ABSTRACTS

Adam Adamowicz, Piotr Grześ
Finite Element Analysis of thermal Stresses in a Pad-Disc Brake System (a Review)

Rapid temperature change in components of the sliding systems induces thermal stresses due to thermal expansion. This effect is particularly evident in disc brakes working under high thermal loads. This paper deals with the finite element modelling of frictional heating process in disc brakes and clutches to study the temperature and stress distributions during operation.

Paweł Baranowski, Jerzy Małachowski, Łukasz Mazurkiewicz, Krzysztof Damaziak
Dynamic Testing of Copper Material – Numerical Approach

Split Hopkinson pressure bar (SHPB) is one of the most important and recognisable apparatus used for characterizing the dynamic behaviour of various materials. Incident pulse generated one the incident bar usually have a rectangular shape, which is proper for some materials but for others is not. Therefore, several methods of shaping the incident pulse are used for obtaining constant strain rate conditions during tests. Very often pulse shapers made of copper or similar material are implemented due to its softness properties. In this paper such material was investigated using the FE model of SHPB. Its mechanical behaviour was characterised with and without copper disc between the striker and incident bar. Numerical simulations were carried out using explicit LS-DYNA code. Two different methods were used for modelling the copper sample: typical finite Lagrangian elements and meshless Smoothed Particle Hydrodynamics (SPH) method. As a result of two techniques used axial stress-strain characteristics were compared for three different striker's velocity with an influence of the copper pulse shaper taking into account. Finally, FE and SPH method was compared with taking into consideration: the efficiency, computer memory and power requirements, complexity of methods and time of simulation.

Józef Błachnio
Analysis of Technical Condition Assessment of Gas Turbine Blades with Non-Destructive Methods

Structural components of gas turbines, particularly the blades, sustain a variety of damages during the operation process. The most frequent cause of these damages are the overheating and thermal fatigue of the material. A primary technique to assess condition of the blades is the metallographic examination. In spite of the fact that metallographic analysis delivers much more information on the structure of examined blade material, it is a type of destructive test resulting in the destruction of the blade which makes further utilization of the item impossible. The paper has been intended to discuss non-destructive testing methods and to present capabilities of applying them to diagnose objectively changes in the microstructure of a turbine blade with computer software engaged to assist with the analyses. The following techniques are discussed: a visual method, based on the processing of images of the material surface in visible light, active thermography, based on the detection of infrared radiation, and the X-ray computed tomography. All these are new non-destructive methods of assessing technical condition of structural components of machines. They have been intensively developed at research centers worldwide, and in Poland. The computer-aided visual method of analyzing images enables diagnosis of the condition of turbine blades, without the necessity of dismantling of the turbine. On the other hand, the active thermography and the X-ray computed tomography, although more sensitive and more reliable, can both be used with the blades dismounted from the turbine. If applied in a complex way, the non-destructive methods presented in this paper, are expected to increase significantly probability of detecting changes in the blade's condition, which in turn would be advantageous to reliability and safety of gas turbine service.

Błachnio Józef, Zabrocka Iwona
Image of the Surface of Gas Turbine Blade as Diagnostic Signal

This paper outlines a non-destructive method that is suitable for evaluation of condition demonstrated by gas turbine blades and is based on digital processing of images acquired from the blade surface in visible light. To enable high clearness of these images the particular attention is paid to the problem of how to provide optimum conditions for investigations and mitigate geometrical distortions of images acquired from maintenance operations. The paper demonstrates that there are relationships between operation lifetime of blades and discoloration of their surfaces due to overheating of the blade material. These relationships are revealed by digital analysis of images acquired for the blade surfaces and expressed as statistical parameter of the first and second order. To improve unambiguity of the analysis results a low-pass filter was applied. It was demonstrated that these relationships are suitable for evaluation how much the status of the blade material microstructure is altered.

Tomáš Brestovič, Natália Jasminská
Software Support Development for Numerical Solution of ANSYS CFX

The paper deals with possibilities to apply a new developed software support for simulation programme ANSYS CFX. A direct export of heat-transfer coefficients into variables used under edge conditions as well as of physical properties of gas mixtures into material properties during simulation solution of technical tasks means a significant saving of time. The paper summarizes in detail description of the software for calculation of heat-transfer coefficient during free convection (HTC-FC) and of material properties of gas mixture (MPGM) that enable to export calculated data directly into the text files which can be imported then into the programme ANSYS CFX.

Ihor Dzioba, Robert Pała, Tadeusz Pała
Temperature Dependency of Fracture Toughness of High-Strength Ferritic Steel Hardox-400

The paper presents experimental results of the changes of strength and fracture toughness characteristics of high-strength ferritic steel Hardox-400 in the temperature range from -100 OC to +20 OC. It has been shown that the strength characteristics values increase linearly with lowering the temperature. Changes of fracture toughness characteristics from temperature are more complex and they are dependent on thickness of the tested specimens.

Ihor Dzioba, Tadeusz Pała, Ilkka Valkonen
Strength and Fracture Toughness of the Welded Joints Made of High-Strength Ferritic Steel

The paper presents experimental results of the characteristics of strength and fracture toughness of the material from the different zones of welded joints made of different participation of the linear welding energy. Strength characteristics and fracture toughness were determined in the weld material, in the area of fusion line, in the material of the heat affected zone and in the base material.

Andriy Kotsyuba
Contact Interaction of Rigid Stamp and Infinite Orthotropic Plate with Close to Elliptical Hole

Numerical method of finding the contact stresses under the stamp of complex shape for the case of orthotropic plates with close to an elliptical hole, which based on constructed in Bozhydarnik et al., (2007) algorithm, is developed. The distribution of contact stresses under the stamp, which shape matches the shape of the hole, is investigated.

Ewa Och
Frictional Heating During Sliding of Two Semi-Spaces with Simple Thermal Nonlinearities

In the article the nonstationary thermal problem of friction for two semi-spaces with taking into account their imperfect thermal contact and thermosensitivity of materials (simple nonlinearity), has been considered. The linearization of this problem has been carried out using Kirchhoff transformation, and next using the Laplace integral transform. The analytical solution to the problem in the case of constant speed sliding, has been obtained. On the basis of the obtained solutions and using Duhamel's formula, the analytical solution to the problem for sliding with constant deceleration, has been obtained, too. The results of numerical analysis are presented for two friction pairs.

Bogdan Sapiński, Marcin Węgrzynowski
Experimental Setup for Testing Rotary MR Dampers with Energy Harvesting Capability

The experimental setup has been developed for laboratory testing of electromechanical energy transducers and rotary magnetorheological (MR) dampers. The design objectives are outlined and the parameters of the key elements of the setup are summarised. The structure of the mechanical and measurement and control systems is presented. Results of functional testing of a newly developed transducer and a MR rotary damper are summarised.