ABSTRACTS

Jan Górecki
Development of a Testing Station for Empirical Verification of the Algebraic Model of Dry Ice Piston Extrusion

Efficient use of resources is a very important consideration for every production process, especially where waste materials are being used as raw materials. One example of these kinds of processes is dry ice extrusion. Based on subject literature, it can be observed that the machines available on the market used to compress dry ice are characterized by high working force value. This leads to low efficiency of resource consumption, both in regards to electrical energy and carbon dioxide. This paper presents a proposed design of a test stand used for measuring compression force as a function of piston displacement in the course of the dry ice extrusion. The first part of the article presents the testing methodology and test stand design. The second part presents results of measurement of compression force as a function of piston displacement with three different die types. The results of the study allowed to establish the difference between values of measured limit force and values calculated with an analytical model. The test stand design as well as the results present in the paper are important for further research and development works in the area of efficient extrusion and compaction of dry ice.

Anupam Bhandari
Mathematical Modeling of Water-Based Fe_3O_4 Nanofluid Due to Rotating Disk and Comparison with Similarity Solution

The current research demonstrates the revolving flow of water-based Fe_3 O_4 nanofluid due to the uniform rotation of the disc. This flow of nanofluid is investigated using CFD Module in COMSOL Multiphysics. However, the similarity solution for this flow is also obtained after transforming the given equation into a non-dimensional form. In the CFD Module, streamlines and surface plots are compared with the similarity solution for the magnitude of the velocity, radial velocity, tangential velocity, and axial velocity. The results from the direct simulation in the CFD Module and the solution of dimensionless equations represent a similar solution of velocity distribution. The derived results show that increasing the volume concentration of nanoparticles and effective magnetic parameters decrease the velocity distribution in the flow. Results in the CFD Module are important for monitoring the real-time particle tracing in the flow and, on the other hand, the dimensionless solution is also significant for the physical interpretation of the problem. Both methods of solution empower each other and present the physical model without sacrificing the relevant physical phenomena.

Serhii Ternytskyi, Ivan Rehei, Nazar Kandiak, Ihor Radikhovskyi, Oksana Mlynko
Experimental Research of the Paperboard Cutting in Die-cutting Press with the Screw-nut Transmission in Drive Mechanism of Movable Pressure Plate

This paper reports experimental research of torques during paperboard cutting in the die cutting press with the screw–nut transmission in the drive mechanism of the movable pressure plate. The purpose of the study is to substantiate the practical implementation of the pressure plate drive mechanism with the use of screw–nut transmission for the production of cartons of paperboard blanks. The manufactured experimental bench for the research of paperboard blanks provides the possibility of getting dependencies of loads on different parameters of the die cutting process. The developed method of the experimental research envisages the use of the strain gauge method and the wireless module for data measurement and software for its processing that allow getting trustworthy results with minimum faults. As a result of experimental research studies, the impact of paperboard thickness and cutting velocity on torque values has been established. Results of experimental research allow getting trustworthy and systematised information about torque values depending on the thickness of the paperboard, the paperboard fibre direction and pressure plate displacement velocity. It is established that torque values on drive shaft during die cutting of paperboard blanks made of folding boxboard with thickness that lay in range of 0.3–0.7 mm. Experimental research studies show the impact of rotation speed of a drive shaft of the pressure plate drive mechanism on the torque value. The article shows the workability of the designed device with screw–nut transmission in the drive mechanism of a movable pressure plate.

Robert Skowronek, Józef Zawora, Krzysztof Kwiatkowski, Konstanty Skalski
Application of Statistical Analysis and Functional Assessment Tests in Patients after Trochanteric Fractures Treated Surgically in an Individual Rehabilitation Programme

Physiotherapeutic procedures after surgical treatment of trochanteric fractures of femurs are a very important element of a post-operative management because they have a significant influence on the final result of physiotherapy. This is due to the nature of the fracture and the frequency of its occurrence. The aim of the work is, in particular, to determine the relationship between functional assessment scales in patients after trochanteric fractures treated surgically using extended statistical analysis including regression equations. Statistical analysis included a group of patients, which participated in a specialized programme of a post-operative procedure, called the 'Individual' Group. The matrix of research results, calculations of basic statistical measures, such as position, variability, interdependence, asymmetry and concentration were presented for this group. Regression equations representing the relationships between the considered variables, in particular concerning the applied scales and post-operative tests, were presented. Their purpose, mathematical interpretation, results of calculations and statistical tests were discussed. Attention was paid to the high correlation between the Parker and Mobility tests. The extended statistical analysis makes it possible to create an own system for assessing the treatment results of patients after trochanteric fractures are treated surgically.

Dhotre Pavan Kumar, Chikkol V. Srinivasa
Modal Characterization of Sandwich Skew Plates

The current work focuses on the experimental and finite element free vibration studies of laminated composite sandwich skew plates. The comparison was made between the experimental values obtained by the Fast Fourier transform (FFT) analyzer and a finite element solution obtained from CQUAD8 finite element of The MacNeal-Schwendler Corporation (MSC) / NASA STRucture Analysis (NASTRAN) software. The influence of parameters such as aspect ratio (AR) (a/b), skew angle (α), edge condition, laminate stacking sequence, and fiber orientation angle (θ°) on the natural frequencies of sandwich skew plates was studied. The values obtained by both the finite element and experiment approaches are in good agreement. The natural frequencies increase with an increase in the skew angle for all given ARs.

Mohamed Arab, Abederezak Lachouri, Mohamed Kerikeb, Lamine Mehennaoui, Faouzi Bouchareb
Backlash Fault Suppression Using LQ-RST Controller in Wind Turbine System using Bond Graphs and MATLAB/Simulink

The presence of backlash in wind turbines is a source of limitations as it introduces nonlinearities that reduce their efficiency in speed/torque control which affect the performance of the power quality. Because of production tolerances during rotation, the teeth contact is lost for a small angle; until it is re-established, it produces a backlash phenomenon. The desire to eliminate this phenomenon is often hard to realise due to the nonlinear dynamic behaviour, which arises with the presence of backlash fault in a system. Therefore, the goal of this study is to develop an LQ optimal control structure in a form of an R-S-T controller in order to reduce the disturbing torque transmitted inside the dead zone of a gearbox in the wind turbine system. The actual system is also developed to be used as a demonstration model at lectures or presentations. The efficacy of the proposed control is illustrated via simulations.

Stanimir Karapetkov, Hristo Uzunov, Liliana Indrie, Zlatin Zlatev
Driving Comfort Assistance System Considering Two Sensors Data

In the present work, a system using data from two sensors located next to the driver and to the mass centre of the bus is pro-posed. Three degrees of discomfort have been used – comfortable, moderately uncomfortable and very uncomfortable. These levels are set out in the questionnaire. A survey was conducted. Respondents were selected between the ages of 14 and 65 and were divided into three age groups – adults, middle-aged and young. Accelerometer systems with MPU-6500 (TDK InvenSense Corp.) sensors are used. A correlation method (CORR) and sequentially improving estimation methods are used for feature selection, which significantly reduce the number of combinations of features obtained. Selected sensor data is entered into feature vectors. These vectors are reduced by principal component analysis. Predictive models have been created that take into account the age of passengers. The use of data from two sensors and separation of the passengers according their age, leads to an increase in the accuracy of predicting passengers discomfort level (DL) of up to 98%. These results can be used to evaluate and guide the vehicle driver in order to improve his driving style. In addition, the simplified interface does not distract the driver from the road conditions. The results obtained can lead to an improvement in the parameters of the transport process, which covers the interest of the carrier related to the efficient use of vehicles, and hence the reduction of fuel consumption and harmful emissions. However, it should be recommended that, when developing systems to ensure comfort of travel, adjustments should be made to suit the age group of passengers carried on public transport buses.

Volodymyr Morkun, Olha Kravchenko
Three-Dimensional Fuzzy Control of Ultrasonic Cleaning

Consideration of ultrasonic cleaning as a process with distributed parameters enables reduction of power consumption. This approach is based on establishment of control over the process depending on fixed values of ultrasonic responses in set points. The initial intensity of radiators is determined using a three-dimensional (3D) interval type-2 fuzzy logic controller essentially created for processes with distributed parameters, as well as complex expert evaluation of the input data. The interval membership functions for the input and output data consider the space heterogeneity of ultrasonic cleaning. A rule base is formed, which is 2D and not dependent upon the number of input and output parameters. A model illustrating ultrasonic cleaning with a 3D interval type-2 fuzzy logic controller is designed. Comparative analysis of the output parameters of the proposed model and the traditional method indicates an increase in the energy efficiency by 41.17% due to application of only those ultrasonic radiators that are located next to the contamination.

Radovan Gregor, Andrej Babinec, František Duchoň, Michal Dobiš
Hand Guiding a Virtual Robot Using a Force Sensor

The research behind this paper arose out of a need to use an open-source system that enables hand guiding of the robot effector using a force sensor. The paper deals with some existing solutions, including the solution based on the open-source framework Robot Operating System (ROS), in which the built-in motion planner MoveIt is used. The proposed concept of a hand-guiding system utilizes the output of the force–torque sensor mounted at the robot effector to obtain the desired motion, which is thereafter used for planning consequential motion trajectories. Some advantages and disadvantages of the built-in planner are discussed, and then the custom motion planning solution is proposed to overcome the identified drawbacks. Our planning algorithm uses polynomial interpolation and is suitable for continuous replanning of the consequential motion trajectories, which is necessary because the output from the sensor changes due to the hand action during robot motion. The resulting system is verified using a virtual robot in the ROS environment, which acts on the real Optoforce force–torque sensor HEX-70-CE-2000N. Furthermore, the workspace and the motion of the robot are restricted to a greater extent to achieve more realistic simulation.