ABSTRACTS

Władysław Egner, Piotr Sulich, Stanisław Mroziński, Halina Egner
Temperature Dependent Fatigue Characteristics of P91 Steel

In this paper, the experimental investigations, constitutive description and numerical modelling of low-cycle fatigue behaviour of P91 steel in non-isothermal conditions are presented. First, experimental tests are performed to recognise different aspects of material behaviour. Then, an appropriate constitutive model is developed within the framework of thermodynamics of irreversible processes with internal state variables. The model describes two phases of cyclic softening, related to plastic mechanisms. An important goal of the presented research is to include thermomechanical coupling in the constitutive modelling. Next, the model parameters are identified based on the available experimental data. Some parametric studies are presented. Finally, numerical simulations are performed, which indicate the significant influence of thermomechanical coupling on the response of the constitutive model in thermomechanical fatigue conditions.

Heorhiy Sulym,Olena Mikulich, Vasyl' Shvabyuk
Modelling of Impulse Load Influence on Stress State of Foam Materials with Positive and Negative Poisson's Ratio

The influence of impulse load applied for different duration on the distribution of normalised dynamic radial stresses in positive and negative Poisson's ratio medium was investigated in this study. For solving the non-stationary problem in the case of plane deformation for structurally inhomogeneous materials, the model of Cosserat continuum was applied. This model enables accounting for the influence of shear-rotation deformation of micro-particles of the medium. In the framework of Cosserat elasticity, on applying the Fourier transforms for time variable and developing the boundary integral equation method, solving of the non-stationary problem reduces to the system of singular integral equations, where the components that determine the influence of shear-rotation deformations are selected. The numerical calculations were performed for the foam medium with positive and negative Poisson's ratio for different values of time duration of impulse. Developed approach can be used to predict the mechanical behaviour of foam auxetic materials obtained at different values of a volumetric compression ratio under the action of time variable load based on analysis of the distribution of radial stresses in foam medium.

Krzysztof Wałęsa, Ireneusz Malujda, Dominik Wilczyński
Process Analysis of the Hot Plate Welding of Drive Belts

Most industrial machines use belt transmission for power transfer. These mechanisms often use the round belts of several millimetres in diameter that are made of thermoplastic elastomers, especially polyurethane. Their production process calls for bonding the material, which is often performed by hot plate butt welding. In order to achieve proper design of an automatic welding machine, the authors analysed the hot plate welding process of round belts. This process consists of five phases. It is necessary to recognize all the physical phenomena that occur during welding, especially those connected with thermomechanical properties of material. This knowledge is necessary to determine the temperature distribution during each step of the process. The paper presents a standard welding cycle together with an explanation of the physical phenomena in each phase. An analysis of these fundamentals will be used to derivate the function of temperature distribution during all process phases. In addition, some assumptions for calculation of temperature distribution and some fundamental physic correlations were presented.

Krzysztof Popławski, Leszek Ambroziak, Mirosław Kondratiuk
Electro Pneumatic Control System for Inverted Pendulum

The paper concerns the inverted pendulum control system with using pneumatic cylinder. A mathematical model of the pendulum used to derive the LQG controller was presented. Prepared laboratory stand was presented and described in detail. The main purpose of the work was experimental researches. A number of control process tests were conducted with variable model parameters such as additional mass, injected disturbances and so on. The results were shown on the time plots of the control object states.

Houssem Laidoudi
Natural Convection from Four Circular Cylinders in Across Arrangement within Horizontal Annular Space

Numerical investigation is accomplished to study the roles of governing parameters of natural convection on the fluid motion and heat transfer rate of four heated circular cylinders placed inside a circular enclosure of cold surface. The cylinders are positioned in across arrangement. The representative results are obtained within the ranges of initial conditions as: Prandtl number (Pr = 7.1 to 1000) and Rayleigh number (Ra = 103 to 105). The average Nusselt number of each inner cylinder is computed. The effects of thermal buoyancy strength on the fluid motion and temperature are also illustrated. It was found that the heat transfer rate of cylinders depends significantly on the position inside the enclosure. Moreover, the role of Prandtl number on flow and thermal patterns is negligible. The values of Nusselt number are also given, which can be useful for some engineering applications.