ABSTRACTS

Sergey G. Chulkin, Aleksandr D. Breki, Irina V. Soloviova, Roman Kaczyński
Generalized methods of estimations of lubricants’ influence on the tribotechnical characteristics of friction pair “steel-steel” on the four-ball machine

This article is devoted to the development of generalized methods of estimations of lubricants influence on the tribotechnical characteristics of friction pair “steel-steel” and its usage for selection of the best lubricating material out of set of materials “Litol-24” produced by different manufacturers.

Ryszard Dindorf, Paweł Łaski
Design and experimental test of a pneumatic parallel manipulator tripod type 3UPRR

The paper presents the design and experimental test of a tripod type-3UPRR pneumatic parallel manipulator. This manipulator consists of three identical kinematic chains (pneumatic axes) connecting the fixed base and the moving platform. The tool center point TCP of the moving platform is a resultant of relocation of three pneumatic rodless cylinders independently controlled by servo-valves. For simulation purposes a solid model of pneumatic tripod parallel manipulator in SolidWorks was constructed. Since the application of 3-CAD in modeling kinematics and dynamics of parallel manipulators is restricted further simulation was carried out by means of SimMechanics library and Matlab-Simulink package. The experimental research focused on determining the precision of positioning of manipulator's end-effector point of the moving platform during point-to-point control.

Józef Drewniak, Stanisław Zawiślik
Comparison of graph-based methods of kinematical analysis of planetary gears

In the paper three graph-based methods of planetary gear modeling are discussed. The following methods have been considered: Hsu’s graph, contour graph and bond graphs-based methods. The theoretical ideas of the mentioned approaches were shortly revised and compared. Two of them were applied for analysis of an exemplary planetary gear. The consistency with traditional Willis method was checked. Advantages of the proposed approaches are highlighted.

Andrzej Dymarek, Tomasz Dzitkowski
Searching for the values of damping elements with required frequency spectrum

This paper concerns formulating and solving the problem of synthesis of vibrating discrete mechanical systems with two – terminal damper. In this paper a method of synthesis to determination of structure and inertial, elastical, damping parameters has been presented. Such task may be classified as a reverse problem dynamics of vibration subsystems.

Piotr Grześ
Finite element analysis of temperature distribution in axisymmetric model of disc brake

A transient thermal analysis is developed to examine temperature expansion in the disc and pad volume under simulated operation conditions of single braking process. This complex problem of frictional heating has been studied using finite element method (FEM). The Galerkin algorithm was used to discretize the parabolic heat transfer equation for the disc and pad. FE model of disc/pad system heating with respect to constant thermo-physical properties of materials and coefficient of friction was performed. The frictional heating phenomena with special reference to contact conditions was investigated. An axisymmetric model was used due to the proportional relation between the intensity of heat flux perpendicular to the contact surfaces and the rate of heat transfer. The time related temperature distributions in axial and radial directions are presented. Evolution of the angular velocity and the contact pressure during braking was assumed to be nonlinear. Presented transient finite element analysis facilitates to determine temperature expansion in special conditions of thermal contact in axisymmetric model.

Marek Jałbrzykowski, Joanna Mystkowska
Overlay dentures – constructional and research aspects

The paper presents selected issues relating to movable dentures with their general characteristics of fixings. Reference was made to the most important material-constructional aspects and the problems that arise with this type of solutions. In the work the method of durability and reliability evaluation and selection of materials for the kinematics connections of this type of structure was proposed.

Tadeusz Kaczorek
Positive switch 2D linear systems described by the general models

The positive switched 2D linear systems described by the general models are addressed. Necessary and sufficient conditions for the asymptotic stability of the positive switched system are established for any switching. The considerations are illustrated by numerical examples.

Andrzej Kaczyński, Wojciech Kozłowski
Elastostatic problem for an interface rigid inclusion in a periodic two-layer space

The article is devoted to the elastostatic three-dimensional problem of an interface sheet-like inclusion (anticrack) embedded into a periodic two-layered unbounded composite. An approximate analysis is carried out within the framework of the homogenized model with microlocal parameters. The formulation and the method of solving the general problem for an arbitrarily shaped inclusion is presented. As an example illustrating this method, the problem for a rigid circular inclusion under perpendicular tension is solved explicitly and discussed from the point of view of failure theory.
Influence of coordinate measurement parameters on a free-form surface inspection results

Małgorzata Poniatowska

The paper presents experimental results of investigations carried out on the 2024 aluminium alloy and P91 steel under biaxial stress state. The loading programme comprised a monotonic tension assisted by torsion-reverse-torsion cycles. An influence of the cyclic loading and its delay with respect to uniaxial tension on the selected mechanical parameters taken on the basis of tensile characteristics was investigated. Additionally, a relative variation of the proportional limit and yield point due to the loading history applied was analyzed. A permanency of effects observed during combination of tension and cyclic torsion was experimentally assessed on the basis of an initial yield surface evolution.

Arkadiusz Mystkowski

The paper presents the basis of the new method of rotor machine blades during their operation. The method utilizes such diagnostic models as a quotient of diagnostic signal y(t) and signal x(t) of its environment as the blade tip approaches the sensor as well as amplification of these signals as the blade tip recedes from the sensor and phase shift difference of these signals as the blade tip approaches and recedes from the sensor. The adopted diagnostic models indirectly take the current blade environment x(t) into account with no necessity of measuring (Kotowski and Lindstedt, 2007; Lindstedt and Kotowski, 2004). Therefore the model is sensitive to blade technical condition changes remaining only slightly sensitive to environment changes. Suggested method may prove very important in diagnostics of rotor blades during operation of rotor machines (turbines, compressors etc.).

Bohdan Monastyryskyy, Andrzej Kaczyński

Contact strength of a system of two elastic half spaces with an axially symmetric recess under compression

Frictionless contact of two isotropic half spaces is considered one of which has a small smooth circular recess. A method of solving the corresponding boundary value problem of elasticity in axially symmetric case is presented via the function of gap height. The governing integral equation for this function is solved analytically by assuming a certain shape of the initial recess. On the basis of the closed-form solution obtained the strength analysis of a contact couple is performed and illustrated from the standpoint of fracture mechanics.

Romuald Mosdorf, Tomasz Wyszkowski

Frequency and non-linear analysis of bubble paths in bubble chain

In the paper the paths of bubbles emitted from the brass nozzle with inner diameter equal to 1.1 mm have been analyzed. The mean frequency of bubble departure was in the range from 1 to 36 Hz. Bubble paths have been recorded using a high speed camera. The image analysis technique has been used to obtain the bubble paths for different mean frequencies of bubble departures. The Fourier, wavelet analysis and recurrence plots have been used to determine the strength of interaction between bubbles in column. It has been found that the influence of previously departing bubbles on trajectory of next bubble in the column can be significant for f < 30 Hz, in this case the bubble paths become less periodic and more instable. In this case the distance between subsequent departing bubbles (S/D) becomes close to 1. It causes that the vertical interaction between departing bubbles is enough strong to change the dynamical properties of bubble paths.

Arkadiusz Mysztkowski, Leszek Ambroziak

Investigation of passive magnetic bearing with Halbach-array

The paper has described the complete design and investigation processes of permanent magnetic bearing. The passive magnetic bearing (PMB) rotor suspension rig employing no active control components was calculated, designed, constructed and tested. In order to increase the radial passive magnetic bearing stiffness, the Halbach-array configuration was used. The main purpose is to develop the nonlinear model of the PMB. Therefore, the magnetic flux circuit of the PMB was analytically calculated by using Ohm and Kirchhoff methods. The nonlinear effects of the discrete 3D model of the PMB was analyzed by using Finite Element Method (FEM). Finally, the very well matched experimental and analytical static characteristics of the passive magnetic suspension were carried out.

Arkadiusz Mysztkowski

µ-Synthesis control of flexible modes of AMB rotor

In the paper the optimal robust vibration control of flexible rotor supported by the active magnetic bearings (AMBs) is investigated. The purpose of the control system is stabilization of the high speed rotor and effective control of the rotor vibration due to noncollocation, gyroscopic effects and model uncertainties. The noncollocation effect is considered and frequency modal analysis of the noncollocated ambs system with gyroscopic effects is presented. The µ-Synthesis control is applied to stabilize the rigid and flexible critical frequency modes of the rotor, with emphasis structural and parametric uncertainty. The input and output signals in ambs system are limited by the weighting functions. The singular value analysis is used to obtain the robust performances of the closed-loop system. The stable operation and good stiffness of the high speed rotor supported magnetically is reached. The dynamical behaviour of the AMB rotor is evaluated in the range up to 21 000 rpm. The experimental tests show the effectiveness of the robust control system as well as good vibrations reduction and robustness of the designed controllers.

Malgorzata Poniatowska

Influence of coordinate measurement parameters on a free-form surface inspection results

Coordinate measurements are the source of digital data in the form of coordinates of the measurement points of a discrete distribution on the measured surface. The local geometric deviations of free-form surfaces are determined (at each point) as normal deviations of these points from the nominal surface (the CAD model). Obtaining discrete data is inseparably connected with losing information on the surface properties. In contact measurements, the ball tip functions as a mechanical-geometric filter. The results of coordinate measurements of geometric deviations depend not only on the grid size but also on the ball tip diameter. This article presents foundations of the influence of the ball tip diameter and the grid size on coordinate measurement results along with the experimental results of measurement of a free-form milled surface in order to determine its local geometric deviations.
Valentyn Skalsky, Pavlo Halan

Application of acoustic emission in fatigue fracture diagnostics

The most important peculiarities of the acoustic emission under fatigue loading are reviewed. Dependences of the AE signals and parameters of the growing fatigue crack on the basis of an existing literature source review are established. An essential role of the correlation for determining the crack growth rate in the relation between the AE parameters and crack parameters are shown. An energy approach for determination of cycle quantities till the initiation of a crack is proposed.

Andrzej Werner

Measuring the accuracy of producing free-form surfaces with the use of the coordinate measuring method

The present paper presents a method of determining errors in processing complex-shape surfaces produced with the use of a CNC machine tool. In order to achieve this, the whole process of making a three-dimensional object was performed, from creating a CAD model to generating a processing programme for a CNC machine tool and producing the actual object. The obtained surface was measured with a Brown & Sharpe Mistral coordinate measuring machine with the use of a Renishaw TP200 measuring probe.

Andrzej Werner

Coordinate measurements of free-form surfaces in reverse engineering process

This paper presents the issues of coordinate measurements of three-dimensional objects whose shape is defined with the use of parametric surface description methods applied in CAD systems. The paper also describes a mathematical as well as a geometrical presentation of surfaces used CAD systems, and discusses coordinate measurement techniques applied in measuring objects of this class. Further in the article, a practical implementation of the methodology of reconstructing objects described with the use of free-form surface patches has been presented. The methodology includes subsequent object measurements and reconstructing the object’s geometric model, and concentrates on the possibly most accurate reconstruction of the shapes and dimensions of the researched object.

Monika Zimnoch, Wiera Oliferuk, Michał Maj

Estimation of defect depth in steel plate using lock-in IR thermography

The paper deals with the application of lock-in active infrared thermography as one of the non-contact and non-destructive techniques used for defect depth estimation. Preliminary research was done by testing a specimen made of austenitic steel plate with artificially created defects, i.e. flat-bottom holes. The obtained dependence between defect depth and phase shift was presented for different frequencies of “thermal waves” generated inside the sample. The experiment was carried out to determine the application of the lock-in thermography approach in testing materials with a high thermal diffusivity.