ABSTRACTS

Grzegorz Budzik, Tadeusz Markowski, Michał Batsch, Jadwiga Pisula, Jacek Pacana, Bogdan Kozik
Stress Assessment of Gear Teeth in Epicyclic Gear Train for Radial Sedimentation Tank

The paper presents the strength evaluation of planetary gear teeth designed for a radial sedimentation tank drive. A novel type of gear drive, composed of a closed epicyclic gear train and an open gear train with internal cycloidal gear mesh is proposed. Contact stress and root stress in the planetary gear train were determined by the finite element method and according to ISO 6336. The influence of the mesh load factor at planet gears on stress values was also established. A comparison of the results followed. It was observed that the mesh load factor on satellites depends mainly on the way the satellites and central wheels are mounted, the positioning accuracy in the carrier and the accuracy of teeth. Subsequently, a material was selected for the particular design of planetary gear and the assumed load. The analysis of the obtained results allowed assuming that in case of gears in class 7 and the rigid mounting of satellites and central wheels, gears should be made of steel for carburizing and hardening. In case of flexible satellites or flexible couplings in the central wheels and gears in class 4, gears can be made of nitriding steel.

Viswanathan Shrinaath, Ramalingam Vaira Vignesh, Ramasamy Padmanaban
Parametric Study on the Spring-Back Effect in AA5052 Alloy in the Course of Three-Point Roll Bending Process

Three-point roll bending is one of the most common forming processes employed to obtain the desired radius of curvature in the sheet metal operations. Upon the removal of the forming load, the sheet metal deforms to a lesser extent than that of the required dimension. This phenomenon is termed as spring-back and is considered the most challenging areas of research in three-point roll bending of sheet metals. This study aims to develop a numerical model using HyperWorks and Radioss solver to understand the influence of load, the distance between the forming rollers, and its thickness on the spring-back effect in the course of three-point roll bending of sheet metal (AA5052). The results of the numerical model are validated with the results of the experimental trials. Besides, a statistical model is developed to relate the amount of spring-back with the three-point roll bending process parameters.

Piotr Jankowski
Effect of Kerr Foundation and In-Plane Forces on Free Vibration of FGM Nanobeams with Diverse Distribution of Porosity

In the present paper, the effect of diverse distribution of functionally graded porous material and Kerr elastic foundation on natural vibrations of nanobeams subjected to in-plane forces is investigated based on the nonlocal strain gradient theory. The displacement field of the nanobeam satisfies assumptions of Reddy higher-order shear deformation beam theory. All the displacements gradients are assumed to be small, then the components of the Green-Lagrange strain tensor are linear and infinitesimal. The constitutive relations for functionally graded (FG) porous material are expressed by nonlocal and length scale parameters and power-law variation of material parameters in conjunction with cosine functions. It created possibility to investigate an effect of functionally graded materials with diverse distribution of porosity and volume of voids on mechanics of structures in nano scale. The Hamilton's variational principle is utilized to derive governing equations of motion of the FG porous nanobeam. Analytical solution to formulated boundary value problem is obtained in closed-form by using Navier solution technique. Validation of obtained results and parametric study are presented in tabular and graphical form. Influence of axial tensile/compressive forces and three different types of porosity distribution as well as stiffness of Kerr foundation on natural frequencies of functionally graded nanobeam is comprehensively studied.

Aashutosh S. Kale, Aleksandra Biszczanik, Krzysztof Wałęsa, Mateusz Kukla, Maciej Berdychowski, Dominik Wilczyński
Designing of the Machine for Cutting Transport Belts: Conceptual Works

Belt conveyors are commonly employed in manufacturing and excavation processes. One of the basic components of such equipment are flat transport belts which can be monolithic or composite. In both cases, the belts are most often made of plastic materials. The manufacturing process of flat transport belts usually involves two stages. During the first stage, belts of very high length of up to several hundred meters are manufactured with use of the correct technology for a given belt type. In order to be usable in the finished conveyor system, correct length of such belts is to be achieved. Considering the above, the subsequent stage of manufacturing requires cutting the belts down to the appropriate length and very often joining the ends to form a closed loop with specific circumference. In an attempt to answer the demand of the manufacturing industry, the authors took up design works on an automated device for crosswise cutting of monolithic and composite belts. This article presents three construction concepts of the authors' own design together with an analysis of construction and operating factors which affect their usability. The presented discussion leads to selecting one of the solutions for which a drive system concept designed by the authors is proposed. Additionally, an analysis of the influence of the cutting knife geometry on cutting force is provided.

Volodymyr Iasnii, Petro Yasniy, Yuri Lapusta, Oleg Yasniy, Oleksandr Dyvdyk
Functional Behavior of Pseudoelastic NiTi Alloy Under Variable Amplitude Loading

Cyclic loading of superelastic NiTi shape memory alloy (SMA) causes forward and reverse austenite–martensite transformations, and also increases the volume of stabilized martensite. This appears in the change of stress-strain curve form, the decrease of dissipation energy, and increase of residual strain, that is, named transformation ratcheting. In real structures, the SMA components in most cases are under the action of variable amplitude loading. Therefore, it is obvious that the loading history will influence the functional fatigue. In the present work, the effect of stress ratio on the functional properties of superelastic NiTi shape memory alloy under variable amplitude loading sequence with two blocks was investigated. The studies were carried out under the uniaxial tension of cylindrical specimens under load-full unload and load-part unload. The change of residual strain, strain range, dissipation, and cumulative dissipation energy density of NiTi alloy related to load sequences are discussed. Under both stress ratios, the residual strain in NiTi alloy is increased depending on the number of loading cycles on the high loading block that is similar to the tests at constant stress or strain amplitude. An unusual effect of NiTi alloy residual strain reduction with the number cycles is found at a lower block loading. There was revealed the effect of residual strain reduction of NiTi alloy on the number of loading cycles on the lower amplitude block. The amount of decrement of the residual strain during a low loading block is approximately equal to the reversible part of the residual strain due to the stabilized martensite. The decrease of the residual strain during the low loading block is approximately equal to the reversible part of residual strain due to the stabilized martensite. A good correlation of the effective Young's modulus for both load blocks with residual strain, which is a measure of the volume of irreversible martensite, is observed.

Ewa Pawłuszewicz, Andrzej Koszewnik, Piotr Burzyński
On Grünwlad-Letinkov Fractional Operator with Measureable Order on Continuous-Discrete Time Scale

Considering experimental implementation control laws on digital tools that measurement cards are discharged every time unit one can see that time of simulations is partially continuous and partially discrete. This observation provides the motivation for defining the Grünvald-Letnikov fractional operator with measurable order defined on continuous-discrete time scale. Some properties of this operator are discussed. The simulation analysis of the proposed approach to the Grünwald-Letnikov operator with the measurement functional order is presented.

Mostefa Salah, Farouk B. Boukhoulda, Mohamed Nouari, Kouider Bendine
Temperature Variation Effect on the Active Vibration Control of Smart Composite Beam

Due to their impressive capacity of sensing and actuating, piezoelectric materials have been widely merged in different industrial fields, especially aeronautic and aerospace area. However, in the aeronautic industry, the structures are operating under critical environmental loads such as high and very low temperature, which made the investigation of the effect of thermal forces on the piezoelectric structures indispensable to reach the high functionality and performance. The present paper focuses on the effect of thermal loads on the active vibration control (AVC) of structures like beams. For this purpose, a finite element model of composite beam with fully covered piezoelectric sensor and actuator based on the well-known high order shear deformation theory is proposed by taking into account the electrical potential field and a linear temperature field. Hamilton's principle is used to formulate the electro-thermo-mechanical governing equations. The negative velocity feedback controller is implemented to provide the necessary gain for the actuator. Different analyses are effectuated to present the effect of the temperature ranging from -70°C to 70°C on the active vibration control of the composite beam.