Aleksandrov A. Yu., Kosov A. A. **On stability of gyroscopic systems** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 3–13.

Mechanical systems described by the Lagrange equations of the second kind influenced by potential, dissipative, gyroscopic and nonconservative forces are considered. It is assumed that gyroscopic forces are dominant. This domination is accounted by in the presence of a large parameter as a coefficient at the vector of these forces. By the use of the Lyapunov function method the lower bounds for the large parameter values are obtained which permit to receive justified conclusions of asymptotic stability of the full system on the base of its decomposition on two subsystems. To provide this decomposition, two approaches are proposed. In the first approach, vector Lyapunov functions are applied, while the second one is based on using scalar Lyapunov functions. It is worth mentioning that compared with the known results the suggested approaches give opportunity to receive stability conditions in the case of nonstationary matrices of dissipative and positional forces. Moreover, systems with nonstationary unboundedly increasing with time parameter at gyroscopic forces are studied. The restrictions on the velocity of parameter increasing are found for which the evolution of the parameter does not destroy the asymptotic stability of the equilibrium position. The cases of linear dissipative forces and essentially nonlinear dissipative forces given by homogeneous Rayleigh functions are considered. Bibliogr. 18.

Key words: mechanical systems, gyroscopic forces, decomposition, stability, Lyapunov functions.

Bregman K. M. **Differentiation algorithm based on the additional variables method** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 14–25.

Symbolic, automatic and numerical differentiation are widely used in various fields of applied mathematics. Symbolic differentiation transforms the formula representation of a function into a formula representation for its derivative. By contrast, automatic differentiation is calculation of the derivative of a function (a computer program), and the result is again a function (a computer program). Numerical differentiation utilizes approximation formulas to derivatives derived by differentiating polynomial approximations of functions given at a few points. All three types of differentiation techniques are complementary and each has its own advantages and drawbacks. A major advantage of symbolic differentiation is that, in principle, evaluation of formulas gives exact values of the derivatives of the function. Its major drawback is that it may generate very complicated expressions containing many unnecessary instances of the same sub-expressions. It is for this reason that symbolic differentiation works well for simple expressions but necessary computation time and memory grow rapidly as a function of an expression size. In the present paper, we propose the new symbolic differentiation algorithm which is free from the drawback mentioned. It is applicable to the class of finite compositions of functions satisfying total system of differential equations with polynomial right-hand sides (note that an ODE system is a special case of a total system). In particular, this class includes four basic arithmetic operations, elementary functions and a wide variety of special functions of mathematical physics. Libraries of functions are used. To be more specific, libraries include names of functions and total polynomial systems of differential equations satisfied by these functions. Using these differential equations from the library to introduce a number of additional variables, the algorithm transforms a system of functions of several variables to the system of polynomials in original and additional variables, and then finds derivatives of additional variables as polynomials in the same variables. Derivatives of functions of the original system could be represented then as recurrent or explicit formulas (polynomials in the same variables too) using polynomial representations of the original functions and derivatives of additional variables. Bibliogr. 15. Il. 1. Table 3.

Key words: symbolic differentiation, automatic differentiation, polynomial system, total polynomial system, additional variables method, library of functions.

Dahl Yu. M. **About V. V. Novozilov's works on the theory of elastocity** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 26–34.

The shot biography of well-known academic V. V. Novozilov is described. It is considered (in chronological order) his books "The basics nonlinear theory of elasticity", "The theory of elasticity", the articles about the problems stress-strain relationship in elastic isotropic materials, the works on plane problem theory of elasticity, the torsions theories of pipes and rods. The review included 27 references from 1940 to 2000 year. Bibliogr. 27.

Key words: nonlinear and linear theory of elasticity, elastic law, anisotropy, polycrystals, torsion, stability.

Ermolaeva N. N., Kurbatova G. I. **The analysis of the approaches to the modeling of thermodynamic processes in gas flow at hyperpressure** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 35–44.

The paper presents the analysis of the approaches to the modeling of thermodynamic processes in different mathematical models of gas transmission. It is shown how simplifications of mathematical models can result in principally wrong inferences about temperature distribution in a gas flow as well as it is proved that full neglecting of inertial forces is inadmissible even if Mach's number is very small. Explicit dependences of internal energy and specific heat at constant volume on temperature and gas density are found for the two-parameter Redlich-Kwong equation of state. Bibliogr. 16.

Key words: hyperpressure, throttling effect, gas-pipelines, analysis the thermodynamic model.

Kalinina E. A. **On Hölder condition numbers** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 45–53.

A matrix with complex elements is considered. An algebraic method to find the maximum order of matrix Jordan block is suggested. The polynomial whose roots are the eigenvalues that correspond to the maximum Jordan block is constructed. The algorithm does not require the knowledge of the Jordan form of the matrix and its characteristic polynomial. It is based on finding Jordan blocks corresponding to the eigenvalue 0 of the other matrix, constructed with the help of Kronecker product. The results presented could be used for calculating the Hölder condition number which is the measure of the eigenvalue variation as small variations of matrix elements. Bibliogr. 7.

Key words: Hölder condition number, matrix eigenvalues and eigenvectors, Kronecker product.

Ovsyannikov A. D. **On optimization of charged particle dynamics in electrostatic field** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 54–59.

The problem of optimization of charged particle dynamics in an electric potential field is considered. A planar problem, corresponding to the case of axial-symmetric field is investigated. Two-dimensional real linear space is identified with the complex plane. The complex potencial is given in an area in the form of an integral of Cauchy. As a control function is considered a function defined on the boundary of the area which defines an analytic function inside the area. Inside the area, dynamics of charged particle is considered and optimization problem is formulated. Use of complex representation of the field can get an explicit form of the dependence of the field inside the area from the control function on the boundary and obtain necessary optimality conditions for the entered functional. In the work an analytic representation of the variation of the investigated functional at a variation of the boundary conditions is found. On base of obtained analytical expression for the variation of the functional directed optimization methods can be constructed. Practical realization of optimized fields is possible in many ways. Bibliogr. 6.

Key words: optimization, mathematical modeling, charged particle dynamics, accelerators.

Ovsyannicov D. A., Edamenko N. S. **Modeling of charged particle beam dynamics** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 60–65.

The problems of modeling of charged particle intense beams are considered. The

integrodifferential model of particle dynamics with a smoothed interaction, for which the existence and uniqueness of solutions are proved, is investigated. Examples of such models are presented. Considered mathematical model of integrodifferential equations with the Coulomb interaction and the constructed examples of such models can be effectively used in solving various problems of modeling and optimization of charged particle beam dynamics in the accelerating and focusing structures. Bibliogr. 3.

Key words: mathematical modeling, charged particle intense beams, integrodifferential equations, accelerator.

Cherneutsanu E. K. **The method of gradient type for solving the problem of strict h-polyhedral separability** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 66–74.

The method of gradient type for solving the problem of strict separation of the convex hull of the finite set A from finite set B with h hyperplanes is considered. Examples of the solution of the problem for parameter values $c = 0$ and $c = \frac{1}{2}$ are given. Particular attention is paid to organization of calculations. Bibliogr. 7. Il. 6.

Key words: h-polyhedral separability, gradient type method.

Shymanchuk D. V., Shmyrov A. S. **Construction of the return trajectory to the neighborhood of the collinear libration point of the Sun–Earth system** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 75–84.

Special type of maneuvering of a spacecraft in the Earth space is investigated. The type is associated with the return to the neighborhood of the collinear libration point L_1. The Hill problem of the circular restricted three body problem of the Sun–Earth system is considered. These trajectories are determined by the "hazard function" which is a special linear form of a phase coordinates. Resulting conditions of the return are used to construct the corrective control. An algorithm for construction of the "return trajectory" in the neighborhood of the collinear libration point is proposed. The results of the numerical integration are graphically illustrated. Bibliogr. 15. Il. 5.

Key words: circular restricted three body problem, Hill problem, orbital controlled motion, collinear libration point, trajectory of the return.

Amelin K. S. **Randomization in control loop for small UAV Fly optimization under unknown changes of wind direction** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 85–101.

The possibilities to add randomization in control loop for optimizing the trajectory of the UAV horizontal flying under unknown changes of wind direction are considered. A small UAV which is equipped only with the GPS module for navigation are suggested. Only the positions data obtained iteratively at discrete time instants can be used. The user has to be able to add test perturbations through the input channel. The assumptions about the noise are reduced to minimum. It can virtually be arbitrary but independent to test perturbations. Simulation of theoretical results are given. The operability of the new algorithm under irregular noises in observations in comparison with traditional approaches is illustrated. For practical usage a small autonomic unmanned planner with an autopilot and additional microcomputer on the board are designed. The effective interoperability processes between autopilot and a microcomputer based on SIP are organized. The connection between microcomputer and the ground base station or between microcomputer and the other UAVs by Wi-Fi or Internet connection is established. Bibliogr. 35. Il. 7.

Key words: randomized control, wind direction, unmanned aerial vehicle, small UAV, optimization, unknown arbitrary noise.

Bogdanov A. V., Ye Myint Naing. **A comparison of several cloud computing platforms** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 102–110.

Cloud computing is a natural move to a new perception of information infrastructure which

appeared as a result of evolution of the technological base of hardware of today's computer complexes. It has been one of the most hot research topics. Now many corporations are involved in cloud computing related techniques and many cloud computing platforms have been put forward. This is a favorable situation to study and apply cloud computing related techniques. For beginning users it is still very hard to make a reasonable choice among large number of offers. What difference are there for different cloud computing platforms and what characteristics and advantages has each? To answer these problems, the characteristics, architectures and applications of several popular platforms of cloud computing are analyzed and discussed in detail. From the comparison of these platforms users can better understand different cloud platforms and more reasonablely choose what they want. This communication present the results of testing Eucalyptus and Opennebula on heterogeneous platforms SMU (PM–PU St. Petersburg University) and analyzes its features and advantages for the project data centers of the University. Bibliogr. 5. Il. 4. Table 1.

Key words: cloud computing, virtualization, infrastructure as a service (IaaS), platform as a service (PaaS), software as a service (SaaS).

Durnovtseva S. A. **The synthesis method of seismic vibrations corresponding to a given family of response spectra** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 111–119.

Acceleration time history in the seismic design is required for nonlinear analytical models, for structures that have different at their parts and for structures with a local damping such as piping protected by viscous dampers. A generation algorithm to get required acceleration time history is proposed. The algorithm is based on spectral analysis and multiparametric optimization. Software program that implements the algorithm is verified through numerical examples. Artificial time histories match multiple damping floor response spectra and meet other requirements of the regulatory design guides. Bibliogr. 13. Il. 7. Table 1.

Key words: seismic design, multiparametric optimization, spectral analysis.

Makarova M. A. **Spherical and cylindrical diodes modeling with the space charges effect** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 120–126.

The space charge effect is often neglected, but when the current density is high, it begins to play an essential role in current control. This article is devoted on the study of the space charges influence on the electron field emission. The electrostatic potential distributions for the vacuum diode emission systems are calculated. Diode systems, which can be readily constructed , are mainly used for the study of the emission properties of novel materials. Moreover they some effective applications in vacuum nano- and microelectronics. The boundary problem for the Poisson's equation is solved. The right-hand member of the Poisson's equation is approximated by the piecewise constant function and determined by the charge conservation law and the energy conservation law. Graphics of the potential distribution and space-charge density are presented. Bibliogr. 12. Il. 2.

Key words: field emission, space charges, diode, Poisson's equation.

Nikiforov K. A., Egorov N. V. **Simulation of emission processes in MATLAB** // Vestnik St. Petersburg University. Ser. 10. 2013. Issue 2. P. 127–134.

The computer model of field electron emission from emitter-arrays in MATLAB is proposed. Physical and mathematical models, computational methods and algorithms of the program complex are presented. Electrostatic simulation of electron transport processes with PDE Toolbox finite element solutions is implemented in MATLAB stand-alone application with graphical user interface. The simulation results by the example of two different diode structures are presented. Two generic cone-shape and wedge-shape non-gated emitter-array diodes are considered. The effects of the variations in device geometrical structure and parameters on its potential distribution, electric field, and emission current are discussed. The current variation rate with respect to the tip-collector distance is calculated. Bibliogr. 7. Il. 5.

Key words: field electron emission, field emitters array, MATLAB PDE Toolbox .