ABSTRACTS

Patryk Różyło
Passive Safety of a Buggy Type Car in the Aspect of a Dynamic Analysis of the Frame

This article presents passive safety issues of a buggy-type car. The issue has been presented in the context of the dynamic impact analysis of the aluminium frame of the vehicle into a rigid wall. The study was conducted using the finite element method in the Abaqus® software. With regard to numerical calculations, a dynamic impact simulation was performed, which defined the critical areas of the structure. Numerical analysis allowed to obtain both the state of the strain of the frame structure and the characteristics of the construction work during the impact. The results of the research provide high-quality prepared FEM model.

Volodymyr Zelenyak
Mathematical Modeling of Stationary Thermoelastic State for a Plate with Periodic System Inclusions and Cracks

Pallet flow rack are widely used in intralogistics to maximize warehouse capacity and to reduce the travel by fork-lifts. However, the use of pallet flow racks is associated with increased danger due to the use of gravity conveyors in their design. For this purpose, the gravity conveyors of pallet flow rack have a two safety elements – brake rollers and a stopping mechanism with pallet separator, which are working as a system. Brake rollers limit the speed of pallets, while the stopping mechanism allows exuding a pressure on the unloading pallet from the following behind it. A pallet should have such a speed, controlled by the brake rollers, so that it could be stopped by a stopping mechanism without damaging it. Based on the Cox impact theory, an original method for determining the allowable speed of a pallet in a pallet flow rack is proposed. The method ensures safe operation of the stopping mechanism with pallet separator and takes into account the mechanical properties and design parameters of the pallet separator stopper. A calculation example is provided for the most commonly used types of pallets – Euro pallet (1200 mm × 800 mm) and Industrial pallet (1200 mm × 1000 mm). The obtained results agree well with the pallet speed range of 0.2 to 0.3 m/s recommended by the manufacturers of pallet flow racks.

Vladimir Morkun, Ihor Kotov
Intellectualization of Emergency Control of Power Systems on the Basis of Incorporated Ontologies of Knowledge-Bases

The research deals with improvement of methods and systems of controlling integrated power systems (IPSs) on the basis of intellectualization of decision-making support. Complex analysis of large-scale accidents at power facilities is performed, and their causes and damages are determined. There is substantiated topicality of building condition knowledge-bases as the foundation for developing decision-support systems in power engineering. The top priorities of the research include developing methods of building a knowledge base based on intensity models of control actions influencing the parameters of power system conditions and introducing the smart system into information contours of the automated dispatch control system (ADCS), as well as assessing practical results of the research. To achieve these goals, the authors apply methods of experiment planning, artificial intelligence, knowledge presentation, mathematical simulation, and mathematical statistics as well as methods of power systems studying. The basic research results include regression models of a power system sensitivity to control actions, methods of building a knowledge base based on the models of sensitivity matrices, a structure of the smart decision-support system, a scheme of introducing the decision-support system into the operating ADCS environment. The problem of building a knowledge base of the dispatch decision-support system on the basis of empirical data resulted from calculating experiments on the system diagram has been solved. The research specifies practical efficiency of the suggested approaches and developed models.

Volodymyr Iasnii, Petro Yasniy
Degradation of Functional Properties of Pseudoelastic NiTi Alloy under Cyclic Loading: an Experimental Study

The influence of the cyclic loading on the functional properties of NiTi was studied. Cylindrical specimens with a diameter of 4 mm and a gage length of 12.5 mm were tested under uniaxial cyclic loading with control crosshead displacement at a temperature of 0°C. The dependences of the stress and strain range as well as dissipation energy on the number of loading cycles at different initial stress range were analysed. During the first 10 loading cycles, a rapid decrease in the strain range and energy dissipation was observed. Dissipation energy was invariant to the loading cycles' number at N > 20 cycles and to the stress range that did not exceed the martensite finish stress level, was within the same scatter band and can be described by the single dependence. With the stress range growth at N < 20 cycles from 509 to 740 MPa, the value of dissipation energy increases and that of relative dissipation energy decreases. Loss coefficient, which characterises material damping ability, significantly decreases during the first 10 loading cycles and remains practically unchanged up to the failure of the specimens. At the stabilisation area, the loss coefficient is almost non-sensitive towards the stress range.

Oleh Knysh, Ivan Rehei, Nazar Kandiak, Serhij Ternytskyi
Experimental Evaluation of the Tractive Effort of the Chain Conveyor During Book Block Spine Processing by Cylindrical Milling Cutter at Perfect Binding

The article reports on a device for book block spines processing that was designed and assembled on a perfect binding machine Trendbinder. The article shows workability of designed device. The authors have developed a methodology for the experimental study of the tractive effort of chain conveyors by technological load, the wireless module for data measurement and software for its processing. Extensive coverage is given to experimental research of the tractive effort of chain conveyors during book block spine processing depending on book block velocity, type of paper from which they are made and setting angle of cylindrical milling cutter relatively to direction of book blocks movement. The authors have examined the change in the tractive effort. The article experimentally confirms that sluggishness of chain drive causes vibration of the tractive effort. This effect can be observed during free-running movement of chain with carriers of perfect binding machine as well as during technological load influence. The article describes that between research parameters the setting angle of cylindrical milling cutter has the main impact relatively on the direction of book blocks movement.

Leon Kukiełka, Radosław Patyk, Łukasz Bohdal, Wojciech Napadłek, Rafał Gryglicki, Piotr Kasprzak
Investigations of Polypropylene Foil Cutting Process Using Fiber Nb:Yag and Diode Nd:YVO4 Lasers

Lasers are widely used in a variety of manufacturing processes including: depaneling, drilling, cutting, repair, trimming, micromachining. Polypropylene foils are intensively investigated as materials with great number of potential applications. Laser cutting is a major operation used in forming these materials and preparing the final workpieces. At the moment, the main challenge when cutting polypropylene is to obtain high quality products characterized by optimum sheared edge condition, minimum surface damage, freedom from burrs, slivers, edge wave, distortion, residual stresses and to obtain minimum width of HAZ zone. The amount of adjusTab. process parameters and the fact that the influence of these parameters on the process is not fully understood makes it difficult to control the cutting process. In practice, the right setup for the lasers is mostly found by trial and error combined with experience. Therefore, the final product frequently has serious defects. The paper presents the possibility of using fiber and diode lasers for forming of workpieces from polypropylene multilayer foil using cutting technology. The effect of selected process parameters and conditions on quality of sheared edge and material degradation is discussed.

Vladimir Golik, Vladimir Morkun, Natalia Morkun, Vitaliy Tron
Investigation of Mechanochemical Leaching of Non-Ferrous Metals

The research deals with metal extraction from off-grade ores and concentration tailings. There are provided results of simulating parameters of reagent leaching of metals in the disintegrator according to the metal recovery ratio. The research substantiates the method of waste-free processing of chemically recovered ores. Recovery of metals into solution is the same both under multiple leaching of tailings or ore in the disintegrator and agitation leaching of tailings or ore previously activated in the disintegrator with leaching solutions. The time of agitation leaching is more by two orders of magnitude than that of the disintegrator processing. Recovery of metals into solution is most affected by the content of sodium chloride in the solution. Then, in decreasing order, go the content of sulfuric acid in the solution, the disintegrator rotor rpm and L:S ratio.

Dorota Kula, Ewaryst Wierzbicki
Surface Localized Heat Transfer Equation for Periodic Composites

A characteristic feature of the description of physical phenomena formulated by an appropriate boundary or initial-boundary value problem and occurring in microstructured materials is the investigation of the unknown field in the form of decomposition referred to as micro-macro hypothesis. The first term of this decomposition is usually the integral average of the unknown physical field. The second term is a certain disturbance imposed on the first term and is represented in the form of a finite or infinite number of singleton fluctuations. Mentioned expansion s usually referred to as a two-scale expansion of the unknown physical field. In the paper, we purpose to apply two-scale expansion in the form of a certain Fourier series as a result of an applying Surface Localization of the unknown field. The considerations are illustrated by two examples, which results in analytical approximated solutions to the Effective Heat Conduction Problem for periodic composites, including the full dependence on the microstructure length parameter.

Zenon Hendzel, Jakub Wiech
Robotic Swarm Self-Organization Control

This article proposes a new swarm control method using distributed proportional-derivative (PD) control for self-organisation of swarm of nonholonomic robots. Kinematics control with distributed proportional-derivative (DPD) controller enables generation of desired robot trajectory achieving collective behaviour of a robotic swarm such as aggregation and pattern formation. Proposed method is a generalisation of virtual spring-damper control used in swarm self-organisation. The article includes the control algorithm synthesis using the Lyapunov control theory and numeric simulations results.

Maciej Rosół, Bogdan Sapiński

Ability of Energy Harvesting MR Damper to Act as a Velocity Sensor in Vibration Control Systems

The study investigates the self-sensing ability in an energy harvesting magnetorheological damper (EHMRD). The device consists of a conventional linear MR damper and an electromagnetic harvester. The objective of the work is to demonstrate that the EHMRD with specific self-powered feature can also serve as a velocity sensor. Main components of the device and design structure are summarized and its operation principle is highlighted. The diagram of the experimental set-up incorporating the measurement and processing unit is provided, the experimental procedure is outlined and data processing is discussed. The self-sensing function is proposed whereby the relative velocity of the EHMRD can be reconstructed from the electromotive force (emf) induced in the harvester coil. To demonstrate the adequacy of the self-sensing action (i.e., the induced emf should agree well with the relative velocity), the proposed self-sensing function is implemented and tested in the embedded system that will be a target control platform. Finally, the test results of the system utilizing a switching control algorithm are provided to demonstrate the potentials of the EHMRD acting as a velocity sensor and to confirm its applicability in semi-active vibration control systems.