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I.O. Volodin, E.V. Khvorostukhina

DEVELOPMENT OF AN APPLICATION FOR CALCULATING THE NUMBER OF AUTOMORPHISMS FOR A SPECIAL CLASS OF HYPERGRAPHS

Abstract. *Hypergraphs are widely used in the management of large systems, logistics, and modeling electrical circuits and computer networks. The main research ambition includes the problems related to the study of automorphism groups of hypergraphs, since by investigating the properties of the automorphism group of a hypergraph, we can obtain information about the hypergraph. In this paper, the authors solve the problem relating the number of automorphisms of hypergraphs of some classes and use the results to develop a study guide that allows students to visually learn such important concepts as a hypergraph and its automorphisms.*

Keywords: *hypergraph, automorphism, study guide, automorphism group*

V.I. Filippov, O.A. Toropova

MODELING OF SPACES WITH REPRESENTATION OF VARIOUS SIGNALS BY A SINGLER INTEGER DECOMPOSITION AND SCALAR

Abstract. *The paper presents the results on the integer decomposition of elements of multidimensional spaces* $L_p\{(0,1]^m\},\ 1 \le p < \infty$, *by the systems of functions consisting of compressions and shifts of one function with an arbitrary reduction parameter. The models are given when different integer decomposition of signals are represented as a single integer decomposition. The given research may also be of interest to in digital information transmission and processing, since a simple algorithm is proposed for approximating functions from the spaces* $L_p\{(0,1]^m\},\ 1 \le p < \infty$, *characterized by the above mentioned properties.*

Keywords: *integer decomposition, Fourier type series with integer coefficients, systems of functions from compressions and shifts of one function, the* $L_p\{(0,1]^m\},\ 1 \le p < \infty$ *spaces, digital information processing, digital information transfer*

O.V. Zakharov, A.S. Yakovishin, A.V. Zhukov

APPLICATION OF FILTERS OF THE ISO 16610 SERIES TO ANALYZE THE SURFACE STRUCTURE. PART 1. OVERVIEW OF PROFILE FILTERS

Abstract. *The authors present a series of articles devoted to application of the ISO 16610 standard series for filtering the profile and surface texture. This review is important for two reasons. First, not all the standards in the ISO 16610 series have been approved and can be the subject for discussion. Secondly, only two standards of the series have been translated into Russian and are available to metrologists. Therefore, we plan to perform a detailed analysis of the standard series in terms of advantages and disadvantages of individual filtering methods. In each specific case, this will allow researchers to choose the most appropriate method or combination of filtration methods. This article, which opens the cycle, will give a general overview of profile filters, including linear, robust and morphological. The description of the methods is made in line with the following scheme: definitions, principles of construction, mathematical models, examples for the use of surfaces after various processing methods. In subsequent articles of this cycle, individual groups and specific filters will be considered in more detail and the conditions for their effective use will be determined.*

Keywords: *measurement, surface metrology, filtration, profile filter*

A.A. Ignatiev, V.A. Dobryakov, S.A. Ignatiev

EXPERIMENTAL AND ANALYTICAL EVALUATION OF DYNAMIC QUALITY OF MACHINE TOOLS USING STOCHASTIC CHARACTERISTICS OF ACOUSTICALLY-INDUCED VIBRATIONS

Abstract. *The article considers application of the stability margin in dynamic systems, integral estimates of autocorrelation functions, and spectra of vibro-acoustic processes in machines in order to estimate their dynamic quality and assignment of the cutting mode, which is theoretically justified by solution of stochastic equation of vibrations in the «cutter-part» system.*

Keywords: *machines, dynamic quality, acoustically-induced vibrations, autocorrelation function, spectral density, stability margin, integral estimates, processing quality*

D.Yu. Finogeev, D.A. Makarov,
I.V. Golovchenko, O.P. Reshetnikova

THE EFFECTS OF ABRASIVE WEAR ON GEOMETRIC PARAMETERS OF EXTRUSION NOZZLES WHEN PRINTING WITH COMPOSITE MATERIALS USING THE LAYER-BY-LAYER METHOD

Abstract. *The article discusses the problem of abrasive wear of the FDM 3D printer extrusion nozzle after printing with a composite material. A visual aid is provided to the wear of two types of nozzles made from different structural materials.*

Keywords: *additive technologies, 3D-printing, abrasive wear, composites, FDM*

N.V. Bekrenev, I.V. Zlobina

ASSESSMENT OF CHANGES IN THE LIMIT STATE OF STRUCTURAL CARBON FIBER-REINFORCED PLASTICS AT NEGATIVE TEMPERATURES AFTER TREATMENT IN THE MICROWAVE ELECTROMAGNETIC FIELD

Abstract. *The article presents the estimation results provided in line with the Tsai – Wu criterion of the limit state for control samples of toughened carbon fiber-reinforced plastic treated in the microwave electromagnetic field at –20° C, in comparison with the samples preserved under standard conditions in the production room. It is shown that negative temperatures lead to an increase in the Tsai – Wu criterion for both control and test samples. At the same time, the rate of the criterion for the test cooled samples remains almost at the level of control samples under standard conditions, which testifies to an increase in reliability of the limit state of carbon fiber-reinforced plastic structures after microwave exposure.*

Keywords: *polymer composite materials, carbon fiber-reinforced plastics, extreme operating conditions, strength, complex loading, limit state, criteria, microwave electromagnetic field*

I.N. Ganiev, L.Z. Aliyeva, A.E. Berdyev,
S.J. Alikhanov, U.S. Yakubov

EFFECTS OF LITHIUM ADDITIVES ON THERMAL PROPERTIES AND THERMODYNAMIC FUNCTIONS OF THE ZINC ALLOY TsAMSv4-1-2.5

Abstract. *The article presents the research results relating the effect of lithium additives on the heat capacity, heat transfer coefficient and thermodynamic functions of the zinc alloy TsAMSv4-1-2.5. The investigation was carried out in the «cooling» mode within the interval of 325 K – 450 K. It is shown that lithium reduces the heat capacity, heat transfer coefficient, enthalpy, and entropy of the initial alloy, while the value of the Gibbs energy increases. It has been established that an increase in thermophysical properties of alloys and their thermodynamic functions, except for the Gibbs energy, depend on the temperature parameters.*

Keywords: *the zinc alloy TsAMSv4-1-2.5, lithium, «cooling» mode, heat capacity, heat transfer coefficient, thermodynamic functions*

I.V. Zlobina, N.V. Bekrenev

INVESTIGATION INTO KINETICS OF CARBON AND FIBERGLASS HEATING WITH ACCOUNT FOR EFFECTS OF THE MICROWAVE ELECTROMAGNETIC FIELD ON THE TEMPERATURE OF THEIR COMPONENTS

Abstract. *The article presents the research results of the changes in the thermal properties of cured carbon and fiberglass plastics after exposure to the microwave electromagnetic field. It is shown that the microwave treatment effect at the rational modes of carbon fiber-reinforced plastic promotes a significant increase in the heating rate, the coefficient of thermal conductivity, and thermal conductivity (by 27 %, 20 %, and 18,6 %, respectively). A change in the similar parameters for fiberglass plastic is less evident. The fact of increasing uniformity of the thermal field, which is important for operation of these materials under the temperature gradients, has been established: for carbon fiber-reinforced plastic the difference in temperature values in different areas of the heated surface does not exceed 3-5° C, and for fiberglass plastic it does not exceed 8-10° C.*

Keywords: *polymer composite materials, thermal conductivity, thermal diffusivity, heating kinetics, microwave electromagnetic field*

F.K. Khodzhaev

THERMODYNAMIC ACTIVITY AND GIBBS FREE ENERGY OF ALLOYS OF LEAD SYSTEMS WITH THE ELEMENTS OF THE PERIODIC TABLE

Abstract. *Lead forms alloys characterized by high mechanical properties with the elements of the periodic table (EPT). However, there are no complete diagrams relating the state of lead with individual PT elements of the type Pb-O, Al, Si, S, Ga, Rb, or U. As is known, the fundamental basis for the development of new alloys are state diagrams. Statistical, thermodynamic criteria and the zone theory of regular solutions are used to predict and calculate the structure of state diagrams of these systems. In this paper, thermodynamic properties of components from experimentally constructed state diagrams Pb-O, (Al, Si, S, Ga, Rb, U) are calculated in terms of the theory of regular solutions. The state diagrams of these systems are of monotectic type characterized for delamination and homogeneity areas. Based on the analysis of the existing data, an attempt has been made to construct complete diagrams of the state of these systems, taking into account non-invariant transformations on the part of the blocks of interacting components. The obtained results help to calculate complete diagrams of the state of lead systems with individual PT elements, which are the fundamental basis of alloy formation processes and can be useful for the development of various metallurgical processes, such as developing technologies for conducting particular liquation processes.*

Keywords: *lead, state diagrams, thermodynamic properties, system, calculation, Gibbs activity and free energy*