ABSTRACTS

Mariusz Banaszkiewicz, Waldemar Dudda
Applicability of Notch Stress-Strain Correction Methods to Low-Cycle Fatigue Life Prediction of Turbine Rotors Subjected to Thermomechanical Loads

The paper analyses the possibility of using analytical methods of notch stress-strain correction in low-cycle fatigue life predictions of steam turbine rotors operating under non-isothermal conditions. The assessment was performed by comparing strain amplitudes calculated using the Neuber and Glinka-Molski methods and those predicted by the finite element analysis (FEA) employing elastic-plastic material model. The results of investigations reveal that the Neuber method provides an upper bound limit, while the Glinka-Molski method results in a lower bound limit of strain amplitude. In the case of rotor heat grooves, both methods provide equally accurate results of notch strain amplitude and are suited to estimating lower and upper bound limits of low-cycle fatigue life under non-isothermal conditions.

Bogdan Sapiński, Andrzej Matras
Investigation of Velocity Sensing In Harvesters for Magnetorheological Dampers

This paper investigates the performance of electromagnetic vibration harvesters that can be incorporated in energy harvesting magnetorheological (MR) dampers. The study outlines the structure and operating principles of harvesters and compares results of numerical calculations with measurement data obtained under idle run. Results demonstrate the potential applications of harvesters as velocity sensors. The relationship between electromotive force (emf) and velocity across the devices is established. The discussion section suggests that power generation by harvesters can provide the velocity information by utilising the sensing function applicable to a variety of control algorithms.

Heorhiy Sulym, Yosyf Piskozub, Julian Polanski
Antiplane Deformation of a Bimaterial with Thin Interfacial Nonlinear Elastic Inclusion

The problem of longitudinal shear of bimaterial with thin nonlinear elastic inclusion at the interface of matrix materials is considered. Solution of the problem is constructed using the boundary value problem of combining analytical functions and jump functions method. The model of the thin inclusion with nonlinear resilient parameters is built. Solution of the problem is reduced to a system of singular integral equations with variable coefficients. The convergent iterative method for solving such a system is offered for various nonlinear strain models, including Ramberg-Osgood law. Numerical calculations are carried out for different values of non-linearity characteristic parameters for the inclusion material. Their parameters are analysed for the tensely-deformed matrix under loading a uniformly distributed shear stresses and for a balanced system of the concentrated forces.

Taras Nahirnyj, Kostiantyn Tchervinka
Mathematical Modeling of the Coupled Processes in Nanoporous Bodies

The methods of irreversible thermomechanics and functional analysis are used to formulate the mathematical model of thermoelastic solid body taking account of structural heterogeneity of the body material and geometric irregularity of its surface. The density and the chemical potential of skeleton among others are included into the state parameters space. The source of skeleton mass reconciles the actual and reference body states and may be associated with real surface forming method. The analysis of model problem solutions shows that the model is appropriate to describe coupled processes in porous and nanoporous bodies. It allows studying the size effects of strength, elastic moduli, etc. caused by near-surface non-homogeneity.

Piotr Wasilewski
Full-Scale Dynamometer Test of Composite Railway Brake Shoes – Study on the Effect of the reinforcing Fibre Type

When designing or developing friction materials, it is crucial to predict how the modification of the formulation will affect their properties. Fibres are introduced in the composition of the phenolic-based brake friction materials to improve their mechanical strength. Apart from reinforcing the composite, fibres can also affect its tribological and thermophysical properties. In this study two composite friction materials are compared. The difference between the materials was the type of reinforcing fibre used in the formulation – in one case it was glass fibre, in the other steel fibre. Thermal diffusivity of both materials was measured and thermal conductivity was calculated. Frictional characteristics determined by means of full-scale dynamometer tests are analysed and discussed. Substitution of glass fibre with steel fibre led to increase in the friction coefficient. Maximum average temperature below wheel surface, observed during the test of the material containing steel fibre, was lower as compared to the test results of the material with glass fibre in its formulation, despite higher heat flux in the course of brake applications. Thermal conductivity of the friction material was enhanced by including steel fibre in the formulation.

Tadeusz Kaczorek
Characteristic Equations of the Standard and Descriptor Linear Electrical Circuits of Integer and Fractional Orders

The problem of calculation of the characteristic equations of the standard and descriptor linear electrical circuits of integer and fractional orders is addressed. It is shown that the characteristic equations of standard and descriptor linear electrical circuits are independent of the method used in their analysis: the state space method, the mesh method and the node method. The considerations are illustrated by examples of standard and fractional linear electrical circuits.

Małgorzata Zdrodowska, Agnieszka Dardzińska, Monika Chorąży, Alina Kułakowska
Data Mining Techniques as a Tool in Neurological Disorders Diagnosis

Neurological disorders are diseases of the brain, spine and the nerves that connect them. There are more than 600 diseases of the nervous system, such as epilepsy, Parkinson's disease, brain tumors, and stroke as well as less familiar ones such as multiple sclerosis or frontotemporal dementia. The increasing capabilities of neurotechnologies are generating massive volumes of complex data at a rapid pace. Evaluating and diagnosing disorders of the nervous system is a complicated and complex task. Many of the same or similar symptoms happen in different combinations among the different disorders. This paper provides a survey of developed selected data mining methods in the area of neurological diseases diagnosis. This review will help experts to gain an understanding of how data mining techniques can assist them in neurological diseases diagnosis and patients treatment.

Andrzej Borawski
Simulation Study of the Process of Friction in the Working Elements of a Car Braking System at Different Degrees of Wear

Among the many elements of a modern vehicle, the braking system is definitely among the most important ones. Health, and, frequently, life, may rest upon the design and reliability of brakes. The most common friction pair used in passenger cars today is a disc which rotates with the road wheel and a cooperating pair of brake pads. The composite material of the pad results in changing tribological properties as the pad wears, which was demonstrated in experimental studies. The change is also facilitated by the harsh operating conditions of brakes (high and rapid temperature changes, water, etc.). This paper looks into how changing tribology reflects on the heating process of disc and pads during braking. And so a simulation study was conducted, as this method makes it possible to measure temperature in any given point and at any time, which is either impossible or extremely difficult in real life conditions. Finite element method analyses were performed for emergency braking events at various initial speeds of the vehicle reflecting the current road speed limits.

Agnieszka Dardzińska, Anna Kasperczuk
Decision-Making Process in Colon Disease and Crohn's Disease Treatment

The article presents the process of building a logistic regression model, which aims to support the decision-making process in medicine. Currently, there is no precise diagnosis for ulcerative colitis (UC) and Crohn's disease (CD). Specialist physicians must exclude many other diseases occurring in the colon. The first goal of this study is a retrospective analysis of medical data of patients hospitalized in the Department of Gastroenterology and Internal Diseases and finding the symptoms differentiating the two analyzed diseases. The second goal is to build a system that clearly points to UC or CD, which shortens the time of diagnosis and facilitates the treatment of patients. The work focuses on building a model that can be the basis for the construction of classifiers, which are one of the basic elements in the medical recommendation system. The developed logistic regression model will define the probability of the disease and will indicate the statistically significant changes that affect the onset of the disease. The value of probability will be one of the main reasons for the decision.

Leszek Baranowski, Michał Siwek
Use of 3D Simulation to Design Theoretical and Real Pipe Inspection Mobile Robot Model

The main aim of the paper is to present the process of design pipe inspection mobile robot by using 3D simulations. Next methods and processes of making designed components was described. Finally, functional tests of a constructed real robot model such as speed tests, inclined pipe test was carried out. The robot was specifically designed to inspect sewer pipelines. The mobile robot is equipped with a vision system. The structure of the pipe inspection robot allows adjustments to the geometrical parameters of the robot to suit the sewer pipes diameters by using in the construction of a pneumatic system with an actuator.

Heorgij Sulym, Viktor Opanasovich, Mykola Slobodian, Yevhen Yarema
Biaxial loading of a Plate Containing a Hole and Two Co-Axial Through Cracks

The paper presents the solution linear elasticity problem for an isotropic plate weakened by a hole and two co-axial cracks. The plate is exerted by uniform traction at infinity. The corresponding 2D problem is solved by the method of Kolosova-Muskhelishvili complex potentials. The method implies reduction of the problem to simultaneous singular integral equations (SIE) for the functions defined the region of the cracks and hole. For particular case the solution the SIE is obtained analytically in a closed form. A thorough analysis of the stress intensity factors (SIF) is carried out for various cases of the hole shape: penny-shaped, elliptical and rectangular.

Marian Sikora
Modeling and Operational Analysis of an Automotive Shock Absorber with a Tuned Mass Damper

Recently, the topic of energy dissipation efficiency of vehicle suspension dampers has become a research and engineering problem due to structural requirements of vehicle manufacturers and the introduction of electric/hybrid cars. By principle, any disturbances in the damping force generation process translate into pressure fluctuations to be then transferred to the body of the vehicle. The effect known as rattling within the damper engineering community is perceived as detrimental to ride comfort. To improve the performance of a vehicle damper several methods can be devised and used. One approach is to optimize the settings of the valves in the damper. The approach, however, often influences the force output of the damper. Another technique involves the application of add-on systems. One such system is the tuned mass damper concept originally developed by Frahm for structural engineering applications. In the paper the author proposes a damper concept equipped with an external/internal tuned mass damper component for improving the dynamic characteristics of vehicle dampers. The author presents modeling details followed by simulations of the damper with the tuned mass damper concept subjected to oscillatory inputs, and a critical analysis of the presented results.