ABSTRACTS

Wojciech Horak, Marcin Szczęch, Bogdan Sapiński
Magnetorheological Fluids Behavior in Oscillatory Compression Squeeze: Experimental Testing And Analysis

This article deals with experimental testing of magnetorheological fluid (MRF) behaviour in the oscillatory squeeze mode. The authors investigate and analyse the influence of excitation frequency and magnetic field density level on axial force in MRFs that differ in particle volume fraction. The results show that, under certain conditions, the phenomenon of self-sealing can occur as a result of the magnetic field gradient and a vacuum in the working gap of the system.

Arkadiusz Trąbka
Effect of Pulse Shape and Duration on Dynamic Response of a Forging System

Forging hammers are machines whose operation causes negative effects both at the place of their foundation (the soil settlement) and in their surroundings (e.g., vibrations propagating to the other devices, noise, etc.). Knowledge of the parameters characterizing the time history of the force that arises as a result of impact of a ram on a shaped material is of fundamental importance for the correct analysis of both the structure of the hammer and its impact on the surroundings. In the paper, the effect of the shape and duration of a pulse load on the dynamic response of a hammer-foundation forging system was assessed. An analytical method of description of the forces that arise as a result of impact of the ram on the forged material, using different forms of pulses was presented. The forces defined in this way as loads in a mathematical model of three degrees of freedom forging system were used. The equations of motion derived from d'Alembert's principle were solved numerically in the Matlab program. The analyses for eight forms of the pulse loads with the same pulse sizes but different durations were performed. The results in the graphs were presented. It was found, among other things, that a greater impact on the maximum displacement, velocity and acceleration of each component of the hammer-foundation system as well as on the maximum forces transmitted to the soil has the duration of a pulse than its shape.

Kamil Krasuski, Stepan Savchuk
The Impact of Troposphere Correction for Designation of the Ellipsoidal Height of Aircraft at Approach to Landing Procedure

The paper reports on research into the effect of the troposphere correction on the accuracy of the vertical component determination of an aircraft's flight as it approaches landing at Deblin Airport. The article presents ellipsoidal height value of the aircraft when the troposphere correction is considered in navigational calculations and when it is not taken into account. Accuracy of the aircraft positioning in the vertical plane using the SPP method is determined. The study shows that application of the troposphere correction in navigational calculations increases the accuracy of the vertical component determination by 25%–32%. The article and the study may serve as a valuable source of information for pilots, flight instructors and aircraft crews during training in operation and implementation of GNSS in aviation.

Heorhiy Sulym, Iaroslav Pasternak, Mariia Smal, Andrii Vasylyshyn
Mixed Boundary Value Problem for an Anisotropic Thermoelastic Half-Space Containing Thin Inhomogeneities

The paper presents a rigorous and straightforward approach for obtaining the 2D boundary integral equations for a thermoelastic half-space containing holes, cracks and thin foreign inclusions. It starts from the Cauchy integral formula and the extended Stroh formalism which allows writing the general solution of thermoelastic problems in terms of certain analytic functions. In addition, with the help of it, it is possible to convert the volume integrals included in the equation into contour integrals, which, in turn, will allow the use of the method of boundary elements. For modelling of solids with thin inhomogeneities, a coupling principle for continua of different dimensions is used. Applying the theory of complex variable functions, in particular, Cauchy integral formula and Sokhotski–Plemelj formula, the Somigliana type boundary integral equations are constructed for thermoelastic anisotropic half-space. The obtained integral equations are introduced into the modified boundary element method. A numerical analysis of the influence of boundary conditions on the half-space boundary and relative rigidity of the thin inhomogeneity on the intensity of stresses at the inclusions is carried out.

Krzysztof L. Molski
Stress Concentration at Load-Carrying Fillet Welded Cruciform Joints Subjected to Tensile and Bending Loads

This article presents numerical finite element method (FEM) analysis of the stress concentration at toes and crack-like faults in load-carrying fillet welded cruciform joints with transversal slits resulting from non-fused root faces. Potential fatigue damage of such joints subjected to cyclic tensile and bending loads appears in the form of fatigue cracks starting from the weld roots or toes. The aim of this article is to find qualitative and quantitative relationships between geometrical parameters of the load-carrying fillet welded cruciform joint subjected to tensile and bending loads and the stress concentration at weld toes and roots. The results of the analysis represented by the stress concentration factors (SCFs) and the stress intensity factors KI and KII are shown in the form of tables, graphs and mathematical formulas, which may be applied for fatigue assessment of such joints.

Heorhiy Sulym, Nataliia Ilchuk, Iaroslav Pasternak
Heat Conduction in Anisotropic Medium with Perfectly Conductive Thread-Like Inclusions

The paper presents a novel approach for the analysis of steady-state heat conduction of solids containing perfectly conductive thread-like inhomogeneities. Modelling of a thread-like heat conductive inhomogeneity is reduced to determination of density of heat distributed along a spatial curve, which replaces the inclusion. Corresponding boundary integral equations are obtained for anisotropic solids with thread-like inclusions. Non-integral terms are computed in a closed form. It is shown that, nevertheless the singularity of the equation is 1/r, it is hypersingular, since the kernel is symmetric. Boundary element approach is adopted for solution of the obtained equations. Numerical example is presented for a rectilinear conductive thread, which verifies derived boundary integral equations.

Krzysztof Wałęsa, Ireneusz Malujda, Dominik Wilczyński
Shaping the Parameters of Cylindrical Belt Surface in the Joint Area

Most of the industrial machines use round-shaped drive belts for power transfer. They are often a few millimetres in diameter, and made of thermoplastic elastomer, especially polyurethane. Their production process requires the bonding step, which is often per-formed by butt welding, using the hot plate method. The authors have undertaken to design an automatic welding machine for this purpose. Consequently, it is required to carry out a process analysis of hot plate welding, which entails describing the dependency between technological parameters (temperature, pressure force, time) and the quality of the joint, especially the outer surface of the belt around the weld. To analyse this process in a proper way, it is necessary to describe the physical phenomena that occur in the material, during particular operations of the hot plate welding process. One of the most troublesome phenomena occurring during the welding process is removing of the flash. These round rings, placed around the weld, which remains after the joining process, are unacceptable in the finished component. The authors took an effort to design the necessary equipment for removing of the flash after welding, using some simple parts that cut off excessive material. The paper shows the three possible solutions for flash removal. They were verified experimentally, and afterwards, the best solution was chosen. Additionally, a number of analytical calculations were carried out in order to determine the maximum force value required for this operation. Results of the analytical calculations were compared with experimental results.

Olga Porkuian, Vladimir Morkun, Natalia Morkun, Oleksandra Serdyuk
Predictive Control of the Iron ore Beneficiation Process Based on the Hammerstein Hybrid Model

Non-linear, dynamic, non-stationary properties characterize objects of the iron ore beneficiation line. Therefore, for their approximation, it is advisable to use models of the Hammerstein class. As a result of comparing the three models of Hammerstein: simple, parallel and recursive-parallel, it was shown that the best result for identifying the considered processes of magnetic beneficiation of iron ore by the minimum error criterion was obtained using the Hammerstein recursive-parallel model. Hence, it is recommended for the identification of beneficiation production objects.

Dariusz Szpica, Michal Korbut
Modelling Methodology of Piston Pneumatic Air Engine Operation

The article presents a mathematical model describing the operation of a piston pneumatic air engine. Compressed air engines are an alternative to classic combustion solutions as they do not directly emit toxic exhaust components. In the study, a modified internal combustion piston engine was adopted as pneumatic engine. The mathematical model was divided on the two subsystems, that is, mechanical and pneumatic. The mechanical subsystem describes a transformation of compressed air supply process parameters to energy transferred to the piston and further the conversion of the translational to rotary motion; in turn, in the pneumatic part, the lumped elements method was used. Calculations were carried out using the Matlab-Simulink software, resulting in the characteristics of external and economic indicators. The presented mathematical model can be ultimately developed with additional elements, such as the intake or exhaust system, as well as timing system control.