ABSTRACTS

Paweł Bachman, Andrzej Milecki
Investigation of Electrohydraulic Drive Control System with the Haptic Joystick

The term haptic is used to indicate the presence of force feedback from the manipulated object to the operator. One of the most commonly used haptic devices are joysticks. Such joysticks can be successfully applied also in communication with drive system, giving the human operator a feel of the output force. In the paper one axis joystick with force feedback used to control the electrohydraulic drive is proposed. In this joystick, a controlled brake with magnetorheological fluid and a small DC motor are applied. A beam with a strain gauge is used in a joystick arm, enabling the measurement of the force. In the joystick axis also a potentiometer is assembled, which measured the current arm position. In order to develop the control algorithms an electrohydraulic drive simulation and virtual model is worked out and then a haptic joystick is connected to it. The simulation results that have been obtained, enabled to design and test impedance and admittance control strategies for the system composed of haptic joystick and a real electrohydraulic drive. Finally the whole system is built, implemented and investigated in a laboratory environment. Investigations are conducted in conditions similar to real ones, in a situation where hydraulic piston touches an obstacle and the operator cannot observe this piston very accurately. Fifteen operators have been tested this way. The outcomes indicate that haptic control can improve the human feeling of forces between electrohydraulic drive and an obstacle and, thanks to this, the manual control is more accurate and safer.

Krzysztof Kęcik
Energy Recovery from a Non-Linear Electromagnetic System

The paper presents study of a pseudo-magnetic levitation system (pseudo-maglev) dedicated for energy harvesting. The idea rely on motion of a pseudo-levitating magnet in a coil's terminal. The study based on real prototype harvester system, which in the pendulum dynamic vibration absorber is applied. For some parameters, the stability loss caused by the period doubling bifurcation is detected. The coexistence of two stable solutions, one of which is much better for energy harvesting is observed. The influence of the pseudo-maglev parameters on the recovered current and stability of the periodic solutions is presented in detail. The obtained results show, that the best energy recovery occurs for the high pseudo-maglev stiffness and close to the coil resistance. The amplitude's excitation, the load resistances and the coupling coefficient strongly influence on the system's response.

Matej Urbanský, Jaroslav Homišin, Peter Kaššay, Jozef Krajňák
Measurement of Air Springs Volume using Indirect Method in the Design of Selected Pneumatic Devices

At our department, we deal with continuous tuning of torsional oscillating mechanical systems (TOMS) during their operation in terms of torsional oscillation size. Therefore, a new mobile mechanical system was built for purposes of research and presentation of the TOMS continuous tuning using extremal control method, which main advantage is that we do not need to know a mathematical model of the mechanical system. The new mobile device is equipped with a special compressed air distribution system, which important components are air springs. The air springs are modified and used as air pressure tanks with various functions in the mobile device. Therefore, it is important to know the magnitude of the air springs inner volume. This paper deals with determination of air springs volume using indirect method, which is based on the air pressure measurement and also the comparison of obtained results with the results computed from air springs manufacturer data.

Pawel Bogusz, Roman Gieleta, Marcin Konarzewski, Michal Stankiewicz
Crushing Behaviour of the PVC Foam Loaded with Beaters of Various Shapes

Statistically, at least 50% of all injuries experienced by police officers in the line of duty are due to assaults with blunt objects. Therefore, vests used by the police should provide not only good ballistic resistance, but also good protection against such threats. Foamed materials are possible to be used for body protectors or inserts of protective clothes. The effects of dynamic impact with beaters of different shapes onto behaviour of polymeric foamed material were determined. There were used four types of beaters: flat, cylindrical, edgy and cornered. Strikes with blunt objects such as a flat board, baseball bat, edgy brick, pavement brick or a sharp stone, to which a protective ware can be subjected, were simulated. The impact load was applied to the rectangular specimens, made of polyvinyl chloride foam, with a usage of a drop hammer. Plots of force versus compression for all the tested samples were obtained and analysed. The effects of impacts with beaters of different shapes onto foamed material samples were presented. A shape of the blunt object significantly influences crushing behaviour of the foamed material. The impact energy of a flat beater is absorbed effectively on a short distance, since it is spread on a relatively large surface. The cylindrical and edgy beaters did not cause fragmentation of the samples, however, on the upper surfaces of the samples, permanent deformations mapping the beaters shapes as well as some cracks occurred. An impact with a sharp object, for example, a cornered beater is very difficult to be neutralized by the foam material, because it is cumulated on a small area.

Wojciech Sikora, Krzysztof Michalczyk, Tomasz Machniewicz
Numerical Modelling of Metal-Elastomer Spring Nonlinear Response for Low-Rate Deformations

Advanced knowledge of mechanical characteristics of metal-elastomer springs is useful in their design process and selection. It can also be used in simulating dynamics of machine where such elements are utilized. Therefore this paper presents a procedure for preparing and executing FEM modelling of a single metal-elastomer spring, also called Neidhart's spring, for low-rate deformations. Elastomer elements were made of SBR rubber of two hardness values: 50°Sh and 70°Sh. For the description of material behaviour the Bergström-Boyce model has been used.

Janusz Lewandowski, Dariusz Rozumek
Numerical Analysis of Stress Intensity Factor in Specimens with Different Fillet Geometry Subjected to Bending

The article presents the maps of xx stress component and compares values of analytical and numerical calculations for the stress intensity factor range of welded specimens with fillet welds which subjected to cyclic bending. The tests were performed under constant value of moment amplitude M_a = 9.20 N·m and stress ratio R = σ_{min}/ σ_{max} = -1. The specimens were made of drag steel rod S355. The specimens were solid and welded. The numerical models were simulated with ABAQUS suite and numerical calculations performed with FRANC3D software.

Tadeusz Kaczorek
Invariant, Decoupling and Blocking Zeros of Fractional Linear Systems

The notions of invariant, decoupling and blocking zeros are extended to the fractional linear systems. It is shown that: 1) The zeros are closely connected with the controllability and observability of the linear systems and their transfer functions matrices. 2) The state vector of the fractional system for any input and zero initial conditions is independent of the input decoupling zeros of the system. 3) The output of the fractional system for any input and zero initial conditions is independent of the input-output decoupling zeros of the system.

Agnieszka Wasilewska, Jolanta Pauk, Mikhail Ihnatouski
Image Processing Techniques for ROI Identification in Rheumatoid Arthritis Patients from Thermal Images

Rheumatoid arthritis (RA) is a systemic autoimmune disease that manifests itself by joint inflammation, swelling, pain, tenderness and may involve extra-articular organs in severe cases. Joint inflammatory lesions are associated with higher temperature due to increased vascularity in the area of inflamed tissues. This papers aimed to identify heat patterns from ROIs to interpret the presence of inflammation in rheumatoid arthritis patients. The thermovisual image sequences were collected from 65 patients with Rheumatoid Arthritis (RA). Infrared images were generated by a thermal scanning camera (FLIR E60bx Systems Inc., USA). Separate recordings of left and right foot temperature changes were performed for 3 minute periods. The temperature measurement was performed at the moment right after cold water immersion (post-cooling temperature) and at the moment after thermal recovery (post-recovery temperature). The recording of 3-minute foot thermal recovery was used for analysis. Automatically identified ROI corresponds to the area of the soft tissues covering cuboid and navicular bone.

Maria Kotełko, Mirosław Ferdynus, Jacek Jankowski
Energy Absorbing Effectiveness – Different Approaches

In the paper the study of different crashworthiness indicators used to evaluate energy absorbing effectiveness of thin-walled energy absorbers is presented. Several different indicators are used to assess an effectiveness of two types of absorbing structures, namely thin-walled prismatic column with flaws and thin-walled prismatic frustum (hollow or foam filled) in both cases subjected to axial compressive impact load. The indicators are calculated for different materials and different geometrical parameters. The problem of selection of the most appropriate and general indicators is discussed.

Dominik Wojtkowiak, Krzysztof Talaśka, Ireneusz Malujda
Concept of the Hexa-Quad Bimorph Walking Robot and the Design of its Prototype

Present-day walking robots can increasingly successfully execute locomotive as well as manipulative functions, which leads to their expansion into more and more applications. This article presents the design of a hexa-quad bimorph walking robot with the ability to move at a relatively high speed in difficult terrain. It also has manipulation capabilities both at a standstill and in motion. This feature of the robot is made possible by the ability to easily change the configuration from six-legged to four-legged by elevating the front segment of its body. Presented prototype will be used in further research to develop the hexa-quad bimorph walking robot.

Eugeniusz Mańka, Małgorzata Słomion, Maciej Matuszewski
Constructional Features of Ropes in Functional Units of Mining Shaft Hoist

In this paper structural analysis of steel ropes applied in mining shaft hoists was conducted. Functions of the ropes which they fulfilled in these shaft hoists were identified. Expected operational features of ropes were indicated too. An analysis was carried out four identified groups of ropes: hoisting ropes, balance ropes, leading rope and fender ropes. Basic constructional features: geometrical and material of ropes, which they should be characterized in each of mentioned functional groups were indicated. Constructional structures of mentioned steel ropes, the most often applied in domestic mining shaft hoists were described. Observed tendencies in analyzed issues also were shown.

Bohdan Pavlyk, Markijan Kushlyk, Dmytro Slobodzyan, Igor Matvijishyn, Roman Lys, Marek Jałbrzykowski
Radiation-Stimulated Changes in the Characteristics of Surface-Barrier Al–Si–Bi Structures with Different Concentrations of Dislocations at the Crystal Surface

We report the results of studies for the radiation-stimulated changes in electro-physical characteristics of surface-barrier Al–Si–Bi structures based on p-Si. We demonstrate that the X-ray irradiation is accompanied by different processes which depend on the density of the dislocations in the original silicon crystals. A usual evolution of the existing structural defects and their radiation-stimulated ordering dominate when the concentration remains low enough. Increase in the concentration causes the increasing role of generation of additional radiation defects. Modelling of the underlying physical processes has testified that the near-contact Si layers are strained. They act as getters for the structural defects and impurities.

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Adam Wolniakowski, Andrej Gams, Lilita Kiforenko, Aljaž Kramberger, Dimitrios Chrysostomou, Ole Madsen, Konstantsin Miatliuk, Henrik Gordon Petersen, Frederik Hagelskjær, Anders Glent Buch, Aleš Ude, Norbert Krüger

Compensating Pose Uncertainties through Appropriate Gripper Finger Cutouts

The gripper finger design is a recurring problem in many robotic grasping platforms used in industry. The task of switching the gripper configuration to accommodate for a new batch of objects typically requires engineering expertise, and is a lengthy and costly iterative trial-and-error process. One of the open challenges is the need for the gripper to compensate for uncertainties inherent to the workcell, e.g. due to errors in calibration, inaccurate pose estimation from the vision system, or object deformation. In this paper, we present an analysis of gripper uncertainty compensating capabilities in a sample industrial object grasping scenario for a finger that was designed using an automated simulation-based geometry optimization method (Wolniakowski et al., 2013, 2015). We test the developed gripper with a set of grasps subjected to structured perturbation in a simulation environment and in the real-world setting. We provide a comparison of the data obtained by using both of these approaches. We argue that the strong correspondence observed in results validates the use of dynamic simulation for the gripper finger design and optimization.