ABSTRACTS

Victor Maiboroda, Dmytro Tarhan, Dmytro Dzhulii, Ivanna Slobodianiuk
Features of Magneto-Abrasive Machining of Taps

The features of magneto-abrasive machining of taps for metric thread cutting were investigated. The calculation method of integral intensity of the magneto-abrasive machining of the working surfaces of the taps by the quantitative values of normal and tangential components of moving speed of the quasi-stable volumes of the magneto-abrasive tool was developed. Based on the results of calculations, it was possible to predict the probable influence of the taps' location in the working zone on the quality and efficiency of machining their working surfaces. The calculation method is relevant for taps of all diameters with a profile angle of 60°. The working surfaces of the tool would not be effectively machined if the location angle of taps to the plane of the working zone of the machine equals 20–60°. Depending on the expected major polishing or strengthening effect of magneto-abrasive machining, the taps are required to be located at an angle of 60–90° to the plane of the working zone of the machine.

Andrzej Koszewnik
Experimental Validation of Equivalent Circuit Modelling of the Piezo-Stripe Harvester Attached to the SFSF Rectangular Plate

Plate-like structures with attached piezo-patch elements are widely used in marine, aerospace and civil infrastructure applications to power small devices with low power demand or used for monitoring of vibration structures. In order to assess the feasibility of an energy harvesting system to generate power output from a harvester, an accurate electromechanical model of the piezo-patch harvester attached to a 2D structure in modal coordinates is required. Taking into account this fact, this study is focused on the analysis of the piezo-harvester orientations on the SFSF (Simply Supported-Free-Simply Supported-Free) plate undergoing forced dynamic excitation. The results obtained from the numerical analysis of a smart structure led to determining quasi-optimal piezo-harvester location on the structure, and next, to determining a multi-mode representation of the equivalent circuit model. The experimental set-up carried out on the lab stand properly verified the parameters of the ECM model. Finally, the proposed approach can be used for the structural health monitoring of vibration of some 2D mechanical structures like the front wall of a dishwasher.

Heorgij Sulym, Viktor Opanasovych, Ivan Zvizlo, Roman Seliverstov, Oksana Bilash
A Circular Inclusion and Two Radial Coaxial Cracks with Contacting Faces in a Piecewise Homogeneous Isotropic Plate under Bending

The bending problem of an infinite, piecewise homogeneous, isotropic plate with circular interfacial zone and two coaxial radial cracks is solved on the assumption of crack closure along a line on the plate surface. Using the theory of functions of a complex variable, complex potentials and a superposition of plane problem of the elasticity theory and plate bending problem, the solution is obtained in the form of a system of singular integral equations, which is numerically solved after reducing to a system of linear algebraic equations by the mechanical quadrature method. Numerical results are presented for the forces and moments intensity factors, contact forces between crack faces and critical load for various geometrical and mechanical task parameters.

Łukasz Jastrzębski, Bogdan Sapiński, Arkadiusz Kozieł
Automotive MR Shock Absorber Behavior Considering Temperature Changes: Experimental Testing and Analysis

This study investigates the automotive magnetorheological (MR) shock absorber behaviour in conditions of changing temperature. Its temperature-dependent behaviour was quantified between ambient and maximal operating temperatures of the device. Aspects addressed include the temperature dependence of the control coil resistance in the absorber, the influence of operating current level on control coil temperature and the temperature dependence of the absorber force response and energy dissipation in the system. The results of experiments enabled us to evaluate the mechanical performance of the absorber at varied temperatures.

Dariusz Szpica, Michał Kusznier
Modelling of the Low-Pressure Gas Injector Operation

In recent years, there has been a growing interest in alternative sources of power supply for internal combustion engines. Liquefied petroleum gas injection systems are among the most popular. It becomes necessary to know mathematical descriptions of the operation of individual components. The article presents a mathematical model that describes the operation of the low-pressure gas injector. Valtek plunger injector was chosen as the test object. The mathematical description includes three parts, i.e. electric, mechanical and pneumatic. The electrical part describes the generation of electromagnetic force by a circuit with a coil, in the mechanical equilibrium equation of forces acting on the plunger, and in the pneumatic part the air pressure on the plunger. The calculations were performed in the Matlab/Simulink environment, creating current waveforms, acting forces and plunger displacement. Correctness of mathematical description and determined in the course of opening and closing time calculations were related to the values declared by the manufacturer, showing differences below 3%. The presented mathematical model can be modified for other injector design solutions.

Kamil Krasuski, Janusz Ćwiklak
Accuracy Analysis of Aircraft Position at Departure Phase using DGPS Method

The aim of this paper is to present the problem of implementation of the Differential Global Positioning System (DGPS) technique in positioning of the aircraft in air navigation. The aircraft coordinates were obtained based on Global Positioning System (GPS) code observations for DGPS method. The DGPS differential corrections were transmitted from reference station REF1 to airborne receiver using Ultra High Frequency (UHF) radio modem. The airborne Thales Mobile Mapper receiver was mounted in the cabin in Cessna 172 aircraft. The research test was conducted around the military aerodrome EPDE in Dęblin in Poland. In paper, the accuracy of aircraft positioning using DGPS technique is better than 1.5 m in geocentric XYZ frame and ellipsoidal BLh frame, respectively. In addition, the obtained accuracy of aircraft positioning is in agreement with International Civil Aviation Organization (ICAO) Required Navigation Performance (RNP) technical standards for departure phase of aircraft. The presented research method can be utilised in Ground-Based Augmentation System (GBAS) in air transport. In paper, also the accuracy results of DGPS method from flight test in Chełm are presented. The mean values of accuracy amount to ±1÷2 m for horizontal plane and ±4÷5 m for vertical plane.

Heorgij Sulym, Viktor Opanasovych, Mykola Slobodian, Oksana Bilash
Pure Bending of Strip (Beam) with Crack in Strip of Tensile Stress with Allowance for Plastic Strips Near Crack Tips

In the article, the pure bending problem for strip (beam) with straight, perpendicular to its axis crack located in the zone of tensile stresses is investigated on the assumption of narrow plastic strips near crack tips. Using methods of the theory of functions of a complex variable and complex potentials, the problem is reduced to the several linear conjunction problems. The solutions of latter problems are obtained in the class of functions confined in the edges of plastic strips. Formulas for the calculation of their lengths are derived. Expressions for the determination of crack tip opening values are written. Numerical analysis of the problem is performed.

Patryk Szywalski, Andrzej Waindok
Practical Aspects of Design and Testing an Unmanned Aerial Vehicles

A design of an unmanned aerial vehicle (UAV) construction, intended for autonomous flights in a group, was presented in this article. The design assumptions, practical implementation and results of the experiments were given. Some of the frame parts were made using 3D printing technology. It not only reduces the costs but also allows for better fitting of the covers to the electronics, which additionally protects them against shocks and dirt. The most difficult task was to develop the proper navigation system. Owing to high costs of precision positioning systems, common global positioning system (GPS) receivers were used. Their disadvantage is the floating position error. The original software was also described. It controls the device, allows performing autonomous flight along a pre-determined route, analyses all parameters of the drone and sends them in a real time to the operator. The tests of the system were carried out and presented in the article, as well.

Halina Nieciąg, Rafał Kudelski, Piotr Dudek, Jacek Cieślik
An Exploratory Study on the Accuracy of Parts Printed in FDM Processes from Novel Materials

The paper describes the experiment of assessing the chosen geometric characteristics of test models with simple geometry, shaped by the FDM (fused deposition modelling) method of different materials. The influence of the material grade and the degree of infill density on the shrinkage affecting their dimensional deviations and selected surface topography parameters of printed parts was examined and compared. Three different types of materials were used to fabricate the test models, namely HDGLASS and NANOCARBON, two new fibre reinforced composites available in the market and, additionally ABS, a popular monoplastic material. An infill density ratio of 10, 50 and 90% was assumed for each material. Three specimens were made on the same printer for each infill density, which allowed to assess the repeatability of the analysed characteristics. From among many possible shapes of models, a cube was chosen as representing the simplest geometry, facilitating the measurements themselves and the interpretation of the results. New fibre-reinforced materials are more attractive in industrial applications than pure plastics (ABS) due to their mechanical properties or appearance. They are characterized by a relatively low melting point and short cooling time, after which they can return to their original geometry; however, there is a lack of detailed data on the geometric accuracy of parts made of used composite materials. The presented work was to explanatorily broaden the knowledge about the properties of composite made parts. The practical purpose of the research was that on the basis of measurements, it would be possible to indicate among the materials used that particular material whose properties and method of application would allow obtaining the best quality surface and would be the most resistant to thermal loads. An attempt was also made to explain the possible causes of the differences in the observed characteristics of the tested materials.