medicine, biology, including in ecology. Many of these tasks are related to the processing of data by the method of statistical research. The observation processing by parametric methods is based on a number of a priori assumptions such as the independence of measurements and their errors, uniformity of dispersions, normality of distribution, and so on. Possible deviations from these assumptions, for example, for environmental data, can seriously affect the validity of the final conclusions. Therefore, a modern alternative to parametric methods is the simulation of empirical data distribution using repeat generation methods (numerical resampling). These technologies do not require any a priori information about the law of distribution of the investigated random variable. Instead, they perform multiple processing of different empirical data.

In ecology, it is possible to cut data only in a certain place and at a certain point in time, and if you select a second, third sample, etc., then it will already be data from another place or taken at another time. So, how, having only one single repeat, to evaluate the value of the indicator we need and get the measure of the accuracy of this estimate? At the same time, the exact type of distribution of the processed data is usually not known, therefore, approximate methods of approximating the predicted properties of the investigated statistics are used. How the degree of this approximation affects the final conclusions, remains entirely on the conscience of the researcher. We can say that solving these problems can be done using methods of generation of repeated samples (numerical resampling), which relate to nonparametric methods.

The purpose of this work is to develop and program the implementation of algorithms that allow solving special problems of statistical processing of data. Namely, on the basis of the investigated methods of numerical resampling algorithms for solving typical problems, which were then programmed implemented by means of speech R.

The results of researches of mathematical models of ecological information systems for which algorithms of nonparametric statistics are used give answers to the questions asked and indicate that the developed algorithms can be applied to other classes of applied problems, which in their mathematical formula are similar to the ones presented.

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ANALYTICAL STUDY OF TEMPERATURE FIELDS AND THERMAL STRESSES WHEN HEATING SIMPLE BODIES SIMULTANEOUSLY BY CONVECTION AND RADIATION. MESSAGE 1.

Gorbunov A.D. Ukleina S.V.

Abstract

Relevance. To date, there is a large number of engineering techniques for calculating the joint radiant-convective heating of bodies. However, the solutions obtained are rather complicated and cumbersome even in a simplified formulation for the model of thermally thin bodies. The purpose of this paper is to obtain simpler dependencies. In addition, in these articles there are no formulas for calculating thermal stresses. The main task

is to develop a simple and effective technique for calculating the temperature and thermal stress fields for convective radiation heating of bodies of simple geometric shapes.

Conclusions

1. On the basis of linearizing substitution, a simple and effective engineering method for calculating the heating by radiation and convection of bodies of simple geometric shapes in the form of a plate, a cylinder, and a ball is developed for any Fourier numbers.

2. The method of dividing the heating process into two characteristic cases is used, when the number of Bio is greater than the Stark radiation number and vice versa, which made it possible to reduce the number of variables and present the solution of the problem in tabular and graphical types of execution.

3. For the thermally thin body model, a solution is obtained in a simplified form.

4 The region of linear variation with time of the temperature field is found similar to the regular regime with purely convective heating.

5. A simple formula is obtained for calculating the time of heating the body to a given temperature, which makes it possible to quickly determine the most efficient heating option.

6. Formulas for calculation of axial thermal stresses at any point of the body, on the surface and at the center are obtained.

7. Comparison of the methods with the numerical solution showed that the error in determining the temperatures does not exceed 10% and it can be considered acceptable for engineering calculations.

Prospects:

These studies will make it possible to contribute to the development of methods for approximate analytical solutions in nonlinear nonstationary heat conduction problems.

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GENERAL REFERENCE FRAMES AND DEFINITION OF ENERGY IN THE GRAVITATION THEORY

Samokhvalov S.E.

Abstract

In the general relativity (GR) as the reference frame we understand an arbitrary coordinate system that defines in space-time a holonomic coordinate repère field. The disadvantage of this limitation in the choice of reference frames is the need to use the components of a metric tensor as potentials of the gravitational field, from which it is impossible to construct a scalar Lagrangian of a gravitational field that would depend on metric coefficients and their first derivatives. Such a tensor can be constructed in the gravitation theory in an orthonormal repère, where, as the potentials of the gravitational field, one use the coefficients of transition between orthonormal and coordinate repère. However, in the general case, an arbitrary affine repère field can be used as a reference frame, with a special case being a coordinate and orthonormal repère.

In this paper, the gravitation theory in the affine repère (GTAR) is presented, the main relations of which are given in the general non-holonomic reference frame, that is, a relatively arbitrary affine repère field. The consequences of the generalized gauge translation invariance of theory in the general reference frame are analyzed, as well as the consequences of the theory invariance with respect to linear transformations of the reference fields corresponding to the transition between the general reference frames and implement the general principle of relativity in the GTAR. The expression for the mixed coordinate-repère energy-momentum tensor and the angular momentum tensor of the gravitational field and their superpotentials is given.

The results of the work may prove to be useful in finding new solutions in the theory of gravity, and in the methods of so-called holographic renormalization of energy.

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ON CONTROL OF THE APPROXIMATE SOLUTION OF DIFFERENTIAL EQUATIONS WITH DISCONTINUOUS COEFFICIENTS

Dronov S.G.

This study presents an algorithm for approximate solving of a marginal problem for the common second-order linear differential equations with discontinuous coefficients based using a non-uniform mesh cubic spline asymptotically converging with the interpolation spline of the exact solution. A special feature of this approach is that it guarantees an existence of the approximate solution and the possibility to control it.

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MATHEMATICAL MODELS AND ALGORITHMS

BUILDING AUTOMATION SUBSYSTEM "GUARDIAN" TO DETECT EVOLVING VOIDS IN A CAREER

Smolyan P.S., Kozikova T.C.

Abstract

Search void of technogenic and natural character is an urgent task of geophysics. Linked to this is an increasing danger of a catastrophic collapse of the intensive mining both underground and open pit, especially near the abandoned or existing mine workings or quarries. The most significant risk in this case the voids are evolving, that is voids, which change their position in space and size over time. Unfortunately, at the present stage of development of geophysics there is no simple and reliable way to solve the problem of diagnosing the presence and location in space evolving voids. One promising solution to this problem is gravimetric methods.

Gravimetric methods are based on the theory of inverse ill-posed problems. These problems usually can be reduced to the solution of integral equations of the first kind with respect to the physical characteristics of the object, in this case the density of the medium. Solution classical gravimetry problem leads to multidimensional integral equations of the first kind for the unknown density function of spatially distributed sources of gravitational anomalies. In turn, the solution of the integral equation for the density distribution with acceptable accuracy for practical purposes, even for a simplified environment is almost an impossible task for modern technology and gravimetric methods, except for special cases. Therefore, the paper proposes a simplified and adapted way to solve this kind of problem. The article gives examples of mathematical modeling of the subsystem "Guardian" to identify evolving voids.

Conclusions.

1. Implementation of the subsystem "Guardian" will increase the probability of detecting the presence of voids evolving even in the early stages of their evolution, and to obtain the necessary information for the localization of voids, to determine their quantitative parameters with a high degree of reliability.

2. This information can be used effectively while minimizing the amount of expensive wells of diagnostic for detecting evolving voids.

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REMOVAL OF RESINOUS SUBSTANCES FROM PHENOLIC WASTEWATER: DEVELOPMENT OF A MATHEMATICAL MODEL. PART 2

Trikilo A.I., Yelatontsev D.O.

Abstract

The article represents the cluster analysis of experimental data, which were obtained during the previous researches. It indicates that within the multitude of experiments, two clusters can be differentiated. The first cluster complies with the non-optimal reagents dosages ratio, thus the treatment efficiency is low. Contrariwise, the second one corresponds to optimal ratio of reagents, and provides, thus, high degree of removal of resinous

substances. For each of clusters the mathematical models, which indicate the influence of inlet parameters on treatment efficiency, were created. Essential parameters of first cluster are next: dosage of bentonite clay and initial concentration of resinous substances; and of second one: *pH* value of phenolic wastewater and initial concentration of resinous substances. The values of average relative error and standard deviation for both models are acceptable for chemical technology.

Basing on BET theory of polymolecular adsorption, we calculated the maximum adsorption value of resinous substances on sodium bentonite – 0,0057 mol/g and adsorption constant – 1,0059. Afterwards we estimated the specific surface area of sodium bentonite – 2918 m^2/g. Basing on Vant-Goff equation and the classical definition of the Gibb's energy, we computed the thermodynamic parameters for the adsorption of resinous substances on sodium bentonite: Gibb's energy ΔG = -15,79 J/mol; enthalpy ΔH = -4,99 J/mol; average entropy (in temperature range 318-328 K) $\Delta S \approx 33$ mJ/mol·K. The negative value of ΔH shows that adsorption is exothermic. In general, adsorption mechanism is physical (physisorption), because in physisorption, ΔH is lower than 40 J/mol. The data obtained suggest that resinous substances is adsorbed via a physisorption mechanism generally with Van-Der-Vaal's forces and partially by electrostatic interaction. In addition, the negative value of ΔG signifies that adsorption is spontaneous.

Thus, the profound studies of treatment regularities shown above, confirm our previous recommendations in case of effective removal of resinous substances from phenolic wastewater by using sodium bentonite clay with the addition of the cationic flocculant CW 3279.

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OPTIMIZATION OF THE MASSES OF GEARS MECHANICAL TRANSMISSION DURING THE PRELIMINARY DESIGN

Romaniuk O.D.

Abstract

Stabilization of kinematic and dynamic characteristics of the machine set in the mode of steady motion, as a rule, carried out the increase in the reduced moment of inertia, ie the use of of the flywheel. But the use of of the flywheel increases the acceleration time and weight, but also reduces the productivity of the machine set. Therefore, to eliminate the respective disadvantages of additional masses is necessary to change the approach to the design of mechanical gears.

The essence of this work is that it is necessary to analyze the main parameters according to mechanical transmission with a view to their optimization in the preliminary design stage to select gear mass, which acts as a of the flywheel.

The corresponding analysis was performed according to the equations to determine the mass of gears based on the entered weight ratio. As a result, graphic dependences of mass ratio of gears and gear mechanical transmission weight were obtained. Data on the dependence provide an opportunity depending on the design phase to optimize the ratio of the width of the crown gear on the center distance and the normal engagement module. Since these parameters determine the geometrical dimensions of the gears and thus reach the desired amount of weight.

The resulting dependence and research results provide, at the design stage mechanical transmission, to pick up some mass moments of inertia of the gears which correspond to the time of of the flywheel swinging executive body of the machine set.

The use of this approach in the design will stabilize the dynamic characteristics of the executive body of the machine without installing of the flywheel.

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ALGORITHM FOR MELTING CALCULATION OF THE WEIGHTED COMBINED ALUMINUM-CONTAINING DEOXIDIZER OF CYLINDRICAL FORM IN THE PROTECTIVE COVER

Voloshyn R.V., Babenko M.V., Zhulkovski O.A., Zhulkovska I.I., Degtyarenko Ya.O.

Abstract

One of the problem solutions of resource saving in steel deoxidizing steel with aluminum is the density increasing of the aluminum ingot by adding a weighting agent and with the simultaneous surface insulation from the effects of slag oxidation. This problem relates to the thermal conductivity problems with moving boundaries of phase separation. The aim of the article is the development and improvement of algorithms for solving mathematical models of the melting kinetics of lump materials in cylindrical form in the melt at asymmetric boundary conditions.

We apply the control volume approach. The half of the cylinder cross-section has been chosen as the rated operating conditions. To solve the problem, we form a square grid. As a result, we got control volumes with coordinates **i, j**. The values of the temperatures are determined in the center of the control volumes. The explicit difference scheme is used in the proposed calculating algorithm. The time step is chosen from the conditions of the explicit difference scheme stability. In the calculations we also tried to get the outer boundary of melting (solidification) not to change more than one step of the grid for one step time. This was achieved by reducing the time step with respect to those selected from the stability condition.

The proposed calculation algorithm includes two stages of ingot melting:

1. The freezing of the melt cover during the period when the ingot is fully immersed in the metal melt. Thus, the algorithm describes the process of one-dimensional problem solution of the ingot melting.

2. Ingot melting, located on the border slag-metal, i.e, two-dimensional problem solution of ingot melting is described.

Conclusions.

This article presents the algorithms for calculation of one- and two-dimensional melting mathematical models of weighted combined aluminum-containing deoxidizer of cylindrical form in the protective cover in the melt and under asymmetric boundary conditions on the slag-metal interphase boundary, as well as the results of computational experiments and analysis of the calculated data that allows to establish rational modes of ingots input, ensuring the most favorable conditions for the melt in the casting ladle during metal tapping from the oxygen steel-making converter.

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A MATHEMATICAL MODEL FOR ASSESSMENT SUBSYSTEM FAILURE "HUMAN" IN THE SYSTEM "HUMAN-MACHINE-ENVIRONMENT"

L`Dovskaia A.V., Meshchaninov S.K.

Abstract

In connection with the increasing introduction of more sophisticated technology in all spheres of human activity and accelerated production equipment increasingly there is a need to ensure trouble free operation of machines and various technological equipment in all spheres of human activities, and primarily in production. All emergency situations can be called a failure of the system "Human – Machine - Environment". To date, the subsystem "Human " of the system "Human – Machine - Environment" is, on the one hand, the most vulnerable part, due to the instability of his psychophysiological state, and on the other hand, in case of unexpected technical problems, it is the "Human " can most flexibly respond to the changing situation and minimize the damage from the accident.

The aim of this work is to develop mathematical models for estimating the state of the subsystem "Human" human-machine system.

One of the main difficulties on the way to creating the required models to do with the specifics of the recorded information. Measured parameters on the one hand variable from individual to individual, and on the other there is a need to calculate their "total" value, taking into account the nonlinearity of their interactions. For this reason, difficulties arise in mathematical processing and decision-making.

The paper proposed the mathematical model and method of assessing the risk of failure of the subsystem "Human" human-machine system. In this model, you can use any number of measurable parameters, setting their mutual influence. On the basis of the proposed can be created in the future, computer simulation model to assess the risk of failure of the subsystem "Human" human-machine system.

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JUSTIFICATION FOR RATIO OF CROSS-SECTIONAL AREAS OF GROUND HEAT EXCHANGER FOR GEOTHERMAL VENTILATION

Koviazin A. S.

Abstract

Effective management of the livestock industry is impossible without full feeding and create optimal conditions for the animals, which are mainly determined by the microclimate. Provision of optimal microclimate in livestock buildings requires a considerable amount of energy that is expended to 15 % of the funds manufacturers. Cooling (heating) supply air for livestock buildings can be carried out with the help of

geothermal ventilation that allows the use of thermal energy of the surface of the Earth. The operating element of the geothermal ventilation are ground heat exchangers. For efficient use of ground heat exchanger is required to justify its geometrical parameters, one of which – the ratio of the cross sectional area of the inner tube to the cross sectional area of the tube space.

The purpose of this article is to improve the efficiency of geothermal ventilation by the rational justification of the correlation of cross-sectional areas of ground heat exchanger.

Air cooling better with increasing ratio of the cross sectional area of the inner tube to the cross sectional area of the tube space owing to the increase of air velocity in the tube space and increase the heat transfer coefficient on the surface of the casing tube of ground heat exchanger. On the other hand, increasing the area ratio leads to an increase in pressure loss in a ground heat exchanger. When the ratio of the areas at the level of 0.618 (the Golden ratio) and take place a minimum loss of pressure and effective thermal power of ground heat exchanger close to the maximum values for different volumetric supply of air. To improve the efficiency of ground heat exchanger is assumed that the ratio of the cross-sectional area of the inner tube to the cross-sectional area of the tube space should amount the Golden ratio.

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ABOUT OPTIMISATION OF AUTOMATIC COUNTING'S PARAMETERS OF STUDENT STUDYING PROCESS

Olyinik L.O., Kravets M.Yu.

Abstract

In the whole work authors focus on the problem of studying process automation. It is one of the most actual questions of educational management. The article goal is describing of mathematical model of automation system. This system should allow measuring and account the student's studying activity. The main characteristic of such system is the detailed classification of student's self-preparing. That gives an opportunity to determine special time norms for their studying process in order to assess their final knowledge and achievements more clearly and fairly.

The first part of article describes the initial distribution of time norms allotted for every type of studying activity (e.g. lecture, practice, etc). This grade is determined as solution of equation system that realizes the principle of proportion among several types of studying activities.

The second part of this amazing article tells the world about iterative convergence of earlier distributed marks to some optimum for this or that teacher on this or that discipline. Such as speed of algorithm performance comes first so it is based on the Least Means Square method where only dependable variable is relative time.

The algorithm is realized on the Python language. Although it is realized on the interpretative language it is fast enough. The algorithm form second part of article gives satisfactory result already after three or iterations.

In the conclusion it can be said that built model determines initial marks distribution among studying activity; based on this initial marks distribution the model iteratively converges the marks to some optimal values for this or that 'teacher-discipline' pair. Also, the algorithm is realized as the part of applied client-server software for optimization of students' studying activity process.

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OPTIMIZATION OF OPERATIONAL PARAMETERS OF THE CUTTING PROCESS OF WORN PNEUMATIC TIRES, CHOOSING THE OPTIMAL MATERIAL AND GEOMETRIC PARAMETERS OF CUTTING TOOLS UNDER CERTAIN CONDITIONS

Sokolov A.D., **Korobochka A.N.**, **Sasov A.A.**

Abstract

The main problems facing the industry in the process of waste management for their safe disposal and recycling in the economy is the high cost of equipment of production line and complexity of the recycling technological process.

The structure of the process of recycling of worn pneumatic tires included preliminary stage crushing, which is divided into two operations: cutting in half along the tire treadmill and cut bead rings. To make the process of cutting pneumatic tires most energy efficient and durable cutting tools necessary to be optimized for all factors affecting the cutting process such as a set of geometric parameters and material cutting tools, processing which will be performed with certain operational parameters.

The purpose of this work is optimization of operational parameters of the machining of worn pneumatic tires; geometric parameters of cutting tools; determining the optimal cutting tool material.

In the process of this research, based on the mathematical model [1] with subsequent corrections, graphically and computational methods using Microsoft Excel 2013, in three stages (the first one: optimization of spindle speed - n for different feeds - S; second: optimization front angle - γ for different hardness values, optimization of the angle at the vertex - ε for different hardness values, optimization of the rear angle - α for different hardness values, third: analysis and comparison of the optimal parameters ($n, S_p, \gamma, \varepsilon, \alpha$) for different values of the hardness of the cutting tool) have been optimized parameters of the cutting process for worn-out Bridgestone kart tires with a size of 7.1/11.0-5 with a cutting tool of hardnesses HRA 38, HRA 64, HRA 77, HRA 90, HRA 144; The optimal material of the cutting tool and its geometric parameters for the given

conditions (structural and strength properties of Bridgestone 7.1/11.0-5 tires) are determined. Certain optimal parameters should ensure minimization of cutting forces and energy costs within the selected conditions.

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MATHEMATICAL MODELING OF DYNAMIC MODES OF ASYNCHRONOUS MOTOR OPERATION WITH A MASSIVE FERROMAGNETIC ROTOR

Kosukhina O.S., Polyakov R.M., Syanov O.M.

Abstract

The development of computers and new numerical mathematical methods greatly expanded the possibilities of solving differential equations and the study of transient electromagnetic and mechanical processes in electromechanical transducers. At the same time, new possibilities for solving problems of high complexity and accuracy appeared. High-speed computing on a computer allows using field models in environments with nonlinear and periodic coefficients.

Today, the most models of asynchronous motors (AM) with a massive ferromagnetic rotor (MFR) are built in a nonlinear field environment [1], but without external circles. In this paper, a mathematical model of AM with MFR in the environment field, taking into account external circles and rotor rotation, is developed. This allows to control the modes of operation of the AM with the given physical parameters in the external circuitry and thus study the transients in the AM during the reverse, the failure of one of the stages or the change in the frequency of the source voltage.

During the work the field mathematical model of AM with MFR with the account of external circles is developed. A mathematical model of symmetric and non-metric modes of operation was completed.

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DEVELOPMENT OF MATHEMATICAL MODEL OF SLUDGE CLEANING PROCESS 0F ABRASIVE METAL TREATMENT IN THE CLEANING SOLUTION

Vernyhora V.D.

Abstract

At present engineering companies have huge problems with waste sludge obtained after components grinding. Thousands tons of them are produced every month. They are not utilized and are taken for special storage, but they worsen environmental safety.

The composition of this sludge is a mixture of crushed chips, abrasive, technical oil, coolants, dust and so on. Percentage of crushed metal chips in sludge abrasive processing of metals is 60 - 80%.

Sludge processing of abrasive metal treatment is reasonable and economically beneficial when global prices for raw materials and the development of powder metallurgy are rising, as well as in order to decrease an amount of sludge accumulation of abrasive metal processing and level of pollution. The authors [1] developed a

process and a comprehensive system of equipment for removing metallic particles from the sludge of abrasive metal treatment. The research of sludge cleaning process of abrasive metal treatment has been made [2].

As a result of the experimental data obtained, the most effective time of sludge cleaning process ($\tau = 180 - 540\text{sec.}$) of abrasive metal treatment, when maximum number of oil I-20 passes into the cleaning solution "Labomid", has been defined. Mathematical model of sludge cleaning process of abrasive metal treatment in the cleaning solution "Labomid" has been developed. In mathematical formulation of the problem as a variable the following factors were taken: C_p - concentration of cleaning solution (kg / m^3); T - temperature of cleaning solution (^oC); τ - time of sludge cleaning (sec.). Experimental planning technology is used to develop a mathematical model of the number of pollution $G = f(C_p, T, \tau)$ (kg), which is transferred from the sludge abrasive processing of metals in cleaning solution of the above factors used. Composite rotatable plan of the second order for three factors has been realized for response function as a degree second-order polynomial. A mathematical model is represented by the following formula:

$$G = 108{,}03 - 0{,}824C_p - 0{,}42T - 0{,}0083\tau + 0{,}0185C_pT - 0{,}0001T\tau + 0{,}0084C_p^2 +$$

$$+ 0{,}0031T^2 + 0{,}0000092\tau^2.$$

The mathematical model of the cleaning sludge process of abrasive metal treatment in the cleaning solution allows to determine the amount of oil that goes into cleaning solution for set-up time limits of cleaning. This will optimize the cleaning process and minimize the overall dimensions (length) of cleaning equipment trough for sludge processing of abrasive metal treatment.

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USE OF SPECTRAL INVERSION TO DETECT THE PROCESS OF DESTRUCTION OF ROCKS

Shumeiko O.O, Picarene D.S, Dmitrienko D.B

Abstract

In the paper, the method of fixing the time of the breakage of soil continuity is proposed, as a result of disturbance of the natural equilibrium of formation of layers of rocks for disaster prevention based on the basis of registration with the help of special equipment like oscilloscope of electromagnetic radiation, which arises both during natural processes and as a result of diferent types of human activity, for example working mobile phone or power line. To detect the corresponding signal and time of occurrence, it is suggested to use a filter system based on the spectral inversion method, and to filter the periodic technological noise, use a discrete cosine transform and reverse discrete cosine transform.

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MATHEMATICAL MODEL FOR CALCULATING THE BALANCE OF THE COMPUTER GAME IN THE GENRE *TOWER DEFENSE*

Oliynyk L.O., Bazhan S.M.

Abstract

The aim of the work is to build the mathematical model for calculating the balance of the computer game in the genre *Tower Defense,* based on the mathematical theory of games. Games of this genre today are prominent in the IT industry. While designing the code of the game there must be a sufficiently flexible algorithm of strategies selection for the computer to satisfy the interests of player and encourage him to continue the game. It is the problem of strategies selection for computer's action that this work is devoted to.

Problem statement: designing of a mathematical model for algorithm of strategies selection for the gaming programme that determine the difficulty level of the game and ensure a certain percentage of winnings to the player, in case when he determines the correct strategy game for himself

Mathematical model of the game balance should determine the optimal set of control options that influence the choice of a strategy of player's behavior, and provide the designer with a complete list of strategies, according to the difficulty levels of the game. Control options -a data array that determines the choice of a game strategy.

To obtain winning functions and game matrix a particular calculating instrument was developed. In this work we built a game matrix for towers and units of the same type. As a result of selection of all possible control options game matrix was obtained as well as the obtained strategies were distributed according to difficulty levels of the game.

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COMPUTER MODELING OF THE THERMAL STATE OF THE SYSTEM "SLAG SKULL-LINING" TAKING INTO ACCOUNT THE UNEVENNESS OF ITS THICKNESS

Sigarev E.N., Sokol A.N., Nedbailo N.N.

Abstract

Formulation of the problem

The development of economically substantiated and improved ways to increase the durability of the of oxygen converters, including using the technology of blowing the final slag onto the lining, involves the consideration of the thermal conditions of the "slag skull-lining" system.

Analysis of recent research and publications

In recent decades, the converter steel production in Ukraine and abroad is characterized by a significant increase in the resistance of the lining of aggregates while reducing the cost of refractories [1, 2].

Formulation of research objectives

The aim of the work is numerically study the thermal state of the "slag skull-lining" system of the oxygen converter, taking into account the unevenness of its thickness and the formation dynamics of the slag skull. The base of the mathematical model used the model presented in [8, 9].

Presenting main material

The equation of the mathematical model was solved by the method of finite differences on a uniform chess grid in cylindrical coordinates.

In numerical experiments it was established that for large lining thicknesses the temperature near the converter casing remains unchanged — the heat-insulating properties of the lining, caused by its low thermal

conductivity, are affected. As the thickness of the lining decreases, the heat sink into the environment increases, the lining temperature near the converter casing increases. The temperature of the slag layer in the contact zone with the lining decreases, which ensures the conditions for the crystallization of the slag and the formation of the skull. Thus, it can be concluded that the effect of local cooling of the converter casing (and the appropriateness of using forced heat sink means) with decreasing lining thickness is enhanced. This corresponds to the results of modeling [9] and the scanning image of the converter working space, and also agrees well with the results obtained in [7].

Conclusions and prospects for further research

As a result of the numerical simulation of the thermal state of the "slag skull-lining" system, the assumptions about the efficiency of local cooling organization (on the side of the converter casing) are confirmed.

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MATHEMATICAL MODELING OF PRESSURE LOSSES IN PIPELINES WITH SOFTWARE DEVELOPMENT

Vynnychuk A.G., Grysh Ya.I.

Abstract

The authors of the article justified the urgency of developing a software for simulating pressure losses in pipelines. Since the main task in the calculation of pipelines is to determine the total pressure drop in the pipeline working section and calculate the power required to transport natural gas to a certain volume flow.

Hydraulic calculation of the pipeline is quite complicated. Performing manually requires too much work and takes a long time, so it is advisable to create software for hydraulic calculation of the pipeline, which will greatly simplify the fulfillment of this task.

For building the mathematical model that formed the basis for the developed software, the patterns of pressure loss in pipelines were analyzed. Theoretical modeling of gas pressure losses was investigated in the presence of laminar, transient, and turbulent flow regimes in the pipeline. In this case, known approximations were used for various types of hydraulic resistances.

For the development of software, the programming language "JavaScript" is applied, which is based on the object representation of the browser. It is necessary in order to provide the site with more interactivity than the usual static HTML document, that is, the programming language for scripting on web pages.

The developed software for modeling the pressure loss in pipelines allows you to take into account the geometric shape of the pipeline itself and the flow parameters in the pipeline. The article gives an example of calculations for the flow of natural gas at low flow rates (up to 5.5 m^3/h) in a 16mm diameter pipeline. Such input parameters simulate the home network of natural gas supply to consumers.

The program developed calculates parameters such as: flow mode; speed of gas flow in the pipeline; the Reynolds number; coefficient of friction; coefficient of hydraulic resistance; loss of pressure (local and when folding). A perfect confirmation of the adequacy of the application of the developed software. Based on the results obtained, it is obvious that the software describes hydraulic losses in pipelines with sufficient accuracy and can be used to perform intermediate calculations.

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INVESTIGATION OF THE PHYSICAL MODEL OF THE PROCESS GAS MEASUREMENTTURBINE METERS MONTE CARLO

Klochko N.B., Chehovskiy S.A., Slabinoha M.O.

Abstract

The article is devoted to the practical apply of mathematical modeling methods of physical processes, such as method Monte Carlo. Basing on the model of axial turbine gas meters there were obtained the values of the K factor physical model which were used for plotting and calculation the density distribution of the confidence interval of K factor.

Turbine gas meters are widely uses in engineering practice. Easy installation and operation coupled with high reliability and accuracy are sufficient for their use in solving engineering problems. However, in actual use of turbine gas meters there are opposing forces that change the ratio of angular velocity to a value of volumetric flow. The main parameter of turbine flow meters during calibration is a K factor. That is why, the authors propose to undertake a changing range prediction to determine the theoretically possible limit values of K factor. The purpose of the Monte Carlo method in our case is to minimize an effort and resources of cumbersome mathematical expressions calculation that will predict the limits of K factor.

In our case, when it comes to the physical model of measuring the volumetric flow by turbine flow meters it is necessary to simulate the measurement process by simulating changes of input parameters, set their distribution law, and the range of values. Thus, experimental studies of turbine flow meters we replace by statistical model housing process. As a result of checking all the possible combinations of input each time we get a new model for measuring value. This set of implementations can be used as artificial obtained statistical data and are able to be processed by conventional methods of mathematical statistics.

The results of co-weight coefficient shows that the greatest impact on the mathematical model of turbine flow meters have geometric parameters and the Strouhal number. Therefore, to improve the accuracy of measurement results it is advisable to consider the flow parameters in the assessment of total error.

As a result of statistical processing of simulation data sample set we have got a distribution model of turbine gas meters which is normal, and confidence limits are 26,526.01 imp / $m^3 \leq K \leq$ 26846,9 imp / m^3.

Application of Monte Carlo method gave the possibility to evaluate the distribution law of turbine gas meters and found confidence limits of K factor for turbine gas meter G250 across the measurement range. This lets you to control the limits of K factor during its verification or calibration.

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RESEARCH OF THE WORK RELIABILITY OF HEMODIALYSIS TREATMENT EQUIPMENT

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Abstract

Reliability is particularly important while using of medical equipment, because rejection of equipment cause with risk of injury patients and can decrease the efficiency of health care institutions.

Main objective of hemodialsys treatment is correction of electrolyte level in blood and acid-base status, adequate patient dehydration and reduction of azotemia. Various failure entail attention of medical personnel, not only the device but also for patients that the problem of insecurity puts forward new requirements for operation of the equipment.

Modern dialysis machines because of embedded software, are carried out self-test before the dialysis procedure starts. Each test creates a critical situation with the emergence of alarm and checks the response of security systems.

One of the major mistakes in the dialysis machine is the deviation of 26V voltage signal. The main reasons for such errors are:

Faulty power supply. Causes of errors in the power supply - unstable input voltage and / or failure of individual nodes of the power supply. Characteristics of electric circuit are unstable, due to many different factors that will not affect immediately, but significantly reduces the period of operation of the equipment. Internal power supply failures occur most often in the block Switching Regulators circles rectification and voltage stabilization.

Faults control unit. The causes of the error deviation 26V work-related control unit are: failure of transistor switch, serving a distribution of power between the hydraulic unit and microprocessor unit, failure of transformers voltage levels.

An analysis of this issue leads to few recommendations to improve the reliability of the system:

1. Create an additional line voltage 5.15V in the power supply;
2. Develop a cooling system to stabilize the temperature in the machine;
3. Ensure the use of uninterruptible power supply;
4. Increase the frequency of periodic inspections by tech stuff.

The results of the research have developed recommendations on improving efficiency and reducing the number of failures in the device and modeling conditions of improving "artificial kidney" machine in the proposed recommendations.

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MATHEMATICAL DESIGN OF THE THERMAL STATE OF BUILDING CONSTRUCTIONS WITH THE USE OF MATERIALS WITH PHASE TRANSITIONS

Karimov I.K., Dolgopolov I.S., Jacenko A.L.,Tuchin V.T.

Abstract

The authors focus on the problem the features and advantages of materials with phase change material (PCM) for the use it in build constructions, in particular in the flat roofs of buildings. A task to reseach efficiency of materials with phase transitions application in build constructions for the terms of middle s of Ukraine on the example of Kamenskoe town.To that aim the dynamics of temperature field of three layers flat roof with concrete and PCM material is considered.

The mathematical model of temperature stateprocess of flat roof with concrete and PCM and algorithms of , based on the special method of differential charts of the modified thermal balances method are presented.It is set that in the three-layers flat roof with the use of PCM on the basis of Sal glauberi at the thickness of PCM 3,5 mm is arrived the set level of comfort temperature in building at summer (in the conditions of Kamenskoe), even at fluctuation in the temperature of layer of flat roof from 27 to 60°C. The results of of work of flat roof with Sal glauberi at winter are rotined that at fluctuation in the temperature of external layer of flat roof within the limits of 8-12°C, the temperature of internallayer of flat roof unimportant (15,5-16°C). It can be explained influence of thermophysical properties of PCM, in particular by a heat capacity which differs from the heat capacity of concrete almost twice. It follows from it, that a flat roof with this PCM has the best accumulating qualities even without of phase transition. It can decrease the expense of thermal energy on heating of apartment.

The results of researches arevtestify to perspective of the using of materials withPCM in build constructions of Kamenskoe town.Interesting directions of the using of PCM in build constructions are multi-layered flags with a few layers of PCM materials. It needs subsequent researches in the modelling of the thermal state of such objects.

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DESIGN AND DEVELOPMENT OF A CLIENT-SERVER APPLICATION BASED ON PEER-TO-PEER NETWORKS

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Abstract

A client-server application for data transmission in peer-to-peer networks is designed. It is proposed to use an improved algorithm of string parsing based on regular expressions. This algorithm provides a significant reduction in the time of transfer of client information with its simultaneous protection.

Relevance of the topic of work is determined by the need to improve the quality of service in peer-to-peer transmission data streams. In order to solve this problem, we propose to use an improved algorithm of string parsing between client and server applications based on regular expressions. Utilization of such algorithm will accelerate the user's data transfer and provide its additional security.

The purpose of the work is to improve the quality of service in peer-to-peer streaming data transmission with star topology through the application of an algorithm of string parsing between client and server application based on regular expressions, and also to provide user data security. To achieve this goal, the following stages of the study are performed: 1. Development of algorithm for data transmission in peer-to-peer networks with star-topology, which allows to improve the quality of streaming data transmission and their security. 2. Comparative analysis of the effectiveness of the proposed and existing algorithms for managing the transmission of stream data in peer-to-peer networks. 3. Development of an experimental client-server application based on peer-to-peer networking, both for a limited number of users and for open access.

In the proposed client-server application, data transfer is realized on the basis of peer-to-peer networks with reduced load on the server side with simultaneous increase in data transfer speed through the use of regular expressions. The additional security of customer data and the principle of communicating with client and server applications are implemented.

Further research is the development of a graphical interface for the server, the creation of a rank of users, the use of several TCP ports for downloading and distributing data. The developed algorithms for string parsing and increasing the security of data leakage can be used by programmers to create their own software products. The results can be used in enterprises where there is a need for data exchange on the network.

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MODELING MELT OUTPUT FROM THE CONVERTER USING BOND DIAGRAM METHOD

Pohvality A.A., **Sigarev E.N.**, **Kulik A.D.**, **Poletaev V.P.**

Abstract

A technique for obtaining analytical models using link diagrams is proposed. The code chart is constructed taking into account the principle decomposition, i.e. the dismemberment of the investigated object into separate elements, indicating the type connections between them. Using the technique and the method connection diagrams, a mathematical model hydrodynamics liquid phase flow in the system "liquid bath of the converter - steel channel" has been developed. Limitations and assumptions used in constructing the model: the liquid medium in the model and the steel-outlet channel the 260-ton oxygen converter is represented as an object

with lumped parameters; the hydro- and mechanical side processes flow liquid phase from the steel outlet channel is considered under isothermal conditions; volumetric flow and pressure through the cross sections channel are represented by the averaged values in the fields flow velocities and pressure.

A module functional fluid dynamics hydrodynamics operator, developed in the Mathcad shell, is developed. The results of simulation of the melt discharge of steel from an oxygen converter to a steel-ladle using the method bond diagrams are presented. The proposed model makes it possible to evaluate the effect geometric parameters outlet channel on the duration smelting during course converter's campaign along the lining.

Since the flow liquid phase has an unsteady nature due to the relatively short length of the steel outlet channel, the total coefficient local resistance was determined empirically. For a one-chamber tap, the coefficient local resistance is 0.96-1.05, for a two-chamber resistance it is 0.50-0.65, respectively. When the neutral gas is supplied to the cavity tap with the aim realizing the carbon deoxidation of steel, this coefficient is in the range 0.80-1.25 and depends on the geometric parameters outlet channel.

Based on the results simulation, it was found that a decrease in the thickness lining the oxygen converter and, correspondingly, the length discharge channel, leads to an increase in the duration of melt release from the unit after the melting is completed. At the same time, during the taping campaign, its internal diameter increases, which leads to a reduction in the length release. The information obtained as a result of numerical experiments can be used to solve problems developing and improving new designs converter's steel outlet assembly.

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MATHEMATICAL MODEL OF A STEAM TRACT OF A MULTI-FUEL BOILER UNIT FOR THE DISPOSAL OF COAL MINT METHANE.

Stasevich R.K.

Abstract

Thanks to the creative efforts of the students and workers of IGTM NAS of Ukraine, we take the leading place in the world practice of methane utilization in the coal mine. The issue of recycling methane ventilation jets (MVS), with a percentage less than 1%, is not being solved.

The purpose of the work is to ensure the safe operation of explosive technological processes in the utilization of methane gas in metallurgy.

Steam boilers belong to a wide class of control objects, static and dynamic characteristics, which vary widely in advance in an unforeseen manner. The steam capacity of the boiler unit is regulated in accordance with the load being consumed by influencing the supply of fuel and air to the combustion chamber, which is necessary for combustion. The condition determining its failure rate from exceeding the permissible vapor pressure is a violation of the balance between the steam being consumed and the steam being generated.

The main condition for gas consumption is the maximum use of mine methane.The boiler unit as an object of regulation of pressure or steam consumption can be simplified to be represented in the form of two series-connected elements: the furnace and the evaporative device of the boiler. The economizing and steam-superheating sections of the boiler are conditionally accepted by those entering the evaporation circuit.

The example of a steam boiler proposed for the utilization of coal mine methane shows the mathematical description of the explosive technological process of methane utilization in the form of differential equations and complex transfer function that creates the basis for creating an automatic control system for a boiler that ensures the safety of its operation.

A structural solution of the tricogeneration station on the basis of a multi-fuel boiler, which can safely and energy efficiently utilize not only the natural gas of coal deposits but also low-concentration mine methane, has been developed.

Gained algorithm will serve as a basis for the development of the mathematical support of the system for safe and energy-efficient management of a multi-fuel boiler utilizing coal mine methane.

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MODELING OF THE RELIABLE OPERATION OF ELECTRONIC HUMIDITY CONTROL SYSTEM AT WAREHOUSE PREMISES

Meshchaninov S.K., Bagry V.V., Kampov O.V., Spivak V.M.

Abstract

Air climatic variables are of big importance in the places where the goods are stored.

Both heated and non-heated warehouses have problems with temperature and humidity control. The walls and goods dampen; the wiring breaks down creating the preconditions for the emergence of a fire hazardous situation. Nowadays there are a lot of temperature and humidity control systems similar in their operation. Some of them are given below:

1. The TempControl [5] system allows:

- To keep the temperature and humidity data
- To control the temperature and humidity distantly

- To control the temperature and humidity locally

2. The “Actidata NetViewer” [7] control systems. «Actidata NV-1» is a system that transmits information about temperature, relative humidity, water leakage, activation of the slip sensors, movement and fumigation through the Ethernet interface, which enables sending e-mail messages about the abnormal situation via the Internet to a user's mailbox with the help of a network server. The Actidata NV-1 doesn’t require an additional power line, maintenance, checking and regulation. Its main characteristics are:
- temperature range: –30 — –125 Cº, accuracy — 1 %;
- relative humidity range: 0 — 100 %.

Taking into account the permanent renewal of elemental base of the modern electronics, before being implemented the regulator should be improved: it is necessary to renew the elemental base, to set up the newest sensors, to add the coupling circuit with computer by means of USB, to create a software for device managing. Consequently, the objective of this article is to model the reliable operation of electronic humidity control system at warehouse premises with the help of microcontroller ATmega8-16AI

Each device differs from others of multiple characteristics, ranging from the reliability to price for the installation and maintenance. We propose the device which costs less and is more reliable in use.

Using reference tables, we determine the failure and repair rate of each type of component. With the help of reference data and known reliability theory proportion we calculate and model the reliability of the electronic circuit. The components, which have the same failure and repair rate, we put into one group. Obtained results we add to the initial data and failure rate table.

The methodology for determining and modeling of the reliable operation of electronic humidity control system at warehouse premises is proposed. Based on this methodology, the methods for improving of the reliability of electronic monitoring devices and systems can be developed.

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ELECTROMAGNETICS MODELLING OF WAVEGUIDE PHASED ANTENNA ARRAY WITH MATCHING PERIODICAL STRUCURE AND DIELECTRICAL LAYERS

Marchenko S.V., Gnatyuk M.O, Syanov O.M.

Abstract

Matching of phased array with free space is an important task. There are various methods to improve matching: the use of inductive irises[5], flanges impedance [5] and magnetodielectric inserts and layers [8] etc. This paper investiges the application of the matching structure (MS) in the form of matching periodical structure (MPS) with dielectric layers, as well as the result of the influence of the dielectric filling on the reflection coefficient. The results of the comparison between MPS and MPS with dielectric layers were done.

Electromagnetics modelling of PAA with presented MS was carried out with penetrating area method (PAM). The PAM is a one of methods created on basic of the integral equation method [8]. Accounting of allocated partial and penetrating areas with magnetic-dielectrical including is actual and connect with Green’s function formulating of stratified magnetic-dielectrical including. In spite of existing approaches, account of magnetic-dielectrical including in PAM has own features that described in this paper.

Numerical study of matching of phased antenna array with free space by means of MPS showed that using of PMS with increasing thickness of the waveguide becomes more noticeable. The use of dielectric inclusions in the PMs are useful within the structure, because covers do not contribute to the reduction of reflectance due to the appearance of a surface wave propagating in the dielectric layer. The average decrease in the modulus of the reflection coefficient using PMS with dielectric inclusions in comparison without the filling is 25-35%..

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