Summaries

UDC 517

Churikov V.A.
**LOCAL *d*-OPERATOR OF DIFFERENTIATION
AND INTEGRATION OF FINITE REAL ORDERS
OF FRACTIONAL ANALYSIS**

Local *d*-operator of differentiation and integration of any finite real orders, which is the generalization of differentiation and integration operations of standard analysis, has been introduced. The possibility of constructing fractional analysis on the basis of *d*-operator was discussed. Particular cases of *d*-operator of non-integral and integral orders were obtained.

UDC 519.213;519.23

Denisov V.I., Timofeev V.S.
**STABLE DISTRIBUTIONS AND ESTIMATION
OF REGISTRATION DEPENDENCE PARAMETERS**

The work is devoted to the problem of estimating the regression equation parameters. Using stable distributions the authors propose a new algorithm providing maximum reasonable estimation even in situations when a random error distribution has great variance. The carried out computational experiments proved the capacity of the developed algorithm and allowed giving a number of recommendations of practical use.

UDC 629.7.018.4:534.1.015.1

Berns V.A.
**ON CONSTRUCTING CALCULATED MODELS
OF DYNAMIC SYSTEMS BY TESTING RESULTS**

The calculated models of dynamic systems have as a rule less number of freedom degrees than the original system. This number of freedom degrees equals the number of proper vectors; system oscillations in the developed frequency range are introduced by eigenvector decomposition. The work is devoted to the calculation investigations of dynamic system simulation errors by testing results.

UDC 621.313:534

Slobodyan M.S., Slobodyan S.M.
DESTRUCTION OF SLIDING CONTACT OBJECTS

A probable approach to the description of the dynamic of destructing object contact pair at minor body sliding on endless or closed surface of another body has been proposed. The possibility of applying stochastic chain device for diagnosing object sliding contact survival by the algorithms has been analyzed.

UDC 62−752.34

Gavrilin A.N., Rozhkov P.S., Angatkina O.O., Moyzes B.B.
**DYNAMIC VIBRATION DAMPER WITH AUTOMATIC
VIBRATION FREQUENCY ADJUSTMENT SYSTEM**

This article is focused on the devices used for protection of technological equipment from the effect of vibration. The considered dynamic model of damper allows selecting optimal inertia-dissipative elastic parameters of the dynamic damper for minimal level of vibration in equipment under protection.

UDC 621.787

Skvortsov V.F., Okhotin I.S., Arlyapov A.Yu.
**ACCURACY OF DEEP HOLES WITH SMALL DIAMETER
IN HOLLOW THICK−WALLED CYLINDERS TREATED
BY MANDRELLING AT HIGH ALLOWANCES**

The results of statistic investigations of accuracy of deep holes with small diameter in hollow cylinders at mandrelling with high allowances have been stated. It was determined that at increase of thickness degree of hollow cylinders from 3,5 to 7 the deviations from longitudinal section profile of the holes treated with mandrelling increase and their accuracy decreases. It was found out that mentioned deviations are caused by axial residual stresses occurring in hollow cylinders during mandrelling.

UDC 658.562.012.7;658.563

Ostapenko M.S., Vasilega D.S.
**ACCOUNTING RELIABILITY PROPERTIES AT ESTIMATION
OF ASSEMBLED TURNING TOOLS QUALITY**

The necessity of introducing reliability properties: temperature consistency and tension coefficients into variety of quality indices of assembled turning tools, has been substantiated. The methods of calculating the introduced coefficients are introduced.

UDC 658.562.012.7;658.563

Sidulenko O.A., Ostapenko M.S., Vasilega D.S.
**QUALIMETRIC ESTIMATION
OF METAL−CUTTING TOOL QUALITY**

The technique of estimating metal-cutting tool quality has been developed. The consumer requirements, application conditions factors, engineering performance were determined. It was shown that the factor connecting all the studied characteristics is cutting temperature. The model of the assembled turning tools quality was developed on this basis.

UDC 621.315.61

Petrov A.V., Pytkina Yu.M., Takeeva B.M.
**THE EXPERIENCE OF APPLYING CALIBERS
FOR ROUND WIRE ENAMELING**

Using recommendations for selecting calibers for round wire enameling it was determine that paint layer thickness varnished at each pass may increase from the first pass to the last one or decrease, on the contrary. Therefore, in the first case the degree of structuring wire isolation will be lower than in the second case. The possibility of calculating the paint layer thickness varnished on each pass and correction of caliber routes for providing optimal isolation curing degree of enameled wire if necessary, was shown.

UDC 620.17

**Ismailov G.M., Musalimov V.M.,
Shiyanov V.D., Lutovinov S.V.**
**EVALUATION OF POWER INTERACTION OF CABLE
STRUCTURAL ELEMENTS AT BENDING STRAIN**

The issues of assessing the force interaction of cable structure elements under bending strain have been considered. The method and

implementing device for determining friction force and friction coefficient of individual elements within the twisted products were offered.

UDC 577.3.01;577.38

Borisov A.V., Trifonov A.Yu., Shapovalov A.V.
NONLOCAL REACTION–DIFFUSION FORMATION DYNAMIC
OF TWO–DIMENSIONAL CROSS–SHAPE DISSIPATIVE
STRUCTURES

The cross-shaped two-dimensional dissipative structures described by the Fisher−Kolmogorov−Petrovsky−Piskunov reaction-diffusion equation with nonlocal interaction and initial distribution localized around four centers have been numerically obtained. A structure form variation is considered subject to arrangement of the centers and equation parameters.

UDC 530.18+532.59+534.0+621.37

Romanov I.V., Ismailov I.V., Kokhanenko A.P., Poizner B.N.
NONLINEAR ADMIXING OF RADIO–
AND VIDEO SIGNALS IN COMMUNICATION
SYSTEM USING DYNAMIC CHAOS

The possibility of signal transmission and reception by the method of non-linear admixing and chaotic response on the basis of the dynamic system with nonlinearity possessing three minimums has been experimentally shown.

UDC 537.877

Meshcheryakov A.A., Gosenchenko S.G., Kizhner L.I.
THE INFLUENCE OF TROPOSPHERE REFRACTIVE INDEX
INSTABILITY ON DIRECT VISIBILITY DISTANCE AND ERRORS
OF MEASURING RADAR TARGET COORDINATES

The results of recovering vertical profile of refractive index by the data of atmosphere upper-air sounding over the sea in summer for five years of observation and analysis of its characteristic instability in relating to the issues of estimating accuracy of measuring radar target coordinates have been introduced. The data of sounding absent in scientific articles were used.

UDC 535.2:621.373.826

Lukin I.P., Eyuboglu H.T.
FORMATION OF BESSEL BEAM AT CONIC FOCUSING
IN TURBULENT ATMOSPHERE

Features of focusing Gaussian optical beam with arbitrary curvature of parabolic wave front by conic lens (axicon) in random-inhomogeneous medium have been studied. The analysis of the problem is based on solving the equation for mutual-coherence function of the second order of optical beam field. Medium intensity distribution of optical beam in longitudinal and cross sections to the direction of optical radiation propagation was calculated. The influence of random-inhomogeneous medium on changing radius of optical beam central part in focal distance range behind axicon was estimated. Stability criterion of space pattern of pseudo-Bessel beam formed in this way to the influence of arbitrary irregularities of the medium was obtained.

UDC 539.194;004.4

Bykov A.D., Emelyanov D.S., Stroynova V.N., Tyurin Yu.I.
APPLICATION OF SOFTWARE RELAX FOR COMPUTING
OF RELAXATION PARAMETERS OF SPECTRAL LINES
OF DIATOMIC AND TRIATOMIC MOLECULES

The software RELAX, which was applied for studying the influence of strong vibration excitation on parameters of molecule spectral-line profile has been developed. The variant of Ma−Tipping−Boulet of impact broadening theory was used in the software for computing half-width and shifts of line centers. The direct variation method was used at determining energy levels and wave functions of diatomic molecules, the effective Watson rotational Hamiltonian converted by Pa-de−Borel was applied for triatomic molecules. It was shown that considerable change of intramolecular dynamics at vibration excitation results in significant changes of half-widths and shift of line center formed by transitions to high vibrational states of diatomic and triatomic molecules.

UDC 544.733.422:519.87

Kudryashova O.B., Vorozhtsov B.I.
MATHEMATICAL MODEL OF BLASTING GENERATION
OF LIQUID–DROP AEROSOLS

Mathematical model contains equations describing the dynamic of changing thermodynamic parameters in the frame of blasting generator device of liquid-drop aerosols, flow process and sprayed drop size. The processes of aerosol cloud genesis and its further evolution were described. The criterion characterizing the efficiency of cavitation processes was found. The estimations of compression wave propagation time and flow time were obtained; the dependences of cavitation bubble size and aerosol particles on parameters of generator construction and substance characteristics were determined; aerosol particle size distribution was constructed; the regularities of changing the function of particle size distribution subject to the processes of coagulation, evaporation, precipitation were determined.

UDC 533.9.01

Vlasov V.A., Lutsenko Yu.Yu.,
Korepanova N.V., Zelenetskaya E.P.
THE FEATURES OF ELECTROMAGNETIC FIELD ATTENUATION
IN PLASMA OF HIGH–FREQUENCY CAPACITIVE DISCHARGE

The results of measuring axial distribution of electric field harmonic components of capacitive discharge burning in argon and air medium at change of the main harmonic frequency have been introduced. Poly-resonant behavior of harmonic component attenuation in discharge plasma was determined. The influence of electron temperature and electron concentration of discharge plasma on frequency component attenuation was considered. Anomalous growth of the third harmonic component of electric field at decrease of discharge plasma electron temperature was determined.

UDC 533.9.07

Linnik S.A., Gaydaychuk A.V., Shamanin I.V.
THE SOURCE OF GLOW–DISCHARGE PLASMA
WITH HOLLOW CATHODE EFFECT FOR MODIFYING
SURFACE PROPERTIES AND COATING

The structure of the source of glow-discharge plasma with hollow cathode effect functioning in the pressure range from 10^{-2} to 10^{-4} Pa has been introduced. Titanium nitration process and plasma enhanced chemical vapor deposition of pyrolitic carbon covering to silica surface was experimentally investigated. The data on composition, thickness and micro-hardness of the obtained samples were introduced. The possibility of using the developed source both in nitriding and coating modes was experimentally proved.

UDC 621.315.592+004.942

Philippov M.M., Kochegurov V.A., Babushkin Yu.V.,
Gribenyukov A.I., Ginsar V.E., Verozubova G.A.
STABILIZATION OF CRYSTALLIZATION FRONT SPEED
AT CRYSTAL GROWING IN MULTIZONE THERMAL
INSTALLATION BY BRIDGMAN METHOD

Thermal conditions for crystal growing in Bridgman multizone installation have been optimized. Software of thermal condition continuous correction was used for stabilizing crystallization front speed. Information on changing temperature field at growth container motion in installation effective volume was obtained by the developed package of mathematical models. The behavior of crystal growth axial velocities for static and dynamic temperature growth regimes was studied. It was shown that application of temperature condition continuous correction allows stabilizing crystallization front speed and minimizing its deviation from nominal speed of growth container in the installation.

UDC 539.16.04

**Goryachev B.V., Larionov V.V.,
Mogilnitskiy S.B., Sklyarova E.A., Chernov I.P.
APPLICATION OF MULTIPLE SCATTERING THEORY
TO INTERACTION PROCESSES OF ELECTRONS
WITH METAL HYDROGEN SUBSYSTEM**

Excitation of metal hydrogen subsystem at their radiation by electrons has been considered. It is shown that absorption of exposure energy depends not only on microphysical parameters of system elements but also on its sizes and structure that may be determinative when estimating processes accompanying radiation. The mechanism of increasing deuteron energy is discussed. Energy increase is provided by multiple scattering and re-radiation perturbation in the form of plasmons and oscillations of electron density distributed over the whole mode at radiation external action.

UDC 539.2:669+539.219.3

**Nikitenkov N.N., Khashkhash A.M., Sigfusson T.I.,
Kudryavtseva E.N., Smekalina T.V., Khoruzhiy V.D.,
Sypchenko V.S., Tyurin Yu.I., Chernov I.P.
STUDYING THE FEATURES OF HYDROGEN ABSORPTION
WITH STEEL 12Х12М1БФР AT ELECTROLYTIC, PLASMA
AND HIGH-TEMPERATURE SATURATION METHODS UNDER
PRESSURE**

The features of hydrogen accumulation in the samples of stainless ferrite steel 12X12M1BFR at saturation from water solution (electrolytic method), from hydrogen plasma (plasma saturation) and from gas medium (Siverts saturation method) have been studied by thermo stimulated desorption technique. The analysis of temperature dependences of hydrogen release showed that hydrogen traps are filled in considerably different way depending on saturation technique. The types of traps typical for the studied temperature intervals are identified.

**Ivanov Yu. F., Filimonov S.Yu., Teresov A.D.,
Kolubaeva Yu.A., Budovskikh E.A., Gromov V.E.
DOPING THE SURFACE OF CARBON STEEL
WITH COPPER BY CONDUCTOR ELECTRIC EXPLOSION
AND FOLLOWING ELECTRON BEAM TREATMENT**

The results of analysis of elemental and phase composition, defect structure and micro-hardness profile of carbon steel subjected to combined treatment consisting in its electro- explosive doping with copper and following electron beam treatment have been introduced. Cardinal change of the structure and multiple increase (in 5…6 times towards the sample core) of surface micro-hardness is determined.

UDC 621.785

**Ivanov Yu.F., Filimonov S.Yu., Kolubaeva Yu.A.,
Teresov A.D., Gromov V.E., Budovskikh E.A.
STRUCTURAL-PHASE ANALYSIS OF STEEL SURFACE LAYER
SUBJECTED TO ELECTRO-EXPLOSIVE COPPER DOPING
AND FOLLOWING ELECTRON BEAM TREATMENT**

The results of electron-microscopic micro-diffraction analysis of carbon steel surface layer subjected to combined treatment consisting in electro-explosive copper doping and following radiation with high-intensity electron beam have been introduced. It illustrate the occurrence of copper atoms participating in forming various phases in surface layer with the thickness of ~20 μm.

UDC 621.785;669.14.08.29

**Ovcharenko V.E., Bukrina N.V., Ivanov Yu.F.,
Mokhovikov A.A., Jian-qiang Wang, Bao-hai Yu
PULSE ELECTRON BEAM EXPOSURE OF METAL-CERAMICS
ALLOY IN NITROGEN-CONTAINING ATMOSPHERE**

The results of quantitative calculations of penetration depth and content of nitrogen in surface layer of metal-ceramics alloy TiC-(Ni-Cr) for the time of a single pulse of electron beam exposure of metal-ceramics alloy surface in a chamber with nitrogen-containing atmosphere have been introduced. The results of experimental investigation of nitrogen influence on microstructure and micro-hardness of metal-ceramics alloy surface at pulse electron beam exposure are given.

UDC 537.533;616.71−001.5−089.84

**Koval N.N., Teresov A.D., Shteinle A.V.
POLISHING THE SURFACE OF A PIN OF TRANSOSSEUS
OSTEOSYNTHSIS DEVICE BY A PULSE ELECTRON BEAM
OF SUB-MILLISECOND DURATION
WITH THEIR FOLLOWING GRINDING**

The technique of polishing pin surface by a pulse electron beam of sub-millisecond duration, generated by a source of electrons with plasma cathode on the basis of pulse low pressure arc discharge being a part of vacuum device «SOLO», has been proposed and tested for decreasing injurious exposure of transosseus osteosynthsis pin. The method of grinding a pin front part in the form of drill was developed. It was ascertained that the proposed polishing of the pin surface in conjunction with a new form of grinding allow reducing the time of their getting through the bone tissue, decreasing heating and lowering pin injurious exposure during the whole immobilization period.

UDC 621.793.7

**Kovalevskaya Zh.G., Zhukov A.P.,
Klimenov V.A., Butov V.G., Zaitsev K.V.
CALCULATION OF THE INFLUENCE OF SURFACE
MICRO-RELIEF FORMED BY ULTRASONIC TREATMENT
ON SPRAYED MATERIAL COOLING PROCESS**

Hardening process of gas-thermally sprayed material on steel base surface has been numerically considered. The change of surface micro-relief formed by ultrasonic treatment was taken into account. The solution of nonstationary heat conduction equation subject to phase transition melt-solid metal was used. The method of final elements was applied for numerical calculation. The dependences of temperature thermal cycle and cooling rates on time were obtained. It was shown that the conditions of cooling sprayed material depend on height and frequency of microroughnesses arrangement.

UDC 539.21;534.22

**Belomestnykh V.N., Tesleva E.P., Orlova K.N.
ELASTIC AND ACOUSTIC PROPERTIES
OF TWO-COMPONENT ALLOY Cu₃Au IN TEMPERATURE
RANGE 4,2…725 K**

Anharmonicity of interatomic interaction in two-component alloy Cu_3Au with positional order-disorder (Curie point T_c=661 K) in temperature range from 4,2 to 725 K has been studied. The propagation rates of purely longitudinal and shear elastic waves, temperature changes of Grüneisen parameter components, Poisson ratio and elastic modules in crystallographic directions [100], [110] and [111] monocrystal and for isotropic state of Cu_3Au were calculated on the basis of data on crystal constant hardness $c_{ij}(T)$ and compliance $s_{ij}(T)$.

UDC 621.763

**Khasanov O.L., Shulepov I.A., Polisadova V.V.,
Kachaev A.A., Dvilis E.S., Bikbaeva Z.G.
AUGER SPECTROSCOPY OF MECHANICALLY
ACTIVATED ZIRCONIUM BORIDE POWDERS**

The possibility of successful mechanical dispersion of powders of heat-resistant compound, zirconium boride, in planetary mill-activators till sub-micrometer dimensions has been shown. It was experimentally determined that occurrence of foreign substances in dispersed powder does not exceed critical level. The conclusion was drawn on potential perspectivity of the applied dispersion technique in producing high-density ceramic ZrB_2.

UDC 541.8−145.2

**Antropov N.A., Karpov D.A.,
Kryuchkov Yu.Yu., Strezhneva T.N.
THE TECHNIQUE OF DUAL-ENERGY X-RAY ABSORPTIOME
TRY FOR CONTROLLING WATER SOLUTION DENSITY**

The possibility of using dual-energy X-ray absorptiometry for determining density of water-salt and water-alcohol solutions at variation of sample mass attenuation coefficient to 70 % has been experimentally shown.