

# Summaries

UDC 514.76

**Ivlev E.T., Luchinin A.A.**  
**AFFINE SPACE MAPPING INTO MANIFOLD  
OF THE OTHER SPACE HYPERCONES**

The mapping of the affine space  $\tilde{A}_p$  into the affine space  $A_p$ , hypercones manifold has been considered. The structure of the basic geometric objects of these mappings in the sense of G.F. Laptev is studied analytically and geometrically.

UDC 514.76

**Ivlev E.T., Luchinin A.A.**  
**AFFINE AND EUCLIDEAN SPACES MAPPING**

The mappings of the affine space  $\tilde{A}_p$  into the affine space  $A_p$  (at  $p \geq n$  and  $p < n$ ) and into Euclidean space  $E_n$  have been considered. The structure of the basic geometric objects of these mappings in the sense of G.F. Laptev is studied analytically and geometrically.

UDC 512.541

**Sherstnyova A.I., Grinshpon S.Ya.,  
Yanushchik O.V., Sherstnyov V.S.**  
**CORRECTNESS AND PURE CORRECTNESS  
OF HOMOGENEOUS COMPLETELY  
DECOMPOSABLE GROUPS**

In the article it is determined whether the analogue of the known set-theoretic Cantor–Schröder–Bernstein theorem is correct for the groups in the case when one of the groups is homogeneous completely decomposable. The criteria of correctness and pure correctness of homogeneous completely decomposable group are obtained.

UDC 517.91

**Semenov M.E., Kolupaeva S.N.**  
**THE ANALYSIS OF UNCONDITIONAL STABILITY REGIONS  
OF IMPLICIT METHODS FOR SOLVING THE SYSTEMS  
OF ORDINARY DIFFERENTIAL EQUATIONS**

The brief review of implicit methods of integrating stiff systems of ordinary differential equations has been introduced. Graphic regions of unconditional stability for Gear method (backward differentiation formulae) when solving stiff systems of differential equations, were determined and introduced. The recommendations for choosing Gear method order were given.

UDC 517.9

**Asylbekov T.D., Chamashev M.K.**  
**COEFFICIENT INVERSE PROBLEM FOR LINEAR EQUATION  
IN QUARTIC PARTIAL DERIVATIVES**

The correctness of the coefficient inverse problem for the quartic linear hyperbolic equation with real triple and prime characteristics has been proved by the method of integral equations and contractions.

UDC 519.17

**Bykova V.V.**  
**M-ACYCLIC AND TREE HYPERGRAPHS**

The characterization of two classes of hypergraphs: M-acyclic and tree has been given. The link between these two classes: a hypergraph is M-acyclic if and only if the hypergraph dual to it is a tree was established. This relationship provides an opportunity to join the arsenal of known polynomial algorithms allowing detecting hypergraph belonging to these classes and building the trees of compounds, decompositions and trees of hypergraph realization.

UDC 519.633.6:519.612.2

**Poponin V.S., Kosheutov A.V.,  
Grigoriev V.P., Melnikova V.N.**  
**SPECTRAL ELEMENT METHOD FOR SOLVING  
PLANE PROBLEMS OF VISCOUS LIQUID DYNAMICS  
AT UNDISTRIBUTED UNSTRUCTURED GRIDS**

The algorithm of constructing the plane problems solution of viscous incompressible liquid dynamics by the method of spectral elements has been described. The algorithm allows obtaining solutions of high accuracy order at coarse unstructured grids. The efficient algorithm of computing nonlinear equations in partial derivatives with different types of non-zero boundary conditions was developed by the spectral element method. High efficiency of applying the generalized residual method together with incomplete LU decomposition for computing the system of linear algebraic equations obtained at digitalization of Navier–Stokes equations was shown.

UDC 531.36

**Dubovik V.A., Ziyakaev G.R.**  
**MAIN MOVEMENT OF TWO PENDULUM DEVICE  
AT FLEXIBLE SHAFT WITH ELASTIC SUPPORTS**

The conditions of balancing the unbalanced rotor pendulums at flexible shaft rotating in elastic yielding supports have been obtained.

UDC 621.833

**Yangulov V.S., Edlichko A.A.**  
**THE PRECISION SCREW MECHANISMS AND GEARS  
FOR BEING USED IN REDUCERS  
OF SPACE USE SYSTEM GEARS**

The diagrams of mechanisms with linear movement of an output link adapted to high requirements to the accuracy of movement of the controlled operating devices of space vehicles have been developed. The constructions of the space vehicle systems in which the developed mechanisms may find application were proposed.

UDC 661.87.519

**Orlov A.A., Butov V.G., Timchenko S.N.**  
**MODELING OF DISTURBANCES CONNECTED  
WITH NON-STATIONARY PROCESSES  
IN CENTRIFUGAL CASCADES**

Methods of modeling have been considered and the model imitating disturbances connected with non-stationary hydraulic and separating processes in cascades of uranium enrichment gas centrifuge has been proposed. The results of numerical calculation and experimental study of non-stationary processes occurring at various disturbances are introduced.

UDC 621.34+66.067.5

**Kolodnikov I.A., Kladiyev S.N., Krivopustov S.I.**  
**CLEANING THE SOLUTIONS OF URANIUM-CONTAINING  
COMPOUNDS FROM MECHANICAL IMPURITIES  
BY CENTRIFUGATION**

The possibility of cleaning the uranium ore solutions from insoluble difficult to filter components at bowl screw centrifuge has been shown. Optimal operating conditions for the concrete raw material type are chosen by selecting angular frequencies of rotor and screw revolution. The conclusion was drawn that automated control of rotation frequency of rotor and screw electric drive and relative screw backward from rotor by frequency converters is optimal for studying the modes of separating suspensions at screw centrifuges.

UDC 62-567.1

**Pozdeev L.V., Tselishev G.P., Tsekhmestryuk G.S.**  
**EXPERIMENTAL OBSERVATION AND CALCULATION**  
**OF DEPENDENCE OF RUBBER-METAL SHOCK-ABSORBER**  
**PARAMETERS ON DEFORMATION**

The results of testing rubber-metal shock-absorbers of TSARMWTAT and TSASWTI types at different deformation have been given. The dependence of their parameters on the level of mechanical effect is shown. The method of determining the equipment resonance frequency at shock-absorbers at the specified deformation is proposed.

UDC 62-192

**Reutov A.I.**  
**RELIABILITY POLYMER COMPOSITES PRODUCTS SUBJECT**  
**TO STATISTICAL VARIATION OF THEIR CHARACTERISTICS**

The statistical model of estimating reliability by the criterion of strength of polymer composite product has been proposed. The data on scattering and statistical variation of polymer material characteristics on the bases of polypropylene at the stages of product life cycle – design, production and maintenance are introduced.

UDC 534.6.08

**Soldatov A.I., Shestakov S.A., Ponomarev S.V.**  
**APPLICATION OF METHODS OF THE SECOND**  
**AND THIRD ORDER ENVELOPES FOR DETERMINING**  
**ECHO PULSE TEMPORARY POSITION**

The acoustic tract of ultrasound level meter has been analyzed. The technique of the second and third order envelopes for determining the moment of occurring echo pulse was proposed. It allows increasing the accuracy of level measuring in 1,5...2 times.

UDC 534.6.08

**Soldatov A.I., Makarov V.S., Seleznev A.I., Martemianov S.M.**  
**THE SYSTEM OF ACTIVE TRACKING OF TRANSPORTABLE PIPELINE PIGS WITH THE ACOUSTIC LINK CHANNEL**

The pig tracking allowing determining the pipeline pig position and changing information with it has been described. The mechanism of distributing acoustic vibrations in the pipeline was considered.

UDC 534.2;534.44

**Avramchuk V.S., Goncharov V.I., Tran V.C.**  
**FREQUENCY-TIME CORRELATION ANALYSIS**  
**IN THE PROBLEMS OF DETERMINING**  
**LEAKAGE COORDINATES IN A PIPELINE**

The solution of the problem of detecting leakages in pipeline systems on the basis of developing and analyzing frequency-time correlation function has been considered. The approach allows determining the relation of frequency components of two signals spectra and detecting according to this relation the presence of leakage and its location.

UDC 53.082.4;621.64

**Kurochkin A.A., Bochkarev N.N.**  
**VIBRODIAGNOSTIC TRACKING OF IN-PIPE OBJECTS**

Field observations results of spectral characteristics for gas pipeline vibrations at clearing-scraper movement have been introduced. The experiments were carried out by sensitive acceleration gauge connected to a portal spectrograph. The obtained data shows the possibility of determining the location and speed of in-pipe object.

UDC 622.24.053:531.5

**Saruev L.A., Shadrina A.V., Saruev A.I.**  
**THE EXPERIMENTAL ESTIMATE OF STRESS IN NIPPLE JOINTS**  
**OF DRILL PIPES AT ROTATIONALLY- PERCUSSION LOADING**

The results of experimental researches of dynamic processes in drill pipes nipple joints have been introduced. The regularities of direct and tangential stresses changes in thread connections are established.

UDC 620.621.669.762.763

**Savitskiy A.P., Pribytkov G.A., Vagner M.I., Kutenkov O.P.**  
**POWDER COMPOSITE MATERIALS «METAL – NONMETAL»**  
**FOR BLAST-EMISSION CATHODES**

The first results on developing new ceramic materials from dielectrics and metal bond at the ratio of component volumes in composites 1:1 have been obtained. Powder mixture behavior at compaction and sintering was studied. Microstructures of different content composites and dependences of their volume changes on sintering temperature were studied.

UDC 539.4.015+620.172.242+620.179.17+620.193.33+669.112.227.342

**Apasov A.M.**  
**STUDYING THE INFLUENCE OF OPTICAL QUANTUM GENERATOR RADIATION ON CRACK-LIKE DEFECTS IN STEEL**

The influence of optical quantum generator radiation on crack-like defects in steel has been studied. The structure of the basic metal, the weld area and rivet metal were investigated by means of optical and electronic microscopy methods. Phase composition, grain and dislocation structures of these metals were diagnosed. The quality of melting the crack-like defects in steel was determined.

UDC 535.231.11+621.375.826+620.179.17

**Apasov A.M.**  
**DIAGNOSTICS OF INTERACTION PROCESS**  
**OF LASER FLUENCE WITH A CRACK IN STEEL**  
**ON THE BASIS OF ACOUSTIC EMISSION**

The acoustic emission signals have been recorded at the influence of concentrated flows of laser radiation energy on crack-like defects in steel. The dependence of parameters of the optical quantum generator radiation on the quality of melting the defects in stainless steel was ascertained. The possibility of removing (melting) defects of crack types at the output to metal surface was experimentally confirmed.

UDC 533.9;538.9

**Surmeneva M.A., Surmenev R.A., Khlusov I.A., Pichugin V.F., Konischev M.E., Epple M.**  
**CALCIUM PHOSPHATE COVERS DEVELOPED BY THE METHOD**  
**OF HYDROXYAPATITE HV-MAGNETRON SPUTTERING:**  
**OSTEOGENETIC POTENTIAL *in vitro* AND *in vivo***

The coatings on the basis of stoichiometric hydroxyapatite have been obtained by the method of RF-magnetron sputtering. The morphology of the surface, phase and elemental composition of the coatings were studied by the methods of scanning electron microscopy, energy dispersive analysis of X-rays, infra-red spectroscopy. The coating elemental composition is determined by the composition of target for sputtering. Elements are uniformly distributed over the coating surface. The coatings osteogenic properties are studied by the method of ectopic osteogenesis. The obtained coatings possess biocompatibility without osteoinducing activity. Surface structuring increases considerably the *in vivo* influence of calcium phosphate magnetron coatings on osteogenic activity of stromal stem cells of bone marrow.

UDC 678.5.046;615.462-036.5;615.477

**Bolbasov E.N., Guzev V.V., Dvornichenko M.V., Nechaeva K.A., Tverdokhlebov S.I., Khlusov I.A., Novikov V.A.**  
**HIGH ELASTIC BIOMPLEX COVERS ON THE BASIS**  
**OF TETRAFLUOROETHYLENE COPOLYMER WITH**  
**VINYLDIENE FLUORIDE FILLED UP WITH HYDROXYAPATITE**

Composite material for implants based on tetrafluoroethylene copolymer with vinylidene fluoride filled up with hydroxyapatite and the method of forming bioactive elastic covers with the developed porosity from the material has been proposed. The dependence of chemical composition, morphological and mechanical characteristics of the composite covers on hydroxyapatite weight content was studied. It was shown that the proposed covers meet the requirements to medical implant materials by the GOST R ISO 10993.

UDC 539.216.2, 621.666.762

**Sergeev V.P., Neyfeld V.V., Sungatulin A.R.,  
Sergeev O.V., Fedorischeva M.V., Nikalin A.Yu**  
**INCREASING THERMAL-CYCLE RESISTANCE  
OF COATINGS ON THE BASIS OF Zr-Y-O OBTAINED  
BY THE METHOD OF MAGNETRON DEPOSITION**

The coatings on the basis of Zr-Y-O with different Y concentration have been obtained by the method of magnetron sputtering in direct current and pulse mode. Chemical and phase composition of the coatings were studied by the methods of X-ray analysis and secondary-ion mass spectrometry. The influence of coating deposition mode on their thermal cycle resistance was determined.

UDC 535.36

**Goryachev B.V., Mogilnitskiy S.B.**  
**OPTICAL RADIATION TRANSFER IN CLOUDY ATMOSPHERE**

Clouds parameters influence on atmosphere radiation balance has been studied. The method of computing the radiation interaction value at multiple reradiation between clouds was proposed. It was determined that maximum radiation interaction is observed at certain optical cloud sizes, which depends on radiation phase function.

UDC 533.9.08:519.677

**Kalashnikov A.A., Sharnin A.V.**  
**THE MODEL OF IMPULSE RADAR MICROWAVE  
RADIATION DISTRIBUTION IN FUSION PLASMA**

The urgency of solving the direct problem of microwave pulsed reflectometry of fusion plasma has been shown. The dynamic model of microwave pulsed reflectometry was introduced. The model takes into account two-dimensional spacing interacting effects of transmitted wave and plasma at restrained demands to computer resources.

UDC 533.9.08:519.677

**Kalashnikov A.A.**  
**ANALYTICAL SOLUTION OF THE PROBLEM  
OF DETERMINING ELECTRIC INTENSITY FIELD OF PULSE  
RADAR MICROWAVE IN FUSION PLASMA**

The analytic solution of the problem on determining space-time distribution of electric stress field of pulse radar radiation in plasma has been proposed. The solution was implemented subject to two-dimensional effects of microwave and plasma interaction.

UDC 537.533.9

**Koval T.V., Le Khu Zung**  
**TRANSFORMATION IN TRANSPORT CHANNEL  
OF CHARGE COMPENSATED ELECTRON  
BEAM CROSS SECTION**

The transformation process of weakly relativistic charge compensated electron beam cross section in transport channel has been theoretically studied. It was shown that round electron beam may be transformed into rectangular section at formation of magnetic field of special configuration: longitudinal driving one and the one produced by the reverse current distributor.

UDC 533.9(537.52);621.362

**Zimin V.P.**  
**THE INFLUENCE OF PLASMA FORMATION FORM  
ON ARC DISCHARGE BURNING TEMPERATURE**

Boundary value problem solutions on plasma density distribution and arc discharge combustion equation for four forms of plasma formations have been obtained and analyzed. It was shown that electrode geometry influences the arc burning temperature in thermionic converters and their efficiency. The influence of plasma formation geometric factors on the arc burning temperature in the problem of modeling competition is discussed.

UDC 548.31;538.915;538.951

**Lisitsyn V.M., Zhuravlev Yu.N.**  
**STRUCTURAL PHASES OF SILVER AZIDE**

Structural phases of silver azide have been studied by the methods of functional theory of local electron density with gradient approximation of exchange-correlation potential by the program code CRY-STALOG. The possibility of existence of tetragonal symmetry phases as well as orthorhombic one in which the nitrogen molecules and the chains of covalently bound atoms of silver and nitrogen, practically non interacting to each other, are structural elements, is shown. Elastic constants of such crystal do not meet the requirements of mechanical stability. The band gap width in it equals 0,02 eV.

UDC 546.244:536.63

**Rustembekov K.T.**  
**HEAT CAPACITY AND THERMODYNAMIC FUNCTIONS  
OF CALCIUM-CADMIUM TELLURITE IN THE RANGE  
OF 298,15...673 K**

Calcium-cadmium tellurite has been synthesized for the first time from oxides of tellurium (IV), cadmium and calcium carbonate by solid phase method. Isobaric heat capacity, on the basis of which the dependence equations  $C_p^0 - f(T)$  were selected and thermodynamic functions were determined, was studied by the method of dynamic calorimetry in the range of 298,15...673 K. The sharp abnormal steps connected, probably, with phase transitions of the second order were observed on dependence diagram  $C_p^0 - f(T)$ .

UDC 538.971

**Evteeva N.A., Cherdantsev Yu.P., Lider A.M.,  
Chernov I.P., Garanin G.V., Dubrova N.A., Pushilina N.S.**  
**MODELING THE PROCESS OF HYDROGEN  
THERMOSTIMULATED DESORPTION IN METALS  
AND ALLOYS BY NUMERICAL METHODS**

Hydrogen concentration redistribution from the depth in titanium samples at the initial profiles specified in the form of linear and exponential dependences has been calculated. The finite difference method was used for solving Fick's equation. The results of calculation were introduced by sculpted surfaces showing the dependence of hydrogen concentration distribution on time and depth of the studied sample. The obtained results allowed modeling the process of hydrogen thermostimulated desorption. It was determined that at one type of hydrogen traps two peaks intensity are observed in thermostimulated desorption spectra.

UDC 541.15:358.91:538.975

**Gubareva T.V.**  
**AEROSOL PARTICLES TRANSFORMATION  
IN ATMOSPHERE**

The experimental data on radiation-stimulated reactions in the system of «alkali-halide microcrystal – free air» have been introduced. The products obtained after processing coincide with the products of chemical transformation of alkali-halide aerosol particles in atmosphere. The radiation-chemical mechanism of transforming atmospheric alkali-halide aerosol particles was introduced.

UDC 535.34;541.15

**Gubareva T.V.**  
**ABSORPTION SPECTRA OF SEA AEROSOL  
ALKALI-HALIDE PARTICLES**

The experimental results of ionization radiation action on heterogeneous reactions in the system «alkali-halide microcrystal – free air» have been introduced. It was shown that chemical transformations of alkali-halide particles is attended by the change of optical properties owing to occurrence of additional absorption bands in ultraviolet, visible and infrared regions of the spectrum.

UDC 551.510;539.163

**Yakovleva V.S.**  
**MODELING THE INFLUENCE OF ATMOSPHERE  
AND LITHOSPHERE STATE AND INSTABILITY ON RADON  
AND THORON FLUX DENSITY FROM EARTH SURFACE**

Variation change of radon and thoron flux density from Earth surface at external factors influence and depending on the change of physico-geological characteristics of surficial soils has been estimated. The change of atmosphere and lithosphere state was simulated by the change of advection velocity and radon and thoron diffusion coefficient in soil. It was taken into account that the change of vertical temperature and pressure gradients, surface atmosphere turbulence as well as stress-strain state of the Earth crust influence the advection velocity of soil gases. Rainfalls which result in increase of soil moisture and change of temperature condition, respectively, influence the diffusion coefficient of soil gases. The estimates were carried out by the diffusive-advective model of radon transfer in porous media.

UDC 551.510.535:551.501.8

**Yakovleva V.S., Vukolov A.V.**  
**THE METHOD OF COOPERATIVE MEASURING RADON  
AND THORON FLUX DENSITY FROM SOIL SURFACE  
BY ALPHA-RADIATION**

The method of cooperative measuring radon and thoron flux density from soil surface has been developed. It includes recording by alpha-detector the pulse count rate from alpha particles formed at decomposition of radon, thoron and decomposition daughter product accumulated inside the accumulative chamber set on the soil surface. The method is based on the analysis of the rate growth curve of alpha-radiation output inside the accumulative chamber. The method is proposed in two variants: the first is suitable when using the automated recording devices for long monitoring and the second is for single measurements with operator.

UDC 551.510.522:532:526

**Zukau V.V., Yakovleva V.S.,  
Karataev V.D., Nagorskiy P.M.**  
**SURFACE ATMOSPHERE IONIZATION  
WITH SOIL RADIONUCLIDES**

The results of simulating vertical profile of surface atmosphere layer ionization density conditioned by radioactive decay of soil radionuclides have been introduced. Ionization density simulation in free air by ionizing radiation was carried out by Monte Carlo method. The secondary radiation and cascade character of radiation interaction with the air are taken into account at simulation. The library of 40 main radionuclides existing everywhere in soils and grounds was developed for computations. The simulation was carried out in conditions of secular radioactive equilibrium between the family parents and daughter products of their decay.

UDC 004.942

**Klimenko S.Yu., Savinov A.P.**  
**THE INFLUENCE OF INTERVAL COEFFICIENTS  
OF NATURAL AND UNIFORM SOUND SEQUENCES  
ON ACOUSTIC VIBRATION BEATS**

The results of theoretical calculations of the beat modulation frequencies and experimental data of beat amplitudes and their modulations typical for total acoustic vibrations with frequency intervals corresponding to natural and uniform sound sequence have been introduced. It was determined that the transition from melodic to the uniform regime of acoustic vibrations is attended, as a rule, by occurrence of multilevel modulation determining the sequence of beat interval alternation with different duration. The possibility of applying the developed technique for objective estimate of concord consonance or dissonance occurring at simultaneous displaying of two tones is shown.