ABSTRACTS

Tomasz Czauderna, Michał Maniowski
Stiffness Analysis of 4-Link Coupler Mechanism used in Low Floor Trams

The paper presents elastokinematic analysis of spatial, 4-link coupler system used in low floor tram power-trains with classic drive bogies. This article is a continuation of previous work, where were analysed only the kinematic properties of such coupling. In this paper, the experimental characterization of linear and angular stiffness of metal and rubber bushing installed in the coupler rods. Estimated stiffness coefficients were then inserted into the coupler model with compliant bushings jointed with perfectly rigid platforms and rods. Stiffness matrix of the coupler was calculated and its selected coefficients were interpreted.

Eliza Romańczuk, Zbigniew Oksiuta
Comparison of Corrosion Resistance in Physiological Saline Solution of Two Austenitic Stainless Steels – 316LV and REX734

In this work two austenitic stainless steels, REX734 and 316LV were tested in terms of their microstructure and corrosion properties. The REX734 is a newer generation stainless steel, with modified chemical composition, in comparison to the 316LV grade. Potentiodynamic study of corrosion resistance was conducted in physiological saline solution (0.9% NaCl solution). In spite of the similarities of microstructure, grain size and phase structure in both materials, the corrosion tests revealed that the REX734, with lower nickel and higher nitrogen content, had better corrosion resistance than 316LV. Repassivation potential in the REX734 was almost six times higher than for the 316LV steel. Superior corrosion resistance of the REX734 steel was also confirmed by surface observations of both materials, since bigger and more densely distributed pits were detected in 316LV alloy.

Fernando Serrano, Josep M. Rossell
Hybrid Passivity Based and Fuzzy Type-2 Controller for Chaotic and Hyper-Chaotic Systems

In this paper a hybrid passivity based and fuzzy type-2 controller for chaotic and hyper-chaotic systems is presented. The proposed control strategy is an appropriate choice to be implemented for the stabilization of chaotic and hyper-chaotic systems due to the energy considerations of the passivity based controller and the flexibility and capability of the fuzzy type-2 controller to deal with uncertainties. As it is known, chaotic systems are those kinds of systems in which one of their Lyapunov exponents is real positive, and hyper-chaotic systems are those kinds of systems in which more than one Lyapunov exponents are real positive. In this article one chaotic Lorentz attractor and one four dimensions hyper-chaotic system are considered to be stabilized with the proposed control strategy. It is proved that both systems are stabilized by the passivity based and fuzzy type-2 controller, in which a control law is designed according to the energy considerations selecting an appropriate storage function to meet the passivity conditions. The fuzzy type-2 controller part is designed in order to behave as a state feedback controller, exploiting the flexibility and the capability to deal with uncertainties. This work begins with the stability analysis of the chaotic Lorentz attractor and a four dimensions hyper-chaotic system. The rest of the paper deals with the design of the proposed control strategy for both systems in order to design an appropriate controller that meets the design requirements. Finally, numerical simulations are done to corroborate the obtained theoretical results.

Radosław Cechowicz
Bias Drift Estimation for MEMS Gyroscope Used in Inertial Navigation

MEMS gyroscopes can provide useful information for dead-reckoning navigation systems if suitable error compensation algorithm is applied. If there is information from other sources available, usually the Kalman filter is used for this task. This work focuses on improving the performance of the sensor if no other information is available and the integration error should be kept low during periods of still (no movement) operation. A filtering algorithm is proposed to follow bias change during sensor operation to reduce integration error and extend time between successive sensor calibrations. The advantage of the proposed solution is its low computational complexity which allows implementing it directly in the micro-controller of controlling the MEMS gyroscope. An intelligent sensor can be build this way, suitable for use in control systems for mobile platforms. Presented results of a simple experiment show the improvement of the angle estimation. During the 12 hours experiment with a common MEMS sensor and no thermal compensation, the maximum orientation angle error was below 8 degrees.

Katarzyna Topczewska
Frictional Heating with Time-Dependent Specific Power of Friction

In this paper analytical solutions of the thermal problems of friction were received. The appropriate boundary-value problems of heat conduction were formulated and solved for a homogeneous semi–space (a brake disc) heated on its free surface by frictional heat fluxes with different and time-dependent intensities. Solutions were obtained in dimensionless form using Duhamel's theorem. Based on received solutions, evolution and spatial distribution of the dimensionless temperature were analyzed using numerical methods. The numerical results allowed to determine influence of the time distribution of friction power on the spatio-temporal temperature distribution in brake disc.

Jozef Bocko, Pavol Lengvarský
Application of Finite Element Method for Analysis of Nanostructures

The paper deals with application of the finite element method in modelling and simulation of nanostructures. The finite element model is based on beam elements with stiffness properties gained from the quantum mechanics and nonlinear spring elements with force-displacement relation are gained from Morse potential. Several basic mechanical properties of structures are computed by homogenization of nanostructure, e.g. Young's modulus, Poisson's ratio. The problems connecting with geometrical parameters of nanostructures are considered and their influences to resulting homogenized quantities are mentioned.

Marek Barski, Piotr Pająk
Determination of Dispersion Curves for Composite Materials with the Use of Stiffness Matrix Method

Elastic waves used in Structural Health Monitoring systems have strongly dispersive character. Therefore it is necessary to determine the appropriate dispersion curves in order to proper interpretation of a received dynamic response of an analyzed structure. The shape of dispersion curves as well as number of wave modes depends on mechanical properties of layers and frequency of an excited signal. In the current work, the relatively new approach is utilized, namely stiffness matrix method. In contrast to transfer matrix method or global matrix method, this algorithm is considered as numerically unconditionally stable and as effective as transfer matrix approach. However, it will be demonstrated that in the case of hybrid composites, where mechanical properties of particular layers differ significantly, obtaining results could be difficult. The theoretical relationships are presented for the composite plate of arbitrary stacking sequence and arbitrary direction of elastic waves propagation. As a numerical example, the dispersion curves are estimated for the lamina, which is made of carbon fibers and epoxy resin. It is assumed that elastic waves travel in the parallel, perpendicular and arbitrary direction to the fibers in lamina. Next, the dispersion curves are determined for the following laminate [0°, 90°, 0°, 90°, 0°, 90°, 0°, 90°] and hybrid [Al, 90°, 0°, 90°, 0°, 90°, 0°], where Al is the aluminum alloy PA38 and the rest of layers are made of carbon fibers and epoxy resin.

Jana Šugárová, Peter Šugár, Martin Frnčík
Friction Evaluation of Laser Textured Tool Steel Surfaces

Surface textures can be defined as a regularly arranged micro-depressions or grooves with defined shape and dimensions. These textures, if they are manufactured by laser ablation process, contribute to a significant improvement of the tribological, optical or various biological properties. The aim of this paper is to analyze the influence of the surface textures prepared by laser surface texturing (LST) at the friction coefficient value measured on the tool (90MnCrV8 steel) – workpiece (S235JRG1 steel) interface. Planar frontal surfaces of compression platens have been covered by parabolic dimple-like depressions with different dimensions. The morphological analysis of such manufactured depressions has been performed by laser scanning microscopy. Influence of such created textures on the tribological properties of the contact pair has been analyzed by the ring compression test method in the terms of hydrodynamic lubrication regime. The experimental research shown that by applying of surface textures with defined shape and dimensions and using an appropriate liquid lubricant at the same time, the coefficient of contact friction can be reduced nearly to the half of its original value.

Adam Idźkowski, Jerzy Gołębiowski, Wojciech Walendziuk
The Calibration Process and Metrological Analysis of a Transducer Used to Measure Two Physical Quantities

This article presents a way of calibration of an unconventional two-current circuit, named 2J+2R, which consists of two current sources and two referential resistors connected to the circuit mass. This bridge was used to measure the beam deflection and the temperature increase simultaneously with the use of a pair of metal strain gauges. This paper contains theoretical and corrected (after calibration) processing characteristics of the measurement circuit. Calibration coefficients of both inputs, responsible for measurement of the measured values in the places where the strain gauges are attached, were calculated. Moreover, the standard combined and expanded uncertainties of both calibration coefficients were calculated and an uncertainty budget was made.

Miroslav Džupon, Ľuboš Kaščák, Dušan Németh, Réne Kubík
Failure of Physical Vapour Deposition Coating Zirconium Nitride on the Punch of Clinching Tool

A tool with a punch of ø5 mm and a die with a specially formed circular cavity and an annular gap was used for mechanical joining of thin hot-dip galvanized steel sheets. The active parts of punch and die were covered by PVD coating of ZrN type with LARC technology. The punches and the dies were tested in a complex tool by joining thin hot-dip galvanized steel sheets with the pressing force of 7,000 N. Decohesion of coating with width of 100 – 200 μm was observed in the perimeter of cylindrical part of ø5x4 mm in the in edge of punch radius R = 0.5 mm with deposited ZrN coating after the creation of 150 mechanical joints. The decohesion of PVD coating occurred mainly in the surroundings of the radius R = 0.5 mm on the front plane of ø15 mm part.

Gastone Ferrarese
Bandwidth Assessment for MultiRotor UAVs

This paper is a technical note about the theoretical evaluation of the bandwidth of multirotor helicopters. Starting from a mathematical linear model of the dynamics of a multirotor aircraft, the transfer functions of the state variables that deeply affect the stability characteristics of the aircraft are obtained. From these transfer functions, the frequency response analysis of the system is effected. After this analysis, the bandwidth of the system is defined. This result is immediately utilized for the design of discrete PID controllers for hovering flight stabilization. Numeric simulations are shown to demonstrate that the knowledge of the bandwidth is a valid aid in the design of flight control systems of these machines.

Wojciech Tarnowski
Present-day Problems and Methods of Optimization in Mechatronics

It is justified that design is an inverse problem, and the optimization is a paradigm. Classes of design problems are proposed and typical obstacles are recognized. Peculiarities of the mechatronic designing are specified as a proof of a particle importance of optimization in the mechatronic design. Two main obstacles of optimization are discussed: a complexity of mathematical models and an uncertainty of the value system, in concrete case. Then a set of non-standard approaches and methods are presented and discussed, illustrated by examples: a fuzzy description, a constraint-based iterative optimization, AHP ranking method and a few MADM functions in Matlab.