AL-FARABI KAZAKH NATIONAL UNIVERSITY

INFORMATION
about publication activity
FACULTY OF MECHANICS AND MATHEMATICS

№	Наименование публикации	Выходные данные *(doi статьи)*	Аннотация статьи	Ссылка для цитирования *(Ф.И.О., название статьи, название, номер и/или выпуск, том журнала, страницы, doi статьи)*
2022 год				
1.	Application of the lumped-parameter method for modeling nonlinear vibrations of drill strings with stabilizers in a supersonic gas flow	DOI: 10.1016/j.apm.2022.06.022	In this paper, we study the nonlinear dynamics of a drill string under the effect of external loads in a supersonic gas flow, taking into account supporting stabilizers. The case of the drill string spatial lateral vibrations, which are the main cause of the drilling equipment failures, is considered. To account for nonlinear effects, a mathematical model based on the general relations of Novozhilov's nonlinear theory of elasticity is developed. The discretization of the model is conducted using the lumped-parameter method. The explicit fourth order Runge-Kutta method is utilized for obtaining a numerical solution for the studied system. The effect of damping elements (supporting stabilizers) on the drill string lateral vibrations is analyzed. Numerical illustrations are presented,	Khajiyeva Lelya, Sabirova Yuliya, Kudaibergenov Askar, Kudaibergenov Askat Application of the lumped-parameter method for modeling nonlinear vibrations of drill strings with stabilizers in a supersonic gas flow // Applied Mathematical Modelling. – 2022. – Vol. 110. – P. 748 – 766. DOI: 10.1016/j.apm.2022.06.022

			and the corresponding recommendations for deep and shallow drilling are given.	
2.	Analysis of Drill-String Nonlinear Dynamics Using the Lumped-Parameter Method	DOI: 10.3390/sym14071495	This work aims at studying the nonlinear dynamics of drill strings using the lumped-parameter method (LPM). The study is based on the good consistency of the results of the test problem where the model of the longitudinal vibrations of a horizontal drill string with a static compressive load at the left end is considered. In this paper, this method is applied to discretize linear and nonlinear models of the lateral vibrations of a vertical drill string under the effect of a supersonic gas flow. The obtained results are verified with the previously published data. The optimal number of the drill-string partitions is determined using the developed application, which allows us to estimate the accuracy of the loaded data. The numerical solution of the model is obtained using the fourth-order Runge–Kutta method. The optimization of the numerical algorithm using parallel-programming tools is carried out, and the efficiency of the method is analyzed.	Khajiyeva Lelya, Andrianov Igor V., Sabirova Yuliya, Kudaibergenov Askar Analysis of Drill-String Nonlinear Dynamics Using the Lumped-Parameter Method // Symmetry. – 2022. – Vol 14, № 7. – P. 1-18. DOI: 10.3390/sym14071495
3.	Modeling of Nonlinear Dynamics of Planar Mechanisms with Elastic and Flexible Pre-stressed Elements	DOI: 10.1007/978-3-030-83594-1_10	The motion of planar hinge-lever mechanisms with flexible and elastic links in a closed pre-stressed contour is considered. Modeling of the mechanism motion is carried out on the basis of their kinetic-elastodynamic analysis, which takes into account the inertial relationship between the large-scale motion of mechanisms as a rigid body and nonlinear vibrations of the links as a result of their elastic deformation. This work pays attention to both longitudinal and lateral vibrations of elastic links. The equations of motion of the mechanisms are obtained by the use of Novozhilov's nonlinear theory of elasticity, according to which the link deformations are assumed to be finite. Based on Biot's theory of incremental deformations, the field of initial stresses in flexible elements is taken into account due to their preliminary tension, which determines the geometric nonlinearity of dynamic models. As an example, the dynamics of a planar five-link hinge-lever mechanism with closed pre-stressed contour is studied.	Khajiyeva L.A., Kudaibergenov, A.K., Abdraimova, G.A., Sabirova, R.F. Modeling of Nonlinear Dynamics of Planar Mechanisms with Elastic and Flexible Pre-stressed Elements // Mechanisms and Machine Science. – 2022. - Vol. 85. – P. 94-103. DOI: 10.1007/978-3-030-83594-1_10
4.	Numerical Method for a Filtration Model Involving a Nonlinear	DOI: 10.3390/math10081319	In this paper, we propose an efficient numerical method for solving an initial boundary value problem for a coupled system of equations consisting of a nonlinear parabolic partial integrodifferential equation and an elliptic equation with a	Baigereyev Dossan, Omariyeva Dinara, Temirbekov Nurlan, Yergaliyev Yerlan, Boranbek Kulzhamila Numerical Method

	Partial Integro-Differential Equation		nonlinear term. This problem has an important applied significance in petroleum engineering and finds application in modeling two-phase nonequilibrium fluid flows in a porous medium with a generalized nonequilibrium law. The construction of the numerical method is based on employing the finite element method in the spatial direction and the finite difference approximation to the time derivative. Newton's method and the second order approximation formula are applied for the treatment of nonlinear terms. The stability and convergence of the discrete scheme as well as the convergence of the iterative process is rigorously proven. Numerical tests are conducted to confirm the theoretical analysis. The constructed method is applied to study the two-phase nonequilibrium flow of an incompressible fluid in a porous medium. In addition, we present two examples of models allowing for prediction of the behavior of a fluid flow in a porous medium that are reduced to solving the nonlinear integro-differential equations studied in the paper.	for a Filtration Model Involving a Nonlinear Partial Integro-Differential Equation // Mathematics. - 2022. – Vol. 10, № 8. – P. 1-24. DOI: 10.3390/math10081319
5.	The Use of Organic Fraction of Solid Household Waste to Generate Ethanol and Biogas Using a Simulation Model	DOI 10.32014/2022.2518-170X.147	The paper shows the efficiency of collecting and disposing of biogas at a landfill of solid household waste using a biogas plant of a modernized design. Effective solid waste management involves the use of various approaches, technologies and treatment concepts to ensure the protection of public health and the environment. The optimal mode of processes occurring in a biogas plant is determined by computer modeling. The identification of the parameters of a mathematical model for describing the biochemical processes occurring in a biogas plant has been carried out. Two approaches are used to solve the mathematical model: A finite-difference method for solving a system of differential equations and simulation modeling using the Any Logic package. A computer program has been compiled in the algorithmic language C++. Numerous calculations have been carried out, the results of which are presented in the form of graphs and their qualitative picture is consistent with the ongoing processes. The created computer program allows you to make a preliminary forecast of anaerobic fermentation occurring in the bioreactor, depending on the volume of the substrate, methanogenic microorganisms and temperature conditions.	Temirbekova M.N., Temirbekov N.M, Wojcik W., Aliyarova M.B., Elemanova A.A. The Use of Organic Fraction of Solid Household Waste to Generate Ethanol and Biogas Using a Simulation Model // News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences. - 2022. – Vol. 1. – P. 105-114. DOI 10.32014/2022.2518-170X.147

			Alternative methods such as pretreatment of solid household waste, fermentation, ethanol fermentation and anaerobic digestion attract increased attention. Using these methods, a liquid with alcohol-containing substances was obtained from 1.6 kg of organic fraction of solid household waste from the landfill, in which the percentage of ethyl alcohol was 98%, and ethanol (95%) was also obtained from 2.3 kg of the model fraction of waste. Therefore, solid household waste can be a viable source of energy, not a source of pollution. Thus, the article considers the possibility of using mathematical simulation of biogas, as well as a qualitative experiment from organic fraction residues and their further conversion into ethanol.	
6.	Numerical simulation of particle dynamics in the hydrogen-air mixing layer	DOI: 10.26577/ijmph.2022.v13.i1.03	In this paper, supersonic plane turbulent mixing layer of gases with injection of solid particles is studied numerically. The gas phase are determined by DNS solving the multi-species Navier-Stokes equations in the Eulerian approach, and the dynamic of solid particles are traced in the Lagrangian approach. The dynamics of hydrogen – air mixing and the formation of the vortex system in the mixing layer and its effect on the distribution of solid particles in the two free-flow speeds are investigated. The study focuses on detailed analysis an influence of the vortex system in the supersonic turbulent mixing layer on the dispersion solid particles with different size. The results show that heavy particles almost do not react to vortex structures. It is revealed that medium particles tend to accumulate along the circumference of the vortex and along the braid between the two vortices. A quasi-equilibrium state with a gas flow of light particles is established.	G.A. Ashirova, A.K. Manapova, A.O. Beketaeva Numerical Simulation of Particle Dynamics in the Hydrogen-Air Mixing Layer // International Journal of Mathematics and Physics. – 2022 – Vol. 13, №1. – P. 28 – 38. DOI: 10.26577/ijmph.2022.v13.i1.03
7.	On Aspects of Gradient Elasticity: Green's Functions and Concentrated Forces	DOI 10.3390/sym14020188	In the first part of our review paper, we consider the problem of approximating the Green's function of the Lagrange chain by continuous analogs. It is shown that the use of continuous equations based on the two-point Padé approximants gives good results. In the second part of the paper, the problem of singularities arising in the classical theory of elasticity with affecting concentrated loadings is considered. To overcome this problem, instead of a transition to the gradient theory of elasticity, it is proposed to change the concept of concentrated effort. Namely, the Dirac delta function is replaced by the	Andrianov, Igor V.; Koblik, Steve G.; Starushenko, Galina A.; Kudaibergenov, Askat K. On Aspects of Gradient Elasticity: Green's Functions and Concentrated Forces // Symmetry. – 2022. – Vol. 14, № 2. – P. 1-13. DOI 10.3390/sym14020188

			Whittaker–Shannon–Kotel'nikov interpolating function. The only additional parameter that characterizes the microheterogeneity of the medium is used. An analog of the Flamant problem is considered as an example. The found solution does not contain singularities and tends to the classical one when the microheterogeneity parameter approaches zero. The derived formulas have a simpler form compared to those obtained by the gradient theory of elasticity	
8.	Analysis of the Stress-Strain State of Rotating Drill Strings with a Drilling Mud	DOI 10.1007/978-3-030-83594-1_12	This paper studies the stress-strain state of a rotating drill string complicated by the effect of a drilling mud flow and external compressive and twisting forces. The drill string is considered in the form of a homogeneous isotropic elastic rod with constant cross-section. A nonlinear mathematical model of the drill string spatial lateral vibrations based on Novozhilov's nonlinear theory of elasticity is utilized. The Bubnov-Galerkin approach that allows reducing the given PDEs to ODEs and the numerical stiffness-switching method are applied to obtain a solution of the model. To analyze the stress-strain state of the drill string, we use the maximum stress intensity criterion and construct the graphs demonstrating changes of strain and stress in the chosen drill string cross-section with time, and stress distribution over the drill string length with time for nonlinear and linear cases. The research results indicate the significance of accounting for geometric nonlinearity to examine the drill string stress-strain state under the influence of the drilling mud	Kudaibergenov, Askar K. Kudaibergenov, Askat K. Khajiyeva L.A. Analysis of the Stress-Strain State of Rotating Drill Strings with a Drilling Mud // Mechanisms and Machine Science. – 2022. - Vol. 85. – P. 114-122. DOI 10.1007/978-3-030-83594-1_12
9.	Explicit Model for Surface Waves on an Elastic Half-Space Coated by a Thin Vertically Inhomogeneous Layer	DOI: 10.1007/978-3-030-77306-9_23	The study is focussed on surface waves propagating in an isotropic elastic half-space coated with a thin, vertically inhomogeneous layer, subject to action of a prescribed normal surface stress. The effective boundary conditions modelling an inhomogeneous coating are derived in the long-wave limit, generalising the those for a thin homogeneous isotropic layer. A singularly perturbed hyperbolic equation on the interface is then deduced, governing surface wave propagation. The effect of the perturbative pseudo-differential operator including the structure of the quasi-front emerging for a point impulse loading, is analysed.	Mubaraki Alia, Prikazchikov Danila, Kudaibergenov, Askar K. Explicit Model for Surface Waves on an Elastic Half-Space Coated by a Thin Vertically Inhomogeneous Layer // Springer Proceedings in Mathematics and Statistics. – 2022. – Vol. 362. – P. 267-275. DOI: 10.1007/978-3-030-77306-9_23
10.	Simulation of Ternary Fluid	DOI	This article reviews the mathematical and computer modeling of the process of ternary fluid mixture separation by free	Zhakebayev D.B.; Zhumali A.S. Simulation of Ternary Fluid

	Mixtures Separation by Phase-Field Free Energy LBM	10.26577/ijmph.2022.v13.i1.05	energy based phase field Lattice Boltzmann equations method. The process under study is considered in a limited area having the shape of a rectangle. Three different sets of fluid components with different structures are specified. The mathematical model constructed to describe this process is based on the Navier-Stokes equation for an incompressible fluid and the Cahn-Hilliard equation. The numerical model is built on the basis of LBM using the D2Q9 model. Numerical experiments were performed for two scenarios: (1) – investigate the model without gravity, in order to determine the patterns of the surface tension effect and (2)-investigate the model with gravity force. Numerical results showed a spinodal separation depending on the initial fractions of fluid concentrations. The results obtained determine the adequacy of the constructed model for a three-component fluid	Mixtures Separation by Phase-Field Free Energy LBM // International Journal of Mathematics and Physics. - Vol. 13, № 1. – P. 45-51. DOI: 10.26577/ijmph.2022.v13.i1.05
11.	Simulation of three-dimensional forced compressible isotropic turbulence by a redesigned discrete unified gas kinetic scheme	DOI: 10.1063/5.0079714	In this paper, we implemented the Boltzmann-equation-based mesoscopic model, developed recently by Chen et al. ["Inverse design of mesoscopic models for compressible flow using the Chapman-Enskog analysis,"Adv. Aerodyn. 3, 5 (2021)], to simulate three-dimensional (3D) forced compressible isotropic turbulence. In this model, both the Prandtl number and the ratio of bulk to shear viscosity can be arbitrary prescribed. The statistically stationary turbulent flow is driven by a large-scale momentum forcing in the Fourier space, with the internal heating due to the viscous dissipation at small scales being removed by a thermal cooling function. Under the framework of discrete unified gas kinetic scheme (DUGKS), a 3D direct numerical simulation code has been developed, incorporating a generalized Strang-splitting scheme. The weighted essentially non-oscillatory (WENO) scheme is used to increase local spatial accuracy in the reconstruction of particle distribution functions at the cell interface. A 3D discrete particle velocity model with a ninth-order Gauss-Hermite quadrature accuracy is used to ensure accurate evaluation of viscous stress and heat flux in the continuum regime. We simulate forced compressible isotropic turbulence at both low and high turbulent Mach numbers. A direct comparison is performed with the results obtained from a hybrid compact finite difference-WENO scheme solving directly the Navier-Stokes-	Chen Tao, Wen Xinb, Wang Lian-Ping, Guo Zhaolie, Wang Jianchun, Chen Shiyi, Zhakebayev D.B. Simulation of three-dimensional forced compressible isotropic turbulence by a redesigned discrete unified gas kinetic scheme // Physics of Fluids. – 2022. - Vol. 34, № 2. DOI 10.1063/5.0079714

			Fourier system. The comparison validates our DUGKS code and indicates that DUGKS is a reliable and promising tool for simulating forced compressible isotropic turbulence. The work represents a first study to directly simulate forced compressible turbulence by a mesoscopic method based on the Boltzmann equation.	
12.	Simulation of concentration convection in an inclined channel	DOI 10.1615/HeatTransRes.2022043133	Numerical simulation of the concentration convection that occurs in a three-component gas mixture He + Ar – N2 in an inclined channel has been carried out. To describe the occurrence of convective flows in the mixture under consideration, a 3D numerical algorithm based on the D3Q19 model of the Boltzmann lattice equation method has been developed. It is shown that when the slope angle changes in the range from 40° to 80°, the isoconcentration lines are curved, which indicates the presence of convective mechanisms in the total mass transfer. It is shown that at an inclination angle of 60°, the intensity of convective transfer is maximum.	Zhakebayev, D., Fedorenko O., Kossov V., Mukamedenkyzy V., Karuna O. Simulation of concentration convection in an inclined channel // Heat Transfer Research. – 2022. - Vol. 53, № 15. – P. 39-52. DOI 10.1615/HeatTransRes.2022043133
13.	Convective mass transfer of a binary gas mixture in an inclined channel	DOI 10.1002/zamm.201900197	The influence of a slope angle on the stability of mechanical equilibrium in binary gaseous mixtures has been investigated both experimentally and numerically. Experimental studies have shown that the angle of inclination of the channel relative to the horizontal plane can be critical in convective mixing. When this angle is reached, the system performs a kinetic transition from an unstable to a stable state, that is, to diffusion. The problem is solved by the Lattice Boltzmann method using the two-dimensional Navier-Stokes equation, the continuity equation and the equation of concentration. Calculations are performed to study binary mixtures with different angles of inclination of the diffusion channel with respect to the vertical axis. Due to the increase of the angle of inclination, the convective flow intensity decreases. Numerical data on the structure fields of concentrations at different times depending on the increase of the slope angle are obtained.	Kossov V., Fedorenko O., Zhakebayev D., Mukamedenkyzy V., Kulzhanov D. Convective mass transfer of a binary gas mixture in an inclined channel // ZAMM Zeitschrift fur Angewandte Mathematik und Mechanik. – 2022. - Vol. 102, № 1. DOI 10.1002/zamm.201900197
14.	An efficient parallel spectral code for 3D periodic flow simulations	DOI 10.1016/j.softx.2022.101244	Numerical results from a spectral code are the defacto standard in CFD community for many fluid flow problems. Their popularity is motivated by the highest accuracy coupled with decent computational performance. In this work, we introduce the Fortran code based on a pseudospectral solver for tri-	Karzhaubayev Kairzhan, Wang Lian-Ping, Zhakebayev, Dauren An efficient parallel spectral code for 3D periodic flow simulations

			periodic flows. The code relies on the Fast Fourier Transform (FFT) and one of the fastest implementations of the FFT–FFTW Version 3. Code parallelization is performed using 2D domain decomposition and FFTW library. Whenever it is possible we tried to keep the code more explicit, even in cases which resulted in a bit more memory usage by allocating new memory for variables and arrays instead of reusing existing ones. Code validation was performed using results for a decaying 3D Taylor–Green vortex flow. In addition, the code was adapted to use the CUDA parallelization technology. The code can be used and extended by the research community for various periodic flow simulations. The availability of both CPU and GPU parallelized versions of the code provides additional flexibility in choosing the hardware platform.	// SoftwareX. – 2022. – Vol. 20. DOI: 10.1016/j.softx.2022.101244
15.	The Solvability of Mixed Value Problem for the First and Second Approximations of One-Dimensional Nonlinear System of Moment Equations with Microscopic Boundary Conditions	DOI 10.1007/s44198-021-00024-7	The paper gives a derivation of a new one-dimensional non-stationary nonlinear system of moment equations, that depend on the flight velocity and the surface temperature of an aircraft. Maxwell microscopic condition is approximated for the distribution function on moving boundary, when one fraction of molecules reflected from the surface specular and another fraction diffusely with Maxwell distribution. Moreover, macroscopic boundary conditions for the moment system of equations depend on evenness or oddness of approximation fk(t, x, c) , where fk(t, x, c) is partial expansion sum of the molecules distribution function over eigenfunctions of linearized collision operator around local Maxwell distribution. The formulation of initial and boundary value problem for the system of moment equations in the first and second approximations is described. Existence and uniqueness of the solution for the above-mentioned problem using macroscopic boundary conditions in the space of functions C ([0, T]; L2[- a, a]) are proved.	Sakabekov Auzhan, Auzhani Yerkanat The Solvability of Mixed Value Problem for the First and Second Approximations of One-Dimensional Nonlinear System of Moment Equations with Microscopic Boundary Conditions // Journal of Nonlinear Mathematical Physics. – 2022. – Vol. 29, № 1. – P. 124-148. DOI 10.1007/s44198-021-00024-7
16.	Investigation of Aerodynamic Characteristics of Aircrafts in a Rarefied Gas Flow Using the Moment Method	DOI 10.1155/2022/6943602	A one-dimensional nonstationary nonlinear moment system of equations and an approximation of Maxwell's microscopic boundary condition will be introduced. The flight speed and surface temperature of the aircraft are included in the moment system of equations as coefficients. Macroscopic boundary conditions also depend on the surface temperature of the aircraft. The quantity of macroscopic boundary conditions for	Sakabekov Auzhan, Madaliyeva Saltanat, Yergazina Ryskul Investigation of Aerodynamic Characteristics of Aircrafts in a Rarefied Gas Flow Using the Moment Method // International Journal of

			the moment system of equations depends on the parity of the approximation number of the moment system of equations. We state the initial and boundary value problem for the moment system of equations in the third approximation under macroscopic boundary conditions. This paper proves the existence and uniqueness of the solution of the abovementioned problem in the space of functions continuous in time and summable in the square by spatial variable. The theorem on the existence and uniqueness of a solution of the initial and boundary value problem for the moment system of equations in the third approximation is proved by the method of a priori estimation and using the Galerkin method and Tartar's compensated compactness method	Mathematics and Mathematical Sciences. – 2022. – Vol. 2022. DOI 10.1155/2022/6943602
17.	Experimental Data and the Nonlinear Inverse Problem of Heat Transfer	DOI 10.26577/ijmph.2022. v13.i1.01	In the paper the development a method for finding the nonlinear heat-conducting characteristics of the soil is being presented. Two-layer container complexes have been created, the side faces of which are thermally insulated so that the 1D heat equation can be used. In order not to solve the boundary value problem with a contact discontinuity and lose the accuracy of the method's solution, a temperature sensor was placed at the junction of two media, and a mixed boundary value problem is solved in each area (container). To provide the initial data with an inverse coefficient problem, two temperature sensors are used: one sensor was placed at the open boundary of the container and recorded the soil temperature at this boundary, and the second sensor was placed at a short distance from the boundary, which recorded the air temperature. The measurements were carried out on the time interval (0, tmax). First, the initial-boundary value problem of thermal conductivity with nonlinear coefficients of thermal conductivity, heat capacity, heat transfer, and material density are studied numerically. The nonlinear initial-boundary value problem is solved by the finite difference method. Based on the measured data of the complex, special functionals are constructed and the thermal conductivity coefficient k, density ρ, specific heat capacity c, heat transfer coefficient h are found, which depend on the temperature of the material. Based on the experimentally measured data, the corresponding functional is minimized on each time interval using the gradient descent	Rysbaiuly B., Alpar S.D. Experimental Data and the Nonlinear Inverse Problem of Heat Transfer // International Journal of Mathematics and Physics. -2022. - Vol. 13, № 1. – P. 4-18. DOI 10.26577/ijmph.2022.v13.i1.01 – 2022

			method. All thermophysical characteristics for a container with clay were found with a relative error of 5%.	
18.	Iterative Method of Finding All Thermophysical Parameters of a Two-Layer Soil	DOI 10.1088/1742-6596/2224/1/012041	The paper develops methods for finding the thermophysical parameters of a two-layer soil. The difference scheme for the equation of quasi-linear thermal conductivity is taken as the basis for the study. Two-layer complexes of containers have been created, the side faces of which are thermally insulated. Measurement work was carried out to obtain values at the two end borders, the environment and at the contact boundary of the two containers. This circumstance makes it possible to solve the inverse coefficient problem in each container independently of each other. We have developed methods for finding all the thermophysical parameters of the soils in both containers. A rational method of choosing the damping coefficient is also proposed, which provides an indicative rate of convergence of the approximate value of the functional to zero. Computational experiments were carried out on the basis of the developed methods and measured data. The results of which show the viability of the developed iterative methods.	Rysbaiuly B., Mukhametkaliyeva N.E. Iterative Method of Finding All Thermophysical Parameters of a Two-Layer Soil // Journal of Physics: Conference Series. – 2022. – Vol. 2224, № 1. DOI 10.1088/1742-6596/2224/1/012041
19.	Nonlinear Inverse Heat Transfer Problem	DOI 10.1088/1742-6596/2224/1/012039	In this work, a method for finding nonlinear heat-conducting characteristics of soil is developed. Two-layer complexes of containers were created, the side faces of which are thermally insulated, so the 1D thermal conductivity equation is used. A temperature sensor is placed at the junction of the two media, and a mixed boundary value problem is solved in each area. In order to provide the inverse coefficient problem with initial data, two temperature sensors are used: one sensor was placed at the open border of the container and recorded the soil temperature at this border, and the second sensor was placed at a short distance from the border, which recorded the air temperature. The measurements were carried out in the time interval (0,4t max). First, the initial-boundary value problem of thermal conductivity with nonlinear coefficients is investigated by the finite difference method. Two types of difference schemes are constructed: linearized and nonlinear. The linearized difference scheme is implemented numerically by the scalar Thomas method, and the nonlinear difference problem is solved by the Newton method. The solution of the linearized difference problem was taken as the initial	Rysbaiuly B., Alpar S.D. Nonlinear Inverse Heat Transfer Problem // Journal of Physics: Conference Series. – 2022. – Vol. 2224, № 1. DOI 10.1088/1742-6596/2224/1/012039

			approximation of the Newton method. To find the thermophysical parameters, the corresponding functional is minimized using the gradient descent method.	
20.	Controllability of an unmanned aerial vehicle	DOI 10.1109/ENERGYCON53164.2022.9830244	The article deals with the problem of analyzing the controllability of an unmanned aerial vehicle based on interval analysis, computer algebra. On the basis of interval mathematics, a criterion for the controllability of the system under study was obtained. When developing the software, the library of interval mathematics was used. The developed software that implements the introduced interval arithmetic operations can be used in the study of the dynamic properties of automatic control systems, energy, economic and other nonlinear systems.	Mazakova Aigerim, Jomartova Sholpan, Mazakov Talgat, Shormanov Timur, Amirkhanov Bauyrzhan Controllability of an unmanned aerial vehicle // ENERGYCON 2022 - 2022 IEEE 7th International Energy Conference, Proceedings. – 2022. DOI 10.1109/ENERGYCON53164.2022.9830244
21.	Human voice identification based on the detection of fundamental harmonics	DOI 10.1109/ENERGYCON53164.2022.9830471	The article is devoted to the development of a system for biometric identification of a person by voice. The article discusses algorithms for the analysis of audio recordings for biometric identification of a person by voice. The technique of experimental research is considered, the process of processing the results of identification is described. Used algorithms MFCC and PLP for digital processing and analysis of audio recordings. An algorithm based on multi-criteria optimization has been developed for acoustic speech analysis. Various algorithms are used, such as hidden Markov models (CMM or HMM), as well as a model of a mixture of Gaussian distributions (GMM or GMM); in recent years, Wave Net neural networks have been actively used. The result of determining the tone of speech and the content of speech for the purposes of identification by voice is obtained.In the work, to compare the recorded voice with the saved voice for the purpose of personal identification, an unlimited text independent recognition system was applied using the Gaussian mixture model. The recorded voices were processed and stored during the registration phase, and the probing voices were used for comparison during the verification/ recognition phase of the system. For biometric identification of a person by voice, the MFCC and PLP algorithms were used for digital processing and analysis of audio recordings. The result obtained makes it possible to determine the fundamental harmonics of speech	Aliaskar, Magzhan, Mazakov Talgat, Mazakova, Aigerim, Jomartova Sholpan, Shormanov Timur Human voice identification based on the detection of fundamental harmonics // ENERGYCON 2022 - 2022 IEEE 7th International Energy Conference, Proceedings. – 2022. DOI 10.1109/ENERGYCON53164.2022.9830471

			for the purposes of identification by voice. The 'Multiparameter automated system of biometric identification of a person' was developed on the Visual FoxPro DBMS. Today, speech identification and authentication is used in a wide range of applications ranging from smartphone applications to access control systems. Additional confirmation of the relevance of this area is the many research centers.	
22.	An initial boundary value problem for a pseudoparabolic equation with a nonlinear boundary condition	DOI 10.1002/mma.8568	An initial boundary value problem for a quasilinear equation of pseudoparabolic type with a nonlinear boundary condition of the Neumann–Dirichlet type is investigated in this work. From a physical point of view, the initial boundary value problem considered here is a mathematical model of quasistationary processes in semiconductors and magnets, which takes into account a wide variety of physical factors. Many approximate methods are suitable for finding eigenvalues and eigenfunctions in problems where the boundary conditions are linear with respect to the desired function and its derivatives. Among these methods, the Galerkin method leads to the simplest calculations. On the basis of a priori estimates, we prove a local existence theorem and uniqueness for a weak generalized solution of the initial boundary value problem for the quasilinear pseudoparabolic equation. A special place in the theory of nonlinear equations is occupied by the study of unbounded solutions, or, as they are called in another way, blow-up regimes. Nonlinear evolutionary problems admitting unbounded solutions are globally unsolvable. In the article, sufficient conditions for the blow-up of a solution in a finite time in a limited area with a nonlinear Neumann–Dirichlet boundary condition are obtained.	Antontsev, S.N., Aitzhanov, S.E., Zhanuzakova, D.T. An initial boundary value problem for a pseudoparabolic equation with a nonlinear boundary condition // Mathematical Methods in the Applied Sciences, 2023, 46(1), pp. 1111–1136.
23.	SOLVABILITY OF PROBLEMS OF RECOVERING THE EXTERNAL INFLUENCE IN THE FIRST ORDER HYPERBOLIC EQUATIONS	DOI 10.25587/SVFU.2022.91.49.004	We study the solvability in Sobolev spaces of the problem of recovering the coefficients of the right-hand side, or the external influence, in the first order hyperbolic differential equations. Such problems belong to the class of linear inverse problems for partial differential equations. For the problems under study, we prove the existence and uniqueness theorems for regular solutions (having all generalized in Sobolev's sense derivatives entering the equation).	Kozhanov, A.I., Aitzhanov, S.E., Zhalgassova, K.A. SOLVABILITY OF PROBLEMS OF RECOVERING THE EXTERNAL INFLUENCE IN THE FIRST ORDER HYPERBOLIC EQUATIONS// Mathematical Notes of NEFU, 2022, 29(3), pp. 42–56.

24.	An inverse problem for the pseudo-parabolic equation with P-Laplacian	DOI 10.3934/eect.2021005	In this article, we study the inverse problem of determining the right side of the pseudo-parabolic equation with a p-Laplacian and nonlocal integral overdetermination condition. The existence of solutions in a local and global time to the inverse problem is proved by using the Galerkin method. Sufficient conditions for blow-up (explosion) of the local solutions in a finite time are derived. The asymptotic behavior of solutions to the inverse problem is studied for large values of time. Sufficient conditions are obtained for the solution to disappear (vanish to identical zero) in a finite time. The limits conditions that which ensure the appropriate behavior of solutions are considered. © 2022, American Institute of Mathematical Sciences. All rights reserved.	Antontsev, S.N., Aitzhanov, S.E., Ashurova, G.R. An inverse problem for the pseudo-parabolic equation with P-Laplacian Том 11, Выпуск 2, Страницы 399 – 414 April 2022.
25.	Solvability of pseudoparabolic equation with Caputo fractional derivative	DOI 10.1016/j.chaos.2022.112193	This paper is devoted to the study of solvability of the problem for a pseudo-parabolic equation with a Caputo fractional derivative. The existence of the weak solution is investigated by applying Galerkin approximations and a priori estimates. On the way to prove the weak solution's uniqueness of the problem the Sobolev embedding theorem, Rellich-Kondrashov theorem and Gronwall-Bellman Lemma are applied. Along with this, the blow up of the solution to the problem in finite time is proved. The global solvability of the initial boundary value problem and the uniqueness of the weak generalized solution have been studied.	Aitzhanov S.E., Kusherbayeva U.R., Bekenayeva K.S. Solvability of pseudoparabolic equation with Caputo fractional derivative // Chaos, Solitons and Fractals, Том 160, July 2022.
26.	On the Lie-solvability of Novikov algebras	DOI 10.1142/S0219498823501177	We prove that any Novikov algebra over a field of characteristic ≠2 is Lie-solvable if and only if its commutator ideal [N,N] is right nilpotent. We also construct examples of infinite-dimensional Lie-solvable Novikov algebras N with non-nilpotent commutator ideal [N,N]. © 2023 World Scientific Publishing Company.	Tulenbaev, K., Umirbaev, U., Zhelyabin, V. On the Lie-solvability of Novikov algebras// Journal of Algebra and its Applications, 2022, 2350117.
27.	Correctness of the definition of the Laplace operator with delta-like potentials	DOI 10.1080/17476933.2020.1849164	In this paper, we give a correct definition of the Laplace operator with delta-like potentials. Correctly solvable pointwise perturbation is investigated and formulas of resolvent are described. We study some properties of the resolvent. In particular, we prove Krein's formula for these resolvents.	Kanguzhin, B.E., Tulenov, K.S. Correctness of the definition of the Laplace operator with delta-like potentials// Complex Variables and Elliptic Equations, 2022, 67(4), pp. 898–920.

28.	Noetherian solvability and explicit solution of a singular integral equation with weighted Carleman shift in Besov spaces	DOI 10.1080/17476933.2022.2045975	In this paper, we prove Noetherian solvability and obtain the index formula for a singular integral equation with a Carleman shift in Besov spaces. We also obtain the existence of the solution of the singular integral equation as well as their explicit representations in Besov spaces.	Bliev, N.K., Tulenov, K.S., Yerkinbayev, N.M. Noetherian solvability and explicit solution of a singular integral equation with weighted Carleman shift in Besov spaces// Complex Variables and Elliptic Equations, 2022.
29.	Boundedness of the Hilbert transform in Lorentz spaces and applications to operator ideals	DOI 10.2989/16073606.2022.2043481	In this paper, it is investigated the optimal range of the classical Hilbert transform in Lorentz spaces of functions and its non-commutative counterparts including a triangular truncation operator in Schatten-Lorentz ideals. Some applications of obtained results to operator Lipschitz functions and commutator estimates in Schatten-Lorentz ideals of compact operators are presented.	Tulenov, K.S. Boundedness of the Hilbert transform in Lorentz spaces and applications to operator ideals// Quaestiones Mathematicae, 2022.
30.	On hyponormal and dissipative correct extensions and restrictions	DOI 10.1002/mma.8292	The main aim of this paper is to study hyponormal and dissipative correct restrictions and extensions as well as their applications to differential operators.	Kakharman, N., Tulenov, K., Zhumanova, L. On hyponormal and dissipative correct extensions and restrictions// Mathematical Methods in the Applied Sciences, 2022, 45(16), pp. 9049–9060.
31.	Noetherian solvability and explicit solution of a singular integral equation with weighted Carleman shift in Besov spaces	DOI 10.1080/17476933.2022.2045975	In this paper, we prove Noetherian solvability and obtain the index formula for a singular integral equation with a Carleman shift in Besov spaces. We also obtain the existence of the solution of the singular integral equation as well as their explicit representations in Besov spaces.	Bliev, N.K., Tulenov, K.S., Yerkinbayev, N.M Noetherian solvability and explicit solution of a singular integral equation with weighted Carleman shift in Besov spaces// Complex Variables and Elliptic Equations, 2022.
32.	An inverse problem for Kelvin–Voigt equations perturbed by isotropic diffusion and damping	DOI 10.1002/mma.8018	In this paper, we consider an inverse problem of finding a coefficient of right hand side of the following system of Kelvin–Voigt equations perturbed by an isotropic diffusion and damping terms (Formula presented.) (Formula presented.) The damping term $\gamma\|v\|^{m-2}v$ in the momentum equation realizes an absorbtion (sink) if $\gamma \leq 0$, and a source if $\gamma > 0$. We show how the exponents p, m, the coefficients ν, $\varkappa$, γ, the dimension	Khompysh, K., Kenzhebai, K. An inverse problem for Kelvin–Voigt equations perturbed by isotropic diffusion and damping // Mathematical Methods in the Applied Sciences, 2022, 45(7), pp. 3817–3842.

			of the space d, and data of the problem should interact each other for the existence of weak solutions to the problem. We also establish the conditions for uniqueness of the solutions to this problem.	
33.	An inverse source problem for a nonlinear pseudoparabolic equation with p-Laplacian diffusion and damping term	DOI 10.2989/16073606.2022.2115951	In this work, we study the unique solvability of the inverse problem that consists of determining a weak solution u(x, t) to the nonlinear pseudoparabolic equation with p−Laplacian and damping term (Figure presented.) and the coefficient f(t) of right-hand side, which depends on t. Due to the presence of an unknown coefficient in such problems supposes that there is an additional condition along with the initial and boundary conditions. In the present work, an additional condition is represented by the integral overdetermination condition, which represents the average value of a solution tested with some given function over all the domain. The investigating inverse problem considered in two cases: the coefficient of the damping term $\gamma|u|^{\sigma-2}$ u is a positive (nonlinear source term) or negative (an absorption). In both cases, we establish the global and local in time existence and uniqueness of a weak solution to the inverse problem under suitable conditions on the exponents p, σ, the dimension d, and the data of the problem.	Khompysh, K., Shakir, A.G. An inverse source problem for a nonlinear pseudoparabolic equation with p-Laplacian diffusion and damping term// Quaestiones Mathematicae, 2022.
34.	An Initial-Boundary Value Problem for Kelvin-Voigt Equations with (p(x), q(x),m(x)) Structure	DOI 10.26577/ijmph.2022.v13.i1.04	The proof of the global in time existence of solutions of initial-boundary value problems for nonlinear equations in many The proof of the global in time existence of solutions of initial-boundary value problems for nonlinear equations in many cases, is not easy, even in some cases it is impossible. However, by showing some qualitative properties of its solution, one can find answers to such questions. For example, by establishing the blow up in a finite time property of a solution, one can show that a solution does not exist globally in time. Such way, in last years, the investigating the quality properties of solutions as localization and/or blow up in a finite time, has been developing rapidly In this paper, we study the initial-boundary value problem for the Kelvin-Voigt equations with both of diffusion and relaxation term, modified by (p(x),q(x))-Laplacian, respectively, and with the variable exponent damping term. The damping term in the equation realizes as nonlinear source term. In this work, we study the nonlinear initial-boundary value problem for generalized	Khompysh, Kh., Kabidoldanova, A.A. An Initial-Boundary Value Problem for Kelvin-Voigt Equations with (p(x), q(x),m(x)) Structure// International Journal of Mathematics and Physics, 2022, 13(1), pp. 41–47.

			Kelvin-Voigt equations describing the motion of incompressible viscoelastic non-Newtonian fluids. The equations generalized by replacing the diffusion and relaxation terms in equation with p(x)-Laplacian and q(x)-Laplacian, respectively, and adding a nonlinear absorption term with variable exponents and coefficients. The definition of a weak solution is given. Under suitable conditions for variable exponents and coefficients, and data of the problem, the blow up of weak solutions are established.	
35.	Kelvin-Voigt equations for incompressible and nonhomogeneous fluids with anisotropic viscosity, relaxation and damping	DOI 10.1007/s00030-022-00794-z	In this work, we consider the nonlinear initial-boundary value problem posed by the Kelvin-Voigt equations for non-homogeneous and incompressible fluid flows with fully anisotropic diffusion, relaxation and damping. Moreover, we assume that the momentum equation is perturbed by a damping term which, depending on whether its signal is positive or negative, may account for the presence of a source or a sink within the system. In the particular case of considering this problem with a linear and isotropic relaxation term, we prove the existence of global and local weak solutions for the associated initial-boundary value problem supplemented with no-slip boundary conditions. When the damping term describes a sink, we establish the conditions for the polynomial time decay or for the exponential time decay of these solutions.	Antontsev, S.N., de Oliveira, H.B., Khompysh, K. Kelvin-Voigt equations for incompressible and nonhomogeneous fluids with anisotropic viscosity, relaxation and damping// Nonlinear Differential Equations and Applications, 2022, 29(5), 60.
36.	Lyapunov, Hartman-Wintner and De La Vallée Poussin-type inequalities for fractional elliptic boundary value problems	DOI 10.1080/17476933.2020.1825393	In this paper, we show Lyapunov and Hartman-Wintner-type inequalities for a fractional partial differential equations with Dirichlet conditions and we give some applications of these inequalities for the eigenvalue problem. Also, we give de La Vallée Poussin-type inequality for the fractional elliptic boundary value problem and Lyapunov-type inequalities for the fractional elliptic systems with Dirichlet conditions.	Kassymov, A., Kirane, M., Torebek, B.T. Lyapunov, Hartman-Wintner and De La Vallée Poussin-type inequalities for fractional elliptic boundary value problems// Complex Variables and Elliptic Equations, 2022, 67(1), pp. 246–258.
37.	Multi-term time-fractional diffusion equation and system: mild solutions and critical exponents	DOI 10.5486/PMD.2022.8922	The paper deals with a multi-term time-fractional semi-linear diffusion equation and system. Firstly, the existence of local mild solutions to the Cauchy problems for the multi-term time-fractional diffusion equation and system are proved. Also, we obtain Fujita-type and Escobedo–Herrero-type critical exponents for the multi-term time-fractional diffusion equation and system, respectively. It is shown that the nonexistence	Kassymov, A., Tokmagambetov, N., Torebek, B. Multi-term time-fractional diffusion equation and system: mild solutions and critical exponents// Publicationes

			results of solutions depend on the order of the lowest derivatives of the multi-term time-fractional diffusion equation and system.	Mathematicae, 2022, 100(3-4), pp. 295–321.
38.	Direct and inverse problems for time-fractional pseudo-parabolic equations	DOI 10.2989/16073606.2021.1928321	The purpose of this paper is to establish the solvability results to direct and inverse problems for time-fractional pseudo-parabolic equations with the self-adjoint operators. We are especially interested in proving existence and uniqueness of the solutions in the abstract setting of Hilbert spaces.	Ruzhansky, M., Serikbaev, D., Torebek, B.T., Tokmagambetov, N. Direct and inverse problems for time-fractional pseudo-parabolic equations// Quaestiones Mathematicae, 2022, 45(7), pp. 1071–1089.
39.	Direct and inverse problems for nonlocal heat equation with boundary conditions of periodic type	DOI 10.1186/s13661-022-01632-y	A mathematical model of the process of heat diffusion in a closed metal wire is considered. This wire is wrapped around a thin sheet of insulation material. We assume that the insulation is slightly permeable. Because of this, the temperature at the point of the wire on one side of the insulation influences the diffusion process in the wire on the other side of the insulation. Thus, the standard heat equation will change and an extra term with involution will be added. When modeling of this process there arises an initial-boundary value problem for a one-dimensional heat equation with involution and with a boundary condition of periodic type with respect to a spatial variable. We prove the well-posedness of the formulated problem in the class of strong generalized solutions. The use of the method of separation of variables leads to a spectral problem for an ordinary differential operator with involution at the highest derivative. All eigenfunctions of the problem are constructed. In the case when all eigenvalues of the problem are simple, the system of eigenfunctions does not form an unconditional basis. A criterion when this spectral problem can have an infinite number of multiple eigenvalues is proved. Corresponding root subspaces consist of one eigenfunction and one associated function. We prove that the system of root functions forms an unconditional basis and can be used for constructing a solution of the heat conduction problem by the method of separation of variables. We also consider an inverse problem. This is the problem on restoring (simultaneously with solving) of an unknown stationary source	Sadybekov, M., Dildabek, G., Ivanova, M. Direct and inverse problems for nonlocal heat equation with boundary conditions of periodic type// Boundary Value Problems, 2022, 2022(1), 53.

			of external influence with respect to an additionally known final state. The existence of a unique solution of this inverse problem and its stability with respect to initial and final data are proved.	
40.	On boundary value problems of the Samarskii–Ionkin type for the Laplace operator in a ball	DOI 10.1080/17476933.2020.1828377	In this paper, we consider nonlocal boundary value problems for the Laplace operator in a ball, which are a multidimensional generalisation of the Samarskii–Ionkin problem. The well-posedness of the problems are investigated, and Fredholm property of the problems are studied. Moreover, we obtain integral representations of their solutions in explicit forms.	Sadybekov, M., Dukenbayeva, A. On boundary value problems of the Samarskii–Ionkin type for the Laplace operator in a ball// Complex Variables and Elliptic Equations, 2022, 67(2), pp. 369–383.
41.	Correct and Stable Algorithm for Numerical Solving Nonlocal Heat Conduction Problems with Not Strongly Regular Boundary Conditions	DOI 10.3390/math10203780	For a nonlocal initial-boundary value problem for a one-dimensional heat equation with not strongly regular boundary conditions of general type, an approximate difference scheme with weights is constructed. A correct and stable algorithm for the numerical solving of the difference problem is proposed. It is proven that the difference scheme with weights is stable and its solution converges to the exact solution of the differential problem in the grid (Formula presented.) -norm. Stability conditions are established. An estimate of the numerical solution with respect to the initial data and the right-hand side of the difference problem is given.	Sadybekov, M.A., Pankratova, I.N. Correct and Stable Algorithm for Numerical Solving Nonlocal Heat Conduction Problems with Not Strongly Regular Boundary Conditions // Mathematics, 2022, 10(20), 3780.
42.	The Flow of An Inhomogeneous Fluid Inside a Sphere	DOI 10.37934/arfmts.90.2.5563	The research deals with the stationary flow of an inhomogeneous incompressible fluid inside a spherical vessel under the influence of a potential mass force. Using the methods of four-dimensional analysis, the solution to the problem is constructed in an explicit analytical form. Exact solutions of the Euler equations for a homogeneous fluid are obtained only for some of the simplest problems. Researchers usually prove the existence and uniqueness of solutions to various initial - boundary value problems for Euler equations using the methods of a priori estimation. After that, the problem is usually solved by numerical methods. For an inhomogeneous fluid, when the unknown density is a variable, even obtaining a priori estimates becomes much more complicated, not to mention finding exact solutions. Nevertheless, in recent years, new methods of four-dimensional mathematics have been developed, giving previously unknown approaches to the study of nonlinear	Abenov, M.M., Gabbassov, M.B., Ahmedov, A.A. The Flow of An Inhomogeneous Fluid Inside a Sphere // Journal of Advanced Research in Fluid Mechanics and Thermal Sciences, 2022, 90(2).

			problems. In this paper, an exact analytical solution of the Euler equations describing the flow of an ideal inhomogeneous fluid inside a sphere is obtained. At the same time, the authors demonstrate new methods of four-dimensional analysis.	
43.	Completeness of the exponential system on a segment of the real axis	DOI 10.32523/2077-9879-2022-13-2-37-42	Let $\Lambda = \{\lambda_n\}$ be the sequence of all zeros of the entire function (Formula Presented) of exponential type. We consider exponential system of functions (Formula Presented), where m_n-is the multiplicity of the zero λ_n. The question is: for which a, b (a < b) is the system e(Λ) complete (incomplete) in the space $L^2(a,b)$? Let D be the length of the indicator conjugate diagram of the entire function Δ(λ). Then the following statements are valid: • when b - a > D the system e(Λ) is incomplete in $L^2(a,b)$; • when b - a < D the system e(Λ) is complete in $L^2(a,b)$; • if we remove from Λ any two points λ and μ, then the system e(Ω),Ω = Λ/{λ,μ} is incomplete in $L^2(a,b)$ also when b - a = D	Gaisin, A.M., Kanguzhin, B.E., Seitova, A.A. Completeness of the exponential system on a segment of the real axis // Eurasian Mathematical Journal, 2022, 13(2), pp. 37–42.
44.	PROPAGATION OF NONSMOOTH WAVES UNDER SINGULAR PERTURBATIONS OF THE WAVE EQUATION	DOI 10.32523/2077-9879-2022-13-3-41-50	The method of characteristics for the wave equation can be applied not only for unbounded strings. The method of incident and reflected waves is effectively used in the case of a mixed problem for a bounded string. This method can also be modified for multipoint mixed problems for the wave equation. In this paper, the method of incident and reflected waves is adapted for multi-point problems with discontinuous derivatives. An analogue of the d'Alembert formula for discontinuous multipoint problems for the wave equation in the case of a bounded string is proved	Kanguzhin, B.E. PROPAGATION OF NONSMOOTH WAVES UNDER SINGULAR PERTURBATIONS OF THE WAVE EQUATION// Eurasian Mathematical Journal, 2022, 13(3), pp. 41–50.
45.	Uniqueness Criteria for Solving a Time Nonlocal Problem for a High-Order Differential Operator Equation l(·)—A with a Wave Operator with Displacement	DOI 10.3390/sym14061239	This article presents a criterion for the uniqueness of the solution of a problem nonlocal in time for a differential-operator equation with a symmetric operator part on space variables. The symmetry of the operator part of the operator-differential equation guarantees the existence of good basic properties of its system of root elements. The spectral properties of the symmetric operator part make it possible not only to prove the necessity of the criterion formulated by us, but also to substantiate their sufficiency. In contrast to previously known works, in this work the semiboundedness of the symmetric part of the differential-operator equation can be violated. In this article, the differential-operator equation is represented as the difference of two commuting operators. The uniqueness of the	Kanguzhin, B., Koshanov, B. Uniqueness Criteria for Solving a Time Nonlocal Problem for a High-Order Differential Operator Equation l(·)—A with a Wave Operator with Displacement // Symmetry, 2022, 14(6), 1239.

			solution is guaranteed when the spectra of the commuting operators do not intersect. It is important that only one of the operators should be symmetrical.	
46.	On the Uniqueness of the Recovery of the Domain of the Perturbed Laplace Operator	DOI 10.1134/S1995080222090116	Abstract: The paper gives a correct definition of the formal Laplace operator with delta-shaped perturbation. To define the area of use, the limiting potentials of simple and double layers are used. It is proved that from a set of spectra of some reference operators it is possible to unambiguously reconstruct the boundary densities of the potentials and the double layer. Moreover, one of the reference operators coincides with the original Laplace operator with delta-like perturbation.	Kanguzhin, B., Akanbay, Y., Kaiyrbek, Z. On the Uniqueness of the Recovery of the Domain of the Perturbed Laplace Operator// Lobachevskii Journal of Mathematics, 2022, 43(6), pp. 1532–1535.
47.	Conjugation Conditions for Systems of Differential Equations of Different Orders on a Star Graph	DOI 10.3390/sym14091761	In this paper, a one-dimensional mathematical model for investigating the vibrations of structures consisting of elastic and weakly curved rods is proposed. The three-dimensional structure is replaced by a limit graph, on each arc of which a system of three differential equations is written out. The differential equations describe the longitudinal and transverse vibrations of an elastic rod, taking into account the influence of longitudinal and transverse vibrations on each other. Describing conjugation conditions at joints of four or more rods is an important problem. This article assumes new conjugation conditions that guarantee the all-around decidability and symmetry of the resulting boundary value problems for systems of differential equations on a star graph. In addition, the paper proposes a physical interpretation of the conjugation conditions found. Thus, the work presents one more area of knowledge where symmetry phenomena occur. The symmetry here is manifested in the preservation of conjugation conditions when passing to the conjugate operator.	Kanguzhin, B., Auzerkhan, G. Conjugation Conditions for Systems of Differential Equations of Different Orders on a Star Graph// Symmetry, 2022, 14(9), 1761.
48.	Inverse conductivity problem for spherical particles	DOI 10.1016/B978-0-32-390543-5.00010-4	Randomly distributed nonoverlapping perfectly conducting n spheres of radii r_k(k=1, 2,. …, n) are embedded in a conducting matrix occupying a large ball of the normalized unit radius. The potential and the normal flux are given on the boundary of large ball. The locations of inclusions a_k are not known. A perturbation term induced by inclusions is constructed in general case and studied up to for equal spheres when $R=r_k$. It includes the unknown centers $a_k$of inclusions in symbolic form. The inverse problem is reduced to determination of the	Mityushev, V., Rylko, N., Zhunussova, Z., Ashimov, Y. Inverse conductivity problem for spherical particles // Mechanics and Physics of Structured Media: Asymptotic and Integral Equations Methods of Leonid Filshtinsky., 2022, pp. 109–121.

			centers by fitting of the given perturbation term on the unit sphere.	
49.	Heat and Energy Consumption Management of a Public Object	DOI 10.1007/978-3-030-87502-2_31	The effects of market and seasonal changes in the cost of heat and energy resources on the financial self-sufficiency of a public object. As an example, we take a college, the most important link in educational institutions of Kazakhstan. The necessity to calculate the share of the energy-saving budget compensator, the adjustments of which will reduce the loss of unplanned funds during the period of sharp cold snap and achieve financial sustainability of the college as a management object is justified by computer experiments in MathCad 15 and MatLab 6.5 packages. The calculated data make it possible to predict the amplitude-frequency characteristics of the control signal for smoothing jumps and disturbances in the adaptive control system at the optimal time. This allows to ultimately save college money and spend part of it on additional financial support for the educational process and increase teachers' salaries. It is shown, that the introduction of resource saving technologies (heat, electricity, utilities, staff) contributes to the sustainable development of the institution.	Ixanov, S.S., Zhunussova, Z.K., Nikulin, V.V., Zhunussova, K.K. Heat and Energy Consumption Management of a Public Object // Trends in Mathematics, 2022, pp. 305–312.
50.	Optimal Packing of Two Disks on Torus	DOI 10.18576/amis/160407	The article is devoted to recently established connection between the packing problem of disks on torus and the effective conductivity of composites with circular inclusions. The packing problem is usually investigated by geometrical arguments, the conductivity problem by means of elliptic functions. An algorithm is developed in order to determine the optimal location of two disks on torus formed by the hexagonal lattice and square lattice. The corresponding minimization function is constructed in terms of expressions consisting of elliptic functions with unknown arguments. The numerically found roots coincide with the previously established optimal points by a pure geometrical study.	Zhunussova, Zh.Kh., Ashimov, Ye.K., Dosmagulova, K.A., Zhunussova, L.Kh. Optimal Packing of Two Disks on Torus // Applied Mathematics and Information Sciences, 2022, 16(4), pp. 549–554.
51.	On the numerical solution of one inverse problem for a lineari	DOI 10.7494/OpMath.2022.42.5.709	The paper studies the numerical solution of the inverse problem for a linearized two-dimensional system of Navier-Stokes equations in a circular cylinder with a final overdetermination condition. For a biharmonic operator in a circle, a generalized spectral problem has been posed. For the latter, a system of eigenfunctions and eigenvalues is constructed, which is used in the work for the numerical	Jenaliyev, M., Ramazanov, M., Yergaliyev, M. On the numerical solution of one inverse problem for a lineari// Opuscula Mathematica, 2022, 42(5), pp. 709–725.

			solution of the inverse problem in a circular cylinder with specific numerical data. Graphs illustrating the results of calculations are presented.	
52.	Index Sets for Classes of Positive Preorders	DOI 10.1007/s10469-022-09673-z	We study the complexity of index sets with respect to a universal computable numbering of the family of all positive preorders. Let $\leq_c$ be computable reducibility on positive preorders. For an arbitrary positive preorder R such that the R-induced equivalence $\sim R$ has infinitely many classes, the following results are obtained. The index set for preorders P with $R \leq_c P$ is $\sum 30-$complete. A preorder R is said to be self-full if the range of any computable function realizing the reduction $R \leq_c R$ intersects all $\sim R$classes. If L is a non-self-full positive linear preorder, then the index set of preorders P with $P \equiv_c L$ is $\sum 30-$complete. It is proved that the index set of self-full linear preorders is $\prod 30-$complete.	Kalmurzayev, B.S., Bazhenov, N.A., Torebekova, M.A. Index Sets for Classes of Positive Preorders // Algebra and Logic, 2022, 61(1), pp. 30–53.
53.	A competition system with nonlinear cross-diffusion: exact periodic patterns	DOI 10.1007/s13398-022-01299-1	Our concern in this paper is to shed some additional light on the mechanism and the effect caused by the so called cross-diffusion. We consider a two-species reaction–diffusion (RD) system. Both “fluxes” contain the gradients of both unknown solutions. We show that–for some parameter range– there exist two different type of periodic stationary solutions. Using them, we are able to divide into parts the (eight-dimensional) parameter space and indicate the so called Turing domains where our solutions exist. The boundaries of these domains, in analogy with “bifurcation point”, called “bifurcation surfaces”. As it is commonly believed, these solutions are limits as t goes to infinity of the solutions of corresponding evolution system. In a forthcoming paper we shall give a detailed account about our numerical results concerning different kind of stability. Here we also show some numerical calculations making plausible that our solutions are in fact attractors with a large domain of attraction in the space of initial functions.	Kersner, R., Klincsik, M., Zhanuzakova, D. A competition system with nonlinear cross-diffusion: exact periodic patterns // Revista de la Real Academia de Ciencias Exactas, Fisicas y Naturales - Serie A: Matematicas, 2022, 116(4), 187.
54.	Derivation of Evolutionary Equations in the Many-Body Problem with Isotropically Varying Masses	**DOI** 10.1134/S0361768822020098	Abstract: The influence of the variability of the masses of celestial bodies on the dynamic evolution of planetary systems is investigated in the case when the masses of the bodies change isotropically at different rates, and the laws of mass change are assumed to be arbitrary given functions of time. The classical problem of n + 1 bodies of	Prokopenya, A. N., Minglibayev, M. Z., & Kosherbaeva, A. B. (2022). Derivation of evolutionary equations in the many-body problem with isotropically

	Using Computer Algebra		variable mass when n bodies move around a central star in quasi-elliptic nonintersecting orbits and interact according to the law of universal gravitation is used as a model of multi-planet system. Differential equations of body motion in terms of the osculating elements of aperiodic motion in quasi-conic sections are derived. An algorithm for calculating the perturbing function in the form of power series in small parameters and the derivation of differential equations determining the secular perturbations of the orbital elements are discussed. All symbolic computations are carried out using the computer algebra system Wolfram Mathematica.	varying masses using computer algebra. Programming and Computer Software, 48(2), 107-115. doi:10.1134/S0361768822020098
55.	Steady-state deformation of asphalt concrete	**DOI** 10.1016/j.conbuildmat.2022.128754	The steady-state deformation rate of an asphalt concrete is investigated in details within a wide range of a stress variation (from 0.0081 MPa to 3.0 MPa) and a temperature variation (from + 60 °C to −24 °C). A hot dense fine-grained asphalt concrete of type B accepted for the investigation has been prepared with the use of a road viscous bitumen (4.8 % by weight of a dry mineral material) of the grade 100–130 under penetration. The bitumen was produced by the Pavlodar petrochemical plant (Kazakhstan) by the direct oxidation method from an oil of the Western Siberia (Russian Federation). The investigation of the steady-state deformation of the asphalt concrete has been performed by testing of samples (50x50x150 mm) for creep at direct tension. A load and a temperature have been kept as the constant ones from the beginning to the end of testing of all the samples (241 units). The tests of the asphalt concrete samples for creep have been performed in a device, which has been specially invented and assembled. It has been found out that the tested asphalt concrete is deformed under the impact of a constant stress and at a constant temperature during some period in a steady-state regime, i.e. it is deformed with a constant rate; the dependence of a steady-state deformation rate on a stress is described by power function with a high accuracy at all the considered temperatures; a fundamental expression has been obtained which connects the steady-state deformation rate with its	Teltayev, B. B., Iskakbayev, A. I., & Abu, B. D. (2022). Steady-state deformation of asphalt concrete. Construction and Building Materials, 349 doi:10.1016/j.conbuildmat.2022.128754

			viscosity, stress, temperature and activation energy of the viscous deformation; a simplified expression has been obtained for the steady-state deformation rate of the asphalt concrete for the practical use; a similarity has been shown for the dependence of the steady-state deformation rate on a temperature at various stresses in semi-logarithmic coordinates; “the stress substitution principle” has been formulated. The results obtained in this work have shown that the viscous flow and the steady state deformation (steady-state creep) of the elastoviscoplastic materials as the physical phenomena can be explained on the basis of the kinetic theory of liquids (Ya.I. Frenkel) and the theory of rate processes (H. Eyring). The test for the creep can be considered as an alternative method of the experimental determination for the viscosity of the materials.	
56.	Unsteady-State Creep of an Asphalt Concrete	**DOI** 10.3390/app12031615	This paper reports the experimental investigation of the unsteady-state creep process for road hot fine-grained asphalt concrete within the variation for a stress (from 0.0081 to 3 MPa) and a temperature (from +60 to −24 °C) at uniaxial tension. It is found out that unsteady-state creep for the asphalt concrete is approximated with a high accuracy at all the considered temperatures and stresses by the power function (with 3 parameters: ε0, α, δ) obtained from the Rabotnov’s frac-tion-exponential function; at temperatures from −12 to +12 °C the parameter α has the mean value of 0.5; unsteady-state creep duration for the asphalt concrete depends strongly on the stress and the temperature. It is satisfactorily described by the mathematical expression in the form of multiplication of the exponential and the power functions. Mathematical expressions have been obtained which describe the unsteady-state creep and the steady-state creep rates for the asphalt concrete. It was found that the strain rate is varied sharply in the initial time moments from t≈0 to 500–600s (theoretically from ∞ at t = 0 to ≈1–2×10^{-3}%/s at t = 500–600 s); then it decreases monotonously in the following time moments, approximately according to a straight-line dependence. An asphalt concrete creep as a	Teltayev, B., Iskakbayev, A., Rossi, C. O., & Abu, B. (2022). Unsteady-State creep of an asphalt concrete. *Applied Sciences (Switzerland), 12*(3) doi:10.3390/app12031615

			physical process can be similar to the viscous liquid flow: it is proposed to call the sites of the unsteady-state and the steady-state creeps as the sites of the transient and the constant viscosities respectively; a mechanical (rheological) model is represented which describes the sites of the transient and the constant viscosities for the creep curve of the asphalt concrete through Trouton and Newton viscosities respectively. Meanwhile, it has been stated that the viscosity of the asphalt concrete can reach 26,000 and 45,000 MPa at the temperatures of +24 and +36 °C respectively at the end of the unsteady-state creep	
57.	Analysis Of The Architecture Of The Hardware And Software Complex For Ground-Based Ionosphere Radiosounding	**DOI** 10.21303/2461-4262.2022.002381	The relevance of the study is conditioned by the need for qualitative consideration and analysis of the basic architectural principles taken as a basis for the development of a hardware and software complex designed to conduct work on remote radiosounding of the ionosphere. The purpose of this study is to analyse the basic principles of building the architecture of a hardware and software complex for ground-based ionosphere radiosounding, to create a high-quality scientific base for further research of various processes occurring in ionospheric plasma, changes in its structure and state. The basis of the methodological approach in this study is a combination of methods of system analysis of the basic principles of building the architecture of a hardware and software complex of ground-based ionosphere radiosounding with an analytical investigation of the features of the radiosounding procedure, to obtain the most objective and reliable information about the real state of this atmospheric layer of the Earth and the processes occurring in it. The results obtained emphasise the importance of practical issues of creating a high-quality architecture of a hardware and software complex for ground-based radiosounding of the atmosphere and indicate the presence of a systemic relationship between the quality of the hardware and software complex, the presence of disturbances in the ionosphere, and the nature of these disturbances. The results obtained have significant practical significance for developers of modern radiosounding systems of atmospheric layers, and for operators of systems of this	Zikiryaev, N., Grishchenko, V., Rakisheva, Z., & Kovtun, A. (2022). ANALYSIS OF THE ARCHITECTURE OF THE HARDWARE AND SOFTWARE COMPLEX FOR GROUND-BASED IONOSPHERE RADIOSOUNDING. EUREKA, Physics and Engineering, 2022(3), 167-174. doi:10.21303/2461-4262.2022.002381

			kind, whose direct duties include monitoring the state of these systems and maintaining an adequate level of their operability to conduct scientific experiments.	
58.	Automated determination of rock crushing zones in the collapse	**DOI** 10.33271/mining16.03.109	Purpose. Development of an automated method for determining the zones of rock crushing in the collapse in order to select rational technologies for drilling and blasting operations. Methods. Methods for determining the positions of nodal and internal points of the coordinate grid of blasted rock col-lapse, approximation methods, matrix theory, numerical methods in technology are used. Findings. An automated method for determining the zones of rock crushing in the collapse is described. It is based on an analytical method for determining the granulometric composition of blasted rocks in zones of active and passive crushing. The meth-od correlates the granular composition of the blasted rock mass with blockiness of the rock mass, physical and mechanical properties of the blasted rocks, physical and chemical characteristics of the explosive used, and parameters of charge location in the rock mass. Originality. Based on the joint application of methods for determining the nodal and internal points of the coordinate grid and calculation of rock crushing zones in the blasted block, an analytical method for determining the sizes of rock crushing zones in the collapse was developed for the first time in mining. Practical implications. On the basis of the developed method, a computer program was created for the automated determination of the crushing zones sizes of a blasted block. With the help of this program, zones of small, medium and large crushing of the blasted block can be quickly and fairly accurately determined under various parameters and conditions of blasting rock masses. Locations of the blasted block crushing zones thus established serve as a tool for choosing rational technologies of drilling, blasting, excavating and loading operations, which determines their practical value.	Rakishev, B., Rakisheva, Z., Auezova, A., & Orynbay, A. (2022). Automated determination of rock crushing zones in the collapse. Mining of Mineral Deposits, 16(3), 109-114. doi:10.33271/mining16.03.109
59.	Experimental Testing and Numerical	**DOI**	In this article, a single-circuit solar water heater with a thermosiphon was built,	Kunelbayev, M., Guldana, T., Assel, A., Zhumasheva, Z.,

	Simulation of a Single-Circuit Solar Water Heater with a Thermosiphon	10.37394/232015.2022.18.84	tested and numerically modeled in Kazakhstan, Almaty. To heat cold water in the south-eastern region of Kazakhstan, a flat solar collector was developed and studied, as well as a mathematical model of a single-circuit solar installation with a thermosiphon. In this mathematical model, the Bernoulli equation was used to solve the water flow in the dispenser tank and in the collector itself. Numerical modeling in MatLab was developed using a mathematical model. The dependences of the temperature inside the solar collector, which is usually distributed inside the collector in accordance with the law of thermodynamics, were obtained, and the maximum relative humidity, which was 75%, was also solved. In the course of the study, the annual change in the efficiency of the system was decided.	Sholpan, T., Meiramgul, K., . . . Aiman, K. (2022). Experimental testing and numerical simulation of a single-circuit solar water heater with a thermosiphon. WSEAS Transactions on Environment and Development, 18, 894-898. doi:10.37394/232015.2022.18.84
60.	Kinematics of the “Ai-Gerim” Robot Arm	**DOI** 10.1007/978-3-031-04870-8_2	In this paper, the direct and inverse kinematics of the “Ai-Gerim” humanoid robot arm are solved. This robot is a remotely controlled social robot. For the study of kinematics of the robot arm, the Denavit – Hartenberg transformation matrices are derived. The pose of the end-effector (hand) in the direct kinematics is determined by multiplying these matrices. For the study of the inverse kinematics of the robot arm, a reverse decoupling method is used to analytically determine the joint angles.	Baigunchekov, Z., Carbone, G., Zhumasheva, Z., Amanov, B., Zholdassov, Y., Tolenov, S., & Tleukhanov, A. (2022). Kinematics of the “Ai-gerim” robot arm doi:10.1007/978-3-031-04870-8_2 Retrieved from www.scopus.com
61.	Development Of Intelligent And Expert System For Automation Of Processes Of Mining And Transport Works On The Basis Of Satellite Navigation	**DOI** 10.15587/1729-4061.2022.255720	The object of research relates to the field of control systems for mining and transport machines in the development of deposits of solid minerals in an open way. The problem of reducing the cost of transporting 1 ton of rock mass and increasing the efficiency of these machines is being solved. The article develops an expert system for dispatching mining vehicles with a subsystem for selecting their innovative appearance with the ability to control their operational parameters, taking into account the stochastic conditions of the developed sections of the rock mass. The mathematical model for constructing the prospective appearance of a mining and transport machine, based on its functional and economic assessment, is reduced to solving the problem of optimizing the generalized criterion of the required efficiency. As an example of private indicators of their	Kaimov, S., Kaimov, A., Kaimov, A., Kaiym, T., Primbetova, A., Nysanbayeva, S., . . . Serikbayeva, K. (2022). DEVELOPMENT OF INTELLIGENT AND EXPERT SYSTEM FOR AUTOMATION OF PROCESSES OF MINING AND TRANSPORT WORKS ON THE BASIS OF SATELLITE NAVIGATION. Eastern-European Journal of Enterprise Technologies, 2(2-116), 13-26.

			effectiveness in operation, there is an expert analysis of the evaluation of solution options, for example, structuralkinematic and operational parameters of these machines, etc. Innovative designs of a skip body of any size of its carrying capacity of single-rope and multirope steeply inclined skip hoists for highly profitable mining in quarries are substantiated. unlimited values of their depth and annual productivity. In the proposed study, the values of the forces of resistance to the destruction of a section of a rock mass, obtained by analytical and experimental methods, are refined by finding the optimal Kalman coefficient, which increases the efficiency of using mining and transport machines. The proposed methods provide the creation of innovative mining and transport machines with the ability to control their operational parameters, taking into account the stochastic conditions of the developed section of the rock mass	doi:10.15587/1729-4061.2022.255720
62.	Creation Of An Innovative Robot With A Gripper For Moving Plant Microshoots From The In Vitro Transport Tank To The Working Tank With Soil Ground At The Stage Of Their Adaptation In Soil Ground During Microclonal	**DOI** 10.15587/1729-4061.2022.253135	The industrial development of cities is the main cause of the destruction and degradation of natural resources around the world. Urbanization negatively affects the species composition of plants, the atmosphere and soil cover of areas of populated areas of large cities of the World. Tree plantations are the main mechanism for stabilizing the ecological situation in large cities and arid territories of the countries of the World. In this regard, in order to obtain a large number of genetically identical plants using their micropropagation, it is necessary to automate the main stages of this technological process. The result of the study is the creation of an adaptive phalanx gripper of a robotic complex for automating the technological process of handling operations. That will have a positive effect on solving the urgent problem of planting greenery in large cities and areas of arid territories not only in the Republic of Kazakhstan, but also in other countries of the World and represents a fundamentally new approach to solving the environmental problems of the Earth. The article substantiates various options for structural-kinematic schemes of the robot gripper, taking into account the stochastic conditions of its interaction with the overloaded object. Mathematical methods have been created for the selection and	Kaimov, A., Kaimov, S., Syrgaliyev, Y., Tuleshov, A., Kaiym, T., Kaimov, A., . . . Gribanov, V. (2022). CREATION OF AN INNOVATIVE ROBOT WITH A GRIPPER FOR MOVING PLANT MICROSHOOTS FROM THE IN VITRO TRANSPORT TANK TO THE WORKING TANK WITH SOIL GROUND AT THE STAGE OF THEIR ADAPTATION IN SOIL GROUND DURING MICROCLONAL REPRODUCTION. Eastern-European Journal of Enterprise Technologies, 1(7-115), 48-58. doi:10.15587/1729-4061.2022.253135

			justification of the geometric, structural-kinematic and dynamic parameters of grippers for overloading plant microshoots and their computer 3D models. Software has been developed for modeling the functioning of a remotely controlled physical prototype of a mobile robot with an adaptive gripper for reloading microshoots from a transport tank to a cargo tank	
63.	Investigation of Nonlinear Forced Vibrations of the "Rotor-Movable Foundation" System on Rolling Bearings by the Jacobi Elliptic Functions Method	**DOI** 10.3390/app12147042	The paper considers a rotor system with a nonlinear characteristic. Its equations of motion are a kind of Duffing class equations with multiple degrees of freedom. The paper shows the advantage of using the method of elliptic functions for solving problems of this type. This method enables us to take into account not only vibrations of the rotor installed in elastic nonlinear supports, but also vibrations of the foundation. A comparative analysis of application of the method of elliptic functions proposed by the authors is carried out by comparing the derived equations of motion of the system, as well as by comparing the obtained amplitude-frequency characteristics with the results obtained by the numerical Runge–Kutta–Fehlberg's 4-order method and the approximate analytical Van der Pol method. The regions of resonant frequencies for superharmonic oscillations and bifurcation regimes are determined. It is concluded that the method proposed by the authors is a more accurate and general case than the previously used approximate methods.	Kydyrbekuly, A., Zhauyt, A., & Ibrayev, G. -. A. (2022). Investigation of nonlinear forced vibrations of the "Rotor-movable foundation" system on rolling bearings by the jacobi elliptic functions method. Applied Sciences (Switzerland), 12(14) doi:10.3390/app12147042
64.	Modeling the Separation Process in Vertical Rotor Systems	**DOI** 10.1007/978-3-030-83594-1_11	In this paper, we study and analyze the features of the separation process in a centrifugal force field, i.e. centrifugation process in vertical rotor systems. The main parameters that determine the time of separation of particles are revealed, and the optimal modes are indicated both from a constructive and from an economic point of view. Special cases of a fixed rotor are considered. Nonlinear differential equations of motion of a suspension particle are obtained, which do not have an exact solution. The study is carried out by analytical and numerical methods. The dependences of the slope angles of the tubes on the angular velocity of rotation of the rotor, sedimentation curves that allow one to estimate the time of deposition of particles, as well as the effect of the dispersed composition on the separation process as a whole,	Kydyrbekuly, A. B., & Ibrayev, G. E. (2022). Modeling the separation process in vertical rotor systems doi:10.1007/978-3-030-83594-1_11

			are obtained. The results of the study of this work allow us to determine with sufficient accuracy all the necessary characteristics working process of separation and sedimentation, and also allow in certain cases to exclude experimental work.	
65.	Streamlines Based Stochastic Methods and Reactive Transport Simulation Applied to Resource Estimation of Roll-Front Uranium Deposits Exploited by In-Situ Leaching	**DOI** 10.3390/min12101209	Roll-front uranium deposits are ore mineralizations that occur in sandstones or arkoses downstream from redox fronts or reduced/oxidized geochemical barriers. They are often bounded above and below by impermeable shaly/muddy layers making them ideal for in-situ leaching exploitation. Several stochastic simulations were previously investigated either to characterize the ore grade distribution within roll-front type deposits, or for describing geological processes involved in their formation. This work suggests some modifications/improvements of conventional geostatistical algorithms for honoring hydrodynamic constraints that govern fluid flows in ore bearing layers. In particular, instead of using the classical Euclidian or curvilinear (for Sgrid) distance for computing the variogram, it is proposed to calculate the variogram accounting for the time of flight (TOF) of water particles down the streamlines together with available well data. Non-deterministic streamline-based methods seem to provide more accurate interpolation results and resource estimation compared to a traditional geostatistical approach when applied to roll-front deposits.	Aizhulov, D., Tungatarova, M., & Kaltayev, A. (2022). Streamlines based stochastic methods and reactive transport simulation applied to resource estimation of roll-front uranium deposits exploited by in-situ leaching. Minerals, 12(10) doi:10.3390/min12101209
66.	Dynamic modeling of a non-ideal gyroscopic rotor system with nonlinear damping and nonlinear rigidity of an elastic support	**DOI** 10.1177/16878132221108675	The article considers the effect of joint linear and nonlinear cubic damping on dynamics of a gyroscopic rigid rotor interacting with an electric motor with a rectilinear characteristic, taking into account the nonlinear rigidity of the support material. The method of regulating the control parameter (voltage on the motor), the amplitude of vibration, and the angular velocity of the shaft in the frequency equation, depending on the value of the coefficient of nonlinear cubic damping of the support, offers the most effective options for controlling resonant oscillations of large amplitudes. It is shown that the greater the value of the coefficient of nonlinear cubic damping, the easier it is to control these oscillations. Moreover, it is proved that the Sommerfeld effect (of the first kind) can also be weakened and eliminate	Iskakov, Z., Jamalov, N., Bissembayeb, K., & Kamal, A. (2022). Dynamic modeling of a non-ideal gyroscopic rotor system with nonlinear damping and nonlinear rigidity of an elastic support. Advances in Mechanical Engineering, 14(7) doi:10.1177/16878132221108675

			with the help of joint linear and nonlinear damping. To do this, in the case of a rigid characteristic of the nonlinear elasticity of the support material, in a rotor system with a nonideal energy source to eliminate the bistability region, that is, jumping effects, more nonlinear damping of support or energy from a nonideal energy source will be required than in the case of an ideal rotor system	
67.	Resonance vibrations of a gyroscopic rotor with linear and nonlinear damping and nonlinear stiffness of the elastic support in interaction with a non-ideal energy source	**DOI** 10.1016/j.ymssp.2021.108773	The article examines the effect of linear damping and combined linear and nonlinear cubic damping of an elastic support on the dynamics of a gyroscopic rigid rotor with a non-ideal energy source, taking into account cubic nonlinear stiffness of the support material. Analysis of the research results shows that both linear damping and combined linear and nonlinear cubic damping can significantly suppress the resonance peak of the fundamental harmonic, reduce the amplitude of vibration frequency variation and stabilize the shaft rotation speed, but the effect of combined damping is more significant. In non-resonant regions, where the speed is higher than the natural frequency of the rotor system, both types of damping shorten the distance between jumps in nonlinear resonance curves and eliminate them. If linear damping mainly affects the boundaries of the instability region close to the resonant frequency, then nonlinear cubic damping significantly narrows the width of the instability region throughout the entire range beyond the resonant rotation speed. These results can be successfully used for the development of passive vibration isolators used to damp vibrations generated by rotary machines	Iskakov, Z., Bissembayev, K., & Jamalov, N. (2022). Resonance vibrations of a gyroscopic rotor with linear and nonlinear damping and nonlinear stiffness of the elastic support in interaction with a non-ideal energy source. Mechanical Systems and Signal Processing, 170 doi:10.1016/j.ymssp.2021.108773
68.	Design and Construction of a Multifunctional Disinfection Robot	**DOI** 10.15587/1729-4061.2022.252045	This paper proposes a robot designed for automated routine or emergency disinfection in closed premises. The robot is related to the combined type robots. The robot consists of two functional parts: a universal mobile platform (lower part) and a disinfector (upper part), which, if necessary, can be freely moved by personnel on 4 wheels. In the initial position, the upper part of the disinfection robot is at the charging station. The mobile robot drives up to the disinfector, «hooks» it (puts it on itself) and moves along the planned route. The	Tuleshov, A., Jamalov, N., Imanbayeva, N., & Rakhmatulina, A. (2022). Design and construction of a multifunctional disinfection robot. Eastern-European Journal of Enterprise Technologies, 1(1-115), 16-28.

			upper part of the disinfector will have its own independent intelligent system, separate from the mobile robot, which, when a person is recognized, stops liquid disinfection: in this case, the UV lamps turn through 180°, the cylindrical body closes and ventilation of the disinfected air from the enclosed space is turned on. In addition, liquid disinfection is only enabled when detecting beds, tables and chairs. With the spray nozzles located at a height of 400 mm, the disinfector can carry out a simultaneous combined treatment of rooms with equipment and furniture, including high-quality processing of the lower surfaces of tables, chairs and beds. To improve the functional characteristics of robotic disinfectors and to simplify their design, a multifunctional robotic disinfector has been proposed. It was found that the result is achieved by the fact that in a multifunctional disinfection robot containing a mobile cart with an autonomous positioning and navigation system, a disinfection platform with a disinfection liquid spraying system and UV lamps with reflectors installed on it, the disinfection platform will have its own autonomous control and power systems	doi:10.15587/1729-4061.2022.252045
69.	Non-stationary Resonance Transition of the Gyroscopic Rigid Rotor with Nonlinear Damping and Non-ideal Energy Source	**DOI** 10.1007/978-3-031-10776-4_14	The article constructs differential equations of motion of a gyroscopic rigid unbalanced rotor with nonlinear cubic dam ping and nonlinear stiffness, taking into account the anisotropy of the linear stiffness of the elastic support material and interaction with a non-ideal DC motor with a linear characteristic, and the dynamics of the rotor is studied by a numerical method. Two jumping nonlinear effects are observed during the accelerated resonant transition from a large amplitude to a smaller one, accompanied by Sommerfeld effects, during the resonant transition with the decelerated motor from a smaller amplitude of oscillations to a larger one, corresponding to two critical speeds. Nonlinear cubic damping suppresses the maximum amplitudes in the regions of critical velocity and amplitude after similar resonant increasing and damping beats oscillations. At sufficiently close critical velocities, exit from the resonance at a lower critical velocity can lead to capture at another resonance at a higher critical velocity, the severity of	Iskakov, Z., Jamalov, N., & Abduraimov, A. (2022). Non-stationary resonance transition of the gyroscopic rigid rotor with nonlinear damping and non-ideal energy source doi:10.1007/978-3-031-10776-4_14

			the Sommerfeld effect on each of the resonant regions becomes comparable. Therefore, the evaluation of the response of the dynamics of resonant transients is of paramount importance for the correct design of the vibration insulation of the rotor machine.	
70.	Nonstationary Resonant Oscillations of a Gyroscopic Rigid Rotor with Nonlinear Damping and Non-ideal Energy Source	**DOI** 10.1007/978-3-030-91892-7_72	The article is concerned with the effect of nonlinear cubic damping of an elastic support on unsteady resonant vibrations of a gyroscopic rigid rotor when interacting with a non-ideal energy source. It is confirmed that nonlinear cubic damping can suppress not only the maximum amplitude, but also the amplitude of unsteady oscillations behind the rotation speed corresponding to the amplitude peak. It shifts the control parameter corresponding to the maximum amplitude, downward with a rigid nonlinear elastic characteristic of the support material, and upward with a soft nonlinear elastic characteristic of the support material. An increase in the nonlinear cubic damping coefficient can significantly weaken the Sommerfeld effect with a nonlinear jump in unsteady oscillations, up to its complete elimination. The difference in the values of the maximum amplitude and in the corresponding values of the control parameter in the resonance curves with an increasing and decreasing control parameter is explained by the difference in the values of the same parameters relating to the jumping effects during the acceleration and runout of the rotary machine.	Iskakov, Z., Jamalov, N., & Abduraimov, A. (2022). Nonstationary resonant oscillations of a gyroscopic rigid rotor with nonlinear damping and non-ideal energy source doi:10.1007/978-3-030-91892-7_72
71.	Unsteady Resonant Oscillations of a Gyroscopic Rigid Rotor with Non-linear Damping and Non-linear Rigidity of the Elastic Support	**DOI** 10.1007/978-3-030-83594-1_9	The article is concerned with the effect of linear and cubic non-linear damping of an elastic bearing on forced resonant vibrations of a gyroscopic vertical rigid rotor taking into account non-linear stiffness of the cubic nature of the bearing material. It is confirmed that non-linear cubic damping of the support can suppress not only the maximum amplitude, but also the amplitudes of forced unsteady oscillations behind the rotation speed corresponding to the maximum amplitude and the variation of its values in time along the main curve, around its mean values. It shifts the speed of rotation of the amplitude maximum, with rigid and soft non-linear elastic characteristics of the support material downwards and upwards, respectively.	Iskakov, Z., Jamalov, N., & Bissembayev, K. (2022). Unsteady resonant oscillations of a gyroscopic rigid rotor with non-linear damping and non-linear rigidity of the elastic support doi:10.1007/978-3-030-83594-1_9

			It is shown that with a “slow” increase in the shaft rotation speed, an increase in the absolute value of the angular acceleration is accompanied by a shift of the amplitude peak towards high speeds, with a “slow” decrease in the shaft rotation speed – towards low speeds with a decrease in the amplitude of oscillations. It is shown that during the rotor takeoff run, the maximum amplitude for the case with a rigid non-linear elasticity characteristic of the support material is greater than the same value for the case with a soft non-linear elasticity characteristic of the support material, and conversely, during the rotor run-down for similar cases.	
72.	Analysis of operation performance of three indirect expansion solar assisted air source heat pumps for domestic heating	**DOI** 10.1016/j.enconman.2021.115061	To achieve the goal set for net-zero emissions of greenhouse gases in the UK by 2050, the domestic heating must be decarbonised. Solar assisted air source heat pumps, integrating solar collector, thermal energy storage tank and heat pump, offers a promising alternative application under the UK weather conditions. Literature review shows that investigations of solar assisted air source heat pumps in the regions like the UK are still insufficient. The serial, parallel and dual-source indirect expansion solar assisted air source heat pumps are modelled and simulated under the weather conditions in London using TRNSYS to investigate the operation performance over a typical year. These three heat pumps are applied to provide space heating and hot water of 300 L per day for a typical single-family house. The simulation results show comparisons of the three systems. The serial type heat pump shows the highest seasonal performance factor of 5.5, but requiring the largest sizes of the solar collector and thermal energy storage tank. The dual-source and parallel type heat pumps show slightly lower seasonal performance factors of 4.4 and 4.5, respectively, requiring smaller sizes of solar collector and thermal energy storage tank. Furthermore, the results show that the air source part contributes to an important proportion of the heat provision and stable operation of the systems. The yearly seasonal performance factor higher than 4.4 achievable by the three heat pumps suggests that they are potentially	Yang, L. W., Hua, N., Pu, J. H., Xia, Y., Zhou, W. B., Xu, R. J., Yang, T., Belyayev, Y., Wang, H. S. (2022). Analysis of operation performance of three indirect expansion solar assisted air source heat pumps for domestic heating. Energy Conversion and Management, 252 doi:10.1016/j.enconman.2021.115061

			applied in the regions with relatively lower solar irradiance. The economic analyses indicate that the parallel and dual-source type heat pumps provide good alternatives to replace the gas-boiler heating system.	
73.	On hyponormal and dissipative correct extensions and restrictions	10.1002/mma.8292	The main aim of this paper is to study hyponormal and dissipative correct restrictions and extensions as well as their applications to differential operators.	https://www.scopus.com/record/display.uri?eid=2-s2.0-85127969617&origin=resultslist&sort=plf-f Zhumanova, Lyazzat K. Kakharman, N., Tulenov, K. On hyponormal and dissipative correct extensions and restrictions // Mathematical Methods in the Applied Sciences, Том 45, Выпуск 16, Страницы 9049 – 9060, **DOI** 10.1002/mma.8292
74.	Fictitious Domain Method for Atmosphere Boundary Layer Model	10.1063/5.0115504	In this paper, the fictitious domain method with continuation by lower coefficients for the model of the atmospheric boundary layer is mathematically substantiated. The theorem of existence and uniqueness of the solution of the auxiliary problem of the fictitious domain method for the equations of the boundary layer of the atmosphere is shown. The practical part is considered - the spread of harmful impurities in the atmosphere from point sources, taking into account the inhomogeneity of the underlying surface on the basis of the atmospheric boundary layer model.	https://www.scopus.com/record/display.uri?eid=2-s2.0-85142495361&origin=resultslist&sort=plf-f Kasenov Syrym, B. Kulambayev, G. Beissenova, N. Katayev, B. Abduraimova, L. Zhaidakbayeva, A. Sarbassova, O. Akhmetova, S. Issayev, L. Suleimenova, K. Shadinova and A. Shyrakbayev , Fictitious Domain Method for Atmosphere Boundary Layer Model // 5th International Conference of Mathematical Sciences, ICMS 2021, Том 2483, **DOI** 10.1063/5.0115504
75.	A Deep Learning-Based Approach for	10.32604/cmc.2022.029544	Timely detection and elimination of damage in areas with excessive vehicle loading can reduce the risk of road	https://www.scopus.com/record/display.uri?eid=2-s2.0-

	Road Surface Damage Detection		accidents. Currently, various methods of photo and video surveillance are used to monitor the condition of the road surface. The manual approach to evaluation and analysis of the received data can take a protracted period of time. Thus, it is necessary to improve the procedures for inspection and assessment of the condition of control objects with the help of computer vision and deep learning techniques. In this paper, we propose a model based on Mask Region-based Convolutional Neural Network (Mask R-CNN) architecture for identifying defects of the road surface in the real-time mode. It shows the process of collecting and the features of the training samples and the deep neural network (DNN) training process, taking into account the specifics of the problems posed. For the software implementation of the proposed architecture, the Python programming language and the TensorFlow framework were utilized. The use of the proposed model is effective even in conditions of a limited amount of source data. Also as a result of experiments, a high degree of repeatability of the results was noted. According to the metrics, Mask R-CNN gave the high detection and segmentation results showing 0.9214, 0.9876, 0.9571 precision, recall, and F1-score respectively in road damage detection, and Intersection over Union (IoU)-0.3488 and Dice similarity coefficient-0.7381 in segmentation of road damages.	85132356636&origin=resultslist&sort=plf-f Kasenov Syrym, B. Kulambayev, G. Beissenova, N. Katayev, B. Abduraimova, L. Zhaidakbayeva, A. Sarbassova, O. Akhmetova, S. Issayev, L. Suleimenova, K. Shadinova and A. Shyrakbayev, A Deep Learning-Based Approach for Road Surface Damage Detection // Computers, Materials and Continua, Том 73, Выпуск 2, Страницы 3403 – 3418, **DOI** 10.32604/cmc.2022.029544
76.	Application of the Fictitious Domain Method for Navier-Stokes Equations	10.32604/cmc.2022.027830	To apply the fictitious domain method and conduct numerical experiments, a boundary value problem for an ordinary differential equation is considered. The results of numerical calculations for different values of the iterative parameter τ and the small parameter ε are presented. A study of the auxiliary problem of the fictitious domain method for Navier-Stokes equations with continuation into a fictitious subdomain by higher coefficients with a small parameter is carried out. A generalized solution of the auxiliary problem of the fictitious domain method with continuation by higher coefficients with a small parameter is determined. After all the above mathematical studies, a computational algorithm has been developed for the numerical solution of the problem. Two methods were used to solve the problem numerically. The first variant is the fictitious domain method associated with the	https://www.scopus.com/record/display.uri?eid=2-s2.0-85130113770&origin=resultslist&sort=plf-f Temirbekov Almas., Zhaksylykova, Zhadra.,Malgazhdarov, Yerzhan., Kasenov, Syrym, Application of the Fictitious Domain Method for Navier-Stokes Equations // Computers, Materials and Continua, Том 73, Выпуск 1, Страницы 2035 – 2055, **DOI**

			modification of nonlinear terms in a fictitious subdomain. The model problem shows the effectiveness of using such a modification. The proposed version of the method is used to solve two problems at once that arise while numerically solving systems of Navier-Stokes equations: the problem of a curved boundary of an arbitrary domain and the problem of absence of a boundary condition for pressure in physical formulation of the internal flow problem. The main advantage of this method is its universality in development of computer programs. The second method used calculation on a uniform grid inside the area. When numerically implementing the solution on a uniform grid inside the domain, using this method it's possible to accurately take into account the boundaries of the curved domain and ensure the accuracy of the value of the function at the boundaries of the domain. Methodical calculations were carried out, the results of numerical calculations were obtained. When conducting numerical experiments in both cases, quantitative and qualitative indicators of numerical results coincide.	10.32604/cmc.2022.027830
77.	DEVELOPMENT OF PARALLEL IMPLEMENTATION FOR THE NAVIER-STOKES EQUATION IN DOUBLY CONNECTED AREAS USING THE FICTITIOUS DOMAIN METHOD	10.15587/1729-4061.2022.254261	This paper presents a numerical realization of the Navier-Stokes equations in irregular domains using the fictitious domain method with a continuation along with the lowest coefficient. To solve numerous connected issues in irregular regions, the fictitious domain method is broadly used. The advantage of the fictitious domain method is that the problem is solved not in the original complex domain, but in a few other, easier domains. Using the method, computation is done easily for a sufficiently wide class of problems with arbitrary computational domains. The problem is solved using two methods. The primary method is based on the development of a distinct issue in variables of the stream function and the vortex velocity using the pressure uniqueness condition. The second method is to understand the expressed issue by the fictitious domain method with a continuation by lower coefficients. Using the fictitious domain method, a computational algorithm is constructed based on the explicit finite difference schemes. The finite difference scheme is stable and has high computational accuracy and it gives the possibility to parallelize. Temperature distributions and stream	https://www.scopus.com/record/display.uri?eid=2-s2.0-85130057112&origin=resultslist&sort=plf-f Temirbekov Almas., Altybay, Arshyn.,Temirbekova, Laura, Kasenov, Syrym, DEVELOPMENT OF PARALLEL IMPLEMENTATION FOR THE NAVIER-STOKES EQUATION IN DOUBLY CONNECTED AREAS USING THE FICTITIOUS DOMAIN METHOD // Eastern-European Journal of Enterprise Technologies, Том 2, Выпуск 4-116, Страницы 38 – 46, DOI

			functions are presented as numerical results. A parallel algorithm has been developed using Open Multi-Processing (hereinafter OpenMP) and Message Passing Interface (hereinafter MPI) technologies. Within the parallel approach, we used OpenMP technology for parallel calculation of vorticity and stream work, and for calculating temperature we applied MPI technology. The performance analysis on our parallel code shows favorable strong and weak scalability. The test results show that the code running in the parallel approach gives the expected results by comparing our results with those obtained while running the same simulation on the central processing unit (CPU)	10.15587/1729-4061.2022.254261
78.	ALGORITHM CONSTRUCTION AND NUMERICAL SOLUTION BASED ON THE GRADIENT METHOD OF ONE INVERSE PROBLEM FOR THE ACOUSTICS EQUATION	10.15587/1729-4061.2022.253568	The paper considers the problem of continuation of solutions of hyperbolic equations from a part of the domain boundary. These problems include the Cauchy problem for a hyperbolic equation with data on a timelike surface. In the inverse problems, the inhomogeneities are located at some depth under the medium layer, the parameters of which are known. In this case, an important tool for practitioners are the problems of continuation of geophysical fields from the Earth's surface towards the lay of inhomogeneities. In equations of mathematical physics, solution of the continuation problem from part of the boundary is in many cases strongly ill-posed problems in classes of functions of finite smoothness. The ill-posedness of this problem is considered, that is, the example of Hadamard, a Cauchy problem for a hyperbolic equation, is given. The physical formulation of the continuation problem is considered and reduced to the inverse problem. The definition of the generalized solution is formulated and the correctness of the direct problem is presented in the form of a theorem. The inverse problem is reduced to the problem of minimizing the objective functional. The objective functional is minimized by the Landweber method. By the increment of the functional, we consider the perturbed problem for the direct problem. We multiply the equation of the perturbed problem by some function and integrate by parts, we obtain the formulation of the conjugate problem. After that, we get the gradient of the functional. The algorithm for solving the inverse problem is listed. A finite-difference algorithm for the numerical solution of	https://www.scopus.com/record/display.uri?eid=2-s2.0-85130033150&origin=resultslist&sort=plf-f Kasenov Syrym, Janar Askerbekova, Aigerim Tleulesova, ALGORITHM CONSTRUCTION AND NUMERICAL SOLUTION BASED ON THE GRADIENT METHOD OF ONE INVERSE PROBLEM FOR THE ACOUSTICS EQUATION // Eastern-European Journal of Enterprise Technologies, Том 2, Выпуск 5-116, Страницы 43 – 52, **DOI** 10.15587/1729-4061.2022.253568

			the problem is presented. The numerical solution of the direct problem is performed by the method of inversion of difference schemes. The results of numerical calculations are presented	
79.	SIMULATION OF CONCENTRATION CONVECTION IN AN INCLINED CHANNEL	10.1615/HeatTransRes.2022043133	Numerical simulation of the concentration convection that occurs in a three-component gas mixture He + Ar – N2 in an inclined channel has been carried out. To describe the occurrence of convective flows in the mixture under consideration, a 3D numerical algorithm based on the D3Q19 model of the Boltzmann lattice equation method has been developed. It is shown that when the slope angle changes in the range from 40° to 80°, the isoconcentration lines are curved, which indicates the presence of convective mechanisms in the total mass transfer. It is shown that at an inclination angle of 60°, the intensity of convective transfer is maximum.	https://www.scopus.com/record/display.uri?eid=2-s2.0-85139026806&origin=resultslist&sort=plf-f Zhumali Ainur Zhakebayev, Dauren; Fedorenko, Olga; Kossov, Vladimir; Mukamedenkyzy, Venera; Karuna, Oksana, SIMULATION OF CONCENTRATION CONVECTION IN AN INCLINED CHANNEL // Heat Transfer Research, Том 53, Выпуск 15, Страницы 39 – 52, **DOI** 10.1615/HeatTransRes.2022043133
80.	An Interpolated Bounce Back Thermable Method for Simulating Solid Particles Dynamics in a Viscous Medium	10.26577/ijmph.2021.v12.i2.06	In this paper we discuss the mathematical and computer modeling of non-isothermal two-phase flows with suspended particles. Natural convection between an outer cubical cavity and an inner hot sphere is investigated. To simulate heat fluxes loaded with particles, a thermal model of the lattice Boltzmann equation in combination with the interpolated bounce back method (TLBM-IBB) has been developed. In TLBM-IBB, IBB is used to process liquid-solid interfaces, and TLBM is used to simulate the heat flow of a fluid. The momentum exchange method is used to calculate the hydrodynamic force on the particle surface. Simulation performed for a range of Rayleigh numbers (10^5 – 10^6). The accuracy and efficiency of the existing method is demonstrated by the example of solving the test problem of natural convection around a stationary particle and three-dimensional compressible natural convection in a square cavity filled with air, which has a hot wall on the left and	https://www.scopus.com/record/display.uri?eid=2-s2.0-85133154298&origin=resultslist&sort=plf-f Zhumali Ainur Zhakebayev, D.B., Satenova, B.A. International Journal of Mathematics and Physics // Том 12, Выпуск 2, Страницы 50 – 60, **DOI** 10.26577/ijmph.2021.v12.i2.06

			a cold wall on the right, and two horizontal walls are adiabatic. The results obtained are in good agreement with the experimental and numerical results of other authors.	
81.	Simulation of Ternary Fluid Mixtures Separation by Phase-Field Free Energy LBM	10.26577/ijmph.2022.v13.i1.05	This article reviews the mathematical and computer modeling of the process of ternary fluid mixture separation by free energy based phase field Lattice Boltzmann equations method. The process under study is considered in a limited area having the shape of a rectangle. Three different sets of fluid components with different structures are specified. The mathematical model constructed to describe this process is based on the Navier-Stokes equation for an incompressible fluid and the Cahn-Hilliard equation. The numerical model is built on the basis of LBM using the D2Q9 model. Numerical experiments were performed for two scenarios: (1) – investigate the model without gravity, in order to determine the patterns of the surface tension effect and (2)-investigate the model with gravity force. Numerical results showed a spinodal separation depending on the initial fractions of fluid concentrations. The results obtained determine the adequacy of the constructed model for a three-component fluid.	https://www.scopus.com/record/display.uri?eid=2-s2.0-85135766213&origin=resultslist&sort=plf-f Zhumali Ainur Zhakebayev, D.B. Simulation of Ternary Fluid Mixtures Separation by Phase-Field Free Energy LBM // International Journal of Mathematics and Physics, Том 13, Выпуск 1, Страницы 45 – 51, **DOI** 10.26577/ijmph.2022.v13.i1.05