ABSTRACTS

Vladimir V. Savenko
Electroplastic Deformation by Twinningmetals

The article deals with theoretical and experimental approaches to electroplastic deformation caused by twinning of metals. The author specifies physical fundamentals of Kinetics regarding the development of twinning caused by the excitation of electronic subsystem of metals. Physical models of new channels for the realization of twinning aroused under conditions of electroplasticity have been discussed. Mechanisms of plasticized influence of a surface electric charge have been defined as well as the contribution of a dynamic pinch-effect in the elastic plastic deformation of metals with the participation of the intrinsic magnetic field of the current. The dynamic pinch effect creates ultrasonic vibration of the lattice system while Kinetics changes and plastic deformation are stimulated increasing the amplitude of the oscillations of rectilinear dislocations and the periodic change in the position of the dislocation loops with an increase in the probability of detachment of dislocations from the stoppers. When deformed above the yield point and due to the pinch effect the intrinsic magnetic field of the current diffuses into the crystal where the diffusion rate depends both on the conductivity of the metal and on the frequency of the current. It is necessary to take into account the physical conditions for the creation of ponderomotive effects in relation to specific technically important materials for the practical use of electroplastic deformation technology, especially when processing metals with pressure.

Małgorzata Poniatowska
Optimizing Sampling Parameters of CMM Data Acquisition for Machining Error Correction Of Freeform Surfaces

An optimization study using the design of experiment technique is described, in which the surface profile height of a freeform surface, determined in coordinate measurements, is the response variable. The control factors are coordinate sampling parameters, i.e. the sampling grid size and the measuring tip diameter. As a result of the research, an optimal combination of these parameters was found for surface mapping with acceptable measurement uncertainty. The presented study is the first stage of optimization of machining error correction for the freeform surface and was intended to take into account mechanical-geometric filtration of surface irregularities caused by these geometrical parameters. The tests were carried out on a freeform workpiece milled with specific machining parameters, Ra of the surface roughness was 1.62 μm. The search for the optimal combination of parameters was conducted using Statistica software.

Leyla Sultanova
Two-Parametric Analysis of Anti-Plane Shear Deformation of a Coated Elastic Half-Space

The anti-plane shear deformation problem of a half-space coated by a soft or a stiff thin layer is considered. The two-term asymptotic analysis is developed motivated by the scaling for the displacement and stress components obtained from the exact solution of a model problem for a shear harmonic load. It is shown that for a rather high contrast in stiffness of the layer and the half-space Winkler-type behaviour appears for a relatively soft coating, while for a relatively stiff one, the equations of plate shear are valid. For low contrast, an alternative approximation is suggested based on the reduced continuity conditions and the fact that the applied load may be transmitted to the interface. In case of a stiff layer, a simpler problem for a homogeneous half-space with effective boundary condition is also formulated, modelling the effect of the coating, while for a relatively soft layer a uniformly valid approximate formula is introduced.

Józef Tutaj, Bogdan Fijałkowski
A New Fuel-Injection Mechatronic Control Method for Direct-Injection Internal Combustion Engines

In this paper, a novel fuel-injection mechatronic control method and system for direct injection (DI) internal combustion engines (ICE) is proposed. This method and system is based on the energy saving in a capacitance using DC-DC converter, giving a very fast ON state of the fuel injectors' electro-magnetic fluidical valves without an application of the initial load current. A fuel-injection controller for the DI ICEs that provides a very short rising time of an electromagnet-winding current in an initial ON state of the fuel-injector's electromagnetic fluidical valves, which improves a fuel-injection controller reliability and simplify its construction, is presented. Due to a number of advantages of afore -mentioned fuel-injection mechatronic control method and system, it may be utilised for the DI ICEs with fuel injectors dedicated to all types of liquid and/or gas fuels, for example, gasoline, diesel-oil, alkohol, LPG and NPG.

Volodimyr Kalchenko, Andrij Yeroshenko, Sergiy Boyko
Crossing Axes of Workpiece and Tool at Grinding of the Circular Trough with Variable Profile

In the article the method of grinding with crossed axes of the tool and the workpiece got further developed. The work discloses a method of processing details having an external surface with a profile in the form of an arc of a circle of variable radius (for example, rolls of pipe rolling mills). The particular three-dimensional geometric models of the processing, shaping and profiling of abrasive wheels have been developed. A method for controlling the grinding process, which ensures the removal of allowances along equidistant curves has been offered. The developed method of grinding provides a constant depth of cutting according to the coordinate of profile processing. This is achieved at the expense of the synchronous inclination of the wheel and its insertion by the size of the allowance. The diameter of grinding wheel affects on the maximum angle of orientation of the wheel has been proven. It has been shown that increasing the diameter of the abrasive wheel has led to a slight decrease in value orientation angle.

Łukasz Wójcik, Zbigniew Pater
Comparison Analysis of Cockroft – Latham Criterion Values of Commercial Plasticine and C45 Steel

The paper presents and compares the results of theoretical and experimental research in the field of cracking of model material (commercial plasticine) and C45 steel in hot forming conditions. The aim of the research was to determine the limit values of the Cockroft-Latham integral for both materials. The presented research methodology includes experimental tests (tensile tests) and numerical simulations carried out in the DEFORM-3D program. For laboratory tests, axially symmetric samples made of C45 steel and model material were used. On the basis of the obtained experimental and numerical results, a comparative analysis of both materials was carried out.

Santhosh K. Venkata, Bhagya R Navada
Estimation of Flow Rate Through Analysis of Pipe Vibration

In this paper, implementation of soft sensing technique for measurement of fluid flow rate is reported. The objective of the paper is to design an estimator to physically measure the flow in pipe by analysing the vibration on the walls of the pipe. Commonly used head type flow meter causes obstruction to the flow and measurement would depend on the placement of these sensors. In the proposed technique vibration sensor is bonded on the pipe of liquid flow. It is observed that vibration in the pipe varies with the control action of stem. Single axis accelerometer is used to acquire vibration signal from pipe, signal is passed from the sensor to the system for processing. Basic techniques like filtering, amplification, and Fourier transform are used to process the signal. The obtained transform is trained using neural network algorithm to estimate the fluid flow rate. Artificial neural network is designed using back propagation with artificial bee colony algorithm. Designed estimator after being incorporated in practical setup is subjected to test and the result obtained shows successful estimation of flow rate with the root mean square percentage error of 0.667.

Oleg Onopriienko, Volodymyr Loboda, Alla Sheveleva, Yuri Lapusta
An Interface Crack with Mixed Electro-Magnetic Conditions at it Faces in a Piezoelectric/ Piezomagnetic Bimaterial under Anti-Plane Mechanical and In-Plane Electric Loadings

An interface crack between two semi-infinite piezoelectric/piezomagnetic spaces under out-of-plane mechanical load and in-plane electrical and magnetic fields parallel to the crack faces is considered. Some part of the crack faces is assumed to be electrically conductive and having uniform distribution of magnetic potential whilst the remaining part of the crack faces is electrically and magnetically permeable. The mechanical, electrical, and magnetic factors are presented via functions which are analytic in the whole plane except the crack region. Due to these representations the combined Dirichlet-Riemann and Hilbert boundary value problems are formulated and solved in rather simple analytical form for any relation between conductive and permeable zone lengths. Resulting from this solution the analytical expressions for stress, electric and magnetic fields as well as for the crack faces displacement jump are presented. The singularities of the obtained solution at the crack tips and at the separation point of the mention zones are investigated and the formulas for the corresponding intensity factors are presented. The influence of external electric and magnetic fields upon the mechanic, electric and magnetic quantities at the crack region are illustrated in graph and table forms.

Serhii Lupenko, Nadiia Lutsyk, Oleh Yasniy, Łukasz Sobaszek
Statistical Analysis of Human Heart Rhythm with Increased Informativeness

The new methods of statistical analysis of heart rhythm were developed based on its generalized mathematical model in a form of random rhythm function, that allows to increase the informativeness and detailed analysis of heart rhythm in cardiovascular information systems. Three information criteria (BIC, AIC and AICc) were used to determine the cumulative distribution functions that best describe the sample and to assess the unknown parameters of distributions. The usage of the rhythm function to analyse heart rhythm allows to consider much better its time structure that is the basis to improve the accuracy of diagnosis of cardiac rhythm.