ABSTRACTS

Heorgij Sulym, Viktor Opanasovych, Mykola Slobodian, Oksana Bilash
Combined Bending with Tension of Isotropic Plate with Crack Considering Crack Banks Contact and Plastic Zones at its Tops

Stress-strain state of isotropic plate with rectilinear through-crack at combined action of bending and tension, realized by applying distributed forces and bending moments at infinity, the vectors of which are parallel and perpendicular to the crack, is investigated. Under the influence of the internal stress the crack faces contacts on area of constant width near the upper base of plate, and plastic zones forms in its tips. Using methods of the theory of complex variables, complex potentials plane problem of elasticity theory and the classical theory of plates bending, solving of the problem is reduced to the set of linear conjugation problems and their analytical solution is built in a class of functions of limited plastic zones in the crack tips. The conditions of existence of the solution of the problem in these terms are determined. Using Treska plasticity conditions in the form of surface layer or the plastic hinge, the length of plastic zone and crack opening displacement are found analytically. Their numerical analysis for various parameters of the problem is conducted.

Łukasz Jastrzębski, Bogdan Sapiński
Magnetorheological Self-Powered Vibration Reduction System with Current Cut-Off: Experimental Investigation

The paper summarises the results of laboratory testing of an energy harvesting vibration reduction system based on a magnetorheological (MR) damper whose control circuit incorporates a battery of bipolar electrolytic capacitors (current cut-off circuit). It is designed to reduce the undesired effects in vibration reduction systems of this type, associated with the increasing amplitude of the sprung mass vibration under the excitation inputs whose frequency should exceed the resonance frequency of the entire system. Results have demonstrated that incorporating a current cut-off circuit results in a significant decrease of sprung mass vibration amplitudes when the frequency of acting excitation inputs is higher than the resonance frequency.

Adam Brodecki, Tadeusz Szymczak, Zbigniew Kowalewski
Digital Image Correlation Technique as a Tool for Kinematics Assessment of Structural Components

The paper reports the results of tests carried out for kinematic properties determination of components under cyclic loading. DIC system called 5M PONTOS was employed to follow variations of displacement versus time. It was conducted by the use of markers stuck on selected sections of components tested. The results are presented in 2D and 3D coordinate systems expressing behaviour of such elements as: mechanical coupling device, boat frame and car engine. These data enabled to capture weak and strong sections of the component examined at various loading conditions.

Andrea Carpinteri, Vittorio Di Cocco, Giovanni Fortese, Francesco Iacoviello, Stefano Natali, Camilla Ronchei, Daniela Scorza, Sabrina Vantadori, Andrea Zanichelli
Mechanical Behaviour and Phase Transition Mechanisms of a Shape Memory Alloy by Means of a Novel Analytical Model

The aim of the present paper is to examine both the fatigue behaviour and the phase transition mechanisms of an equiatomic pseudo-elastic NiTi Shape Memory Alloy through cyclic tests (up to 100 loading cycles). More precisely, miniaturised dog-bone specimens are tested by using a customised testing machine and the contents of both austenite and martensite phase are experimentally measured by means of X-Ray diffraction (XRD) analyses. On the basis of such experimental results in terms of martensite content, an analytical model is here formulated to correlate the stress-strain relationship to the phase transition mechanisms. Finally, a validation of the present model by means of experimental data pertaining the stress-strain relationship is performed.

Andrzej Kaczyński
On 3D Anticrack Problem of Thermoelectroelasticity

A solution is presented for the static problem of thermoelectroelasticity involving a transversely isotropic space with a heat-insulated rigid sheet-like inclusion (anticrack) located in the isotropy plane. It is assumed that far from this defect the body is in a uniform heat flow perpendicular to the inclusion plane. Besides, considered is the case where the electric potential on the anticrack faces is equal to zero. Accurate results are obtained by constructing suitable potential solutions and reducing the thermoelectromechanical problem to its thermomechanical counterpart. The governing boundary integral equation for a planar anticrack of arbitrary shape is obtained in terms of a normal stress discontinuity. As an illustration, a closed-form solution is given and discussed for a circular rigid inclusion.

Krzysztof Wałęsa, Ireneusz Malujda, Krzysztof Talaśka
Butt Welding of Round Drive Belts

The on-going rapid development of industry encourages development of new production technologies and designing of machines that use inventive mechanical engineering solutions, a big demand for parts of such machines being a natural consequence. Polymeric power transmission belts are a good example of that. This paper proposes an improvement in the process of production of such belting. Their production includes cutting to length and splicing of elastic round belts to obtain endless belts of the specified length. This is the key phase of the whole production process. A number of splicing methods are available using different physical phenomena. One of them is butt welding technique. In this process heat is applied on the material through an additional heating element called the heat platen. The effect depends on several factors, including preparation of the work pieces. Due to its characteristics the process is often carried out by hand. The need for automated manufacturing was created by important factors associated with manufacturing on an industrial scale: cost, time and quality. The proposed butt welding machine, complete with a control system is an answer to this need. The practical benefits include improved repeatability of splices, time savings and less work load for the operator.

Volodymyr Gursky, Igor Kuzio
Dynamic Analysis of a Rod Vibro-Impact System with Intermediate Supports

The two-mass resonant vibro-impact module is presented as the rod system with cylindrical intermediate supports. The corresponding design diagram is constructed. Based on the finite element method, the frequency of free oscillations is defined for the corresponding location of the intermediate supports. A stress-strain state of the elastic element is considered. The stiffness of the intermediate supports is defined by solving the contact problem between the cylindrical rod supports and the flat spring. The dynamics of the vibro-impact rod system with multiple natural frequencies is analyzed taking into account the contact stiffness of the intermediate supports. The determination of contact and equivalent stresses occurring during the operation of the vibro-impact rod system is performed.

Piotr Mrozek, Ewa Mrozek, Andrzej Werner
Electronic Speckle Pattern Interferometry for Vibrational Analysis of Cutting Tools

A Michelson interferometer based ESPI system for static and vibration out of plane displacement measurements is presented. The aim of the article is to demonstrate the usability of ESPI non-contact measurement method in the field of machining. The correlation fringe patterns were visualized using custom software. The accuracy of ESPI interferometer was verified by the comparison with measurement results collected using industrial XL-80 laser system. The efficacy in vibration analysis was tested by studying the mode shapes and resonant frequencies of the transverse vibrations of square plates. The measurement methodology was used to determine natural frequencies and the shapes of vibrational modes of NFTe 100x1.2/64-II circular slitting saw. As a result he values of rotational speed that should be avoided during machining were determined.

Jozef Živčák, Radovan Hudák, Marek Schnitzer, Tomáš Kula
Numerical Simulation and Experimental Testing of Topologically Optimized PLA Cervical Implants Made by Additive Manufacturing Methodics

The article focuses on compressive axial loading experimental testing and simulations of topologically optimized design and additively manufactured cervical implants. The proposed platform design is based on anatomical and biomechanical requirements for application in the cervical area. Thanks to new ways of production, such as additive manufacturing, and new software possibilities in the field of structural analysis, which use the finite element method and analysis, it is possible to execute topological optimization of an implant in construction solution, which would be impossible to make by conventional methods. The contribution of this work lies in investigation of 3D printed PLA cervical implant usage in surgical intervention and creation of a numerical static loading modelling methodics and subsequent experimental confirmation of the modelling correctness.

Ihor Dzioba, Sebastian Lipiec, Piotr Furmanczyk, Robert Pala
Investigation of Fracture Process of S355JR Steel in Transition Region using Metallographic, Fractographic Tests and Numerical Analysis

In the paper are presented test results of fracture process in brittle-to-ductile transition range for two microstructural types of S355JR steel – ferrite-pearlite and ferrite-carbides. For both kinds of S355JR steel obtained in temperature range of transition region the strength and plastic properties are similar, but the fracture toughness characteristics showed significantly are various. To clarify the differences in the course of trends in the mechanical characteristics performed metallographic and fractographic observations using the scanning electronic microscope. The fractographic examination showed that changes in the fracture surface morphology were dependent on the test temperature. It was also found that during the subcritical crack growth the region of ductile fracture extension reduced with decreasing temperature. The results of finite element method (FEM) calculation the stress fields in front of the crack of single edge notch in bending (SENB) specimens in the range of brittle-to-ductile transition are presented also. The FEM calculations were performed on the numerical model of SENB specimen using the ABAQUS program.

Konrad K. Kwaśniewski, Zdzisław Gosiewski
Genetic Algorithm for Mobile Robot Route Planning with Obstacle Avoidance

Nowadays many public and private institutions begin space studies projects. Among many problems to solve there is a planet exploration. Now rovers are controlled directly from the Earth, e.g. Opportunity. Missions must be planned on the Earth using simulators. Much better will be when the mission planner could set the target area and work to do and the rover will perform it independently. The solution is to make it autonomous. Without need of external path planning the rover can cover a much longer distance. To make autonomous rovers real it is necessary to implement a target leaded obstacle avoidance algorithm. Solutions based on graph algorithms use a lot of computing power. The others use intelligent methods such as neural networks or fuzzy logic but their efficiency in a very complex environment is quite low. This work presents an obstacle avoidance algorithm which uses the genetic path finding algorithm. The actual version is based on the 2D map which is built by the robot and the 2nd degree B-spline is used for the path model. The performance in the most cases is high using only one processor thread. The GA can be also easily multithreaded. Another feature of the algorithm is that, due to the GA random nature, the chosen path can differ each time on the same map. The paper shows the results of the simulation tests. The maps have the various complexity levels. On every map one hundred tests were carried out. The algorithm brought the robot to the target successfully in the majority of runs.

Katarzyna Ignatiuk, Agnieszka Dardzińska

The Closest Incomplete Distributed Information System for Medical Query Answering System

The common issue for medical information systems are missing values. Generally, gaps are filled by statistically suggested values or rule-based methods. Another approach is to use the knowledge of information systems working under the same ontology. The medical incomplete system receives a query unable to answer, because of some unknown patient attributes. So, it has to communicate with other medical systems. The result of the collaboration is collective knowledgebase. In this paper, we propose a measure supporting choice of closest pair of systems. It determines the distance between the two systems. We use ERID algorithm to extract rules from incomplete, distributed information systems. Each constructed rule has confidence and support. They allowed to determine the distance between a pair of medical information systems. The proposed solution was verified on the basis of several "manipulated" medical information systems. Next, the solution was verified in systems with randomly selected data. The satisfying results were obtained and based on them, the proposed measure can be successfully used in medical systems to support the work of doctors and the treatment of patients.

Grzegorz Wojnar, Michał Juzek

The Impact of Non-Parallelism of Toothed Gear Shafts Axes and Method of Gear Fixing on Gearbox Components Vibrations

The subject of the experimental research was a modified back-to-back test stand. During the test, the driven gear with a number of teeth z_1=16 was fixed on stationary axis. The tested gearbox worked without load and the closing gearbox was dismantled to avoid any additional vibration and noise. A mechanical system was also used which, during the tests, allowed to change the position of the above mentioned stationary axis. Gear with number of teeth z1 was fixed on a stationary axis with the arrangement of two self-aligning ball bearings which prevented significant changes in the angular position of axis of gear in regard of stationary axis; or fixed on a stationary axis with the arrangement of one self-aligning ball bearing which allowed significant changes in the angular position of axis of gear in regard of stationary axis. On the basis of the conducted studies, it can be stated that only in some of the analyzed cases fixing of gear with the arrangement of one self-aligning ball bearing reduces the vibration of the gearbox elements.