NT01
Profiling of the flat-tool for manufacturing worms with circular eccentric profile by cold forming

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Abstract. The incremental pumps are encountered in pharmaceutical and cosmetics industries. One of the most representative categories of these pumps is formed by the progressing cavity pumps. The helical surfaces with circular profile, eccentrically positioned relative to worm axis, are frequently used in their rotors construction. In this specific case, the constructive dimensions of the worms allow their manufacturing by cold forming, with flat-tools similar to screwing dies. In this paper, an analytical algorithm for profiling such flat-tool is proposed. The algorithm starts from the analytical definition of the helical cylindrical surface with constant pitch of the generated worm, and it lays on the "Minimum distance method". The equations of the gearing surface between worm and flat-tool are found, and, based on this, the active surface of the tool is determined. A MatLab application developed for implementing the profiling algorithm is presented. The results obtained after running the application in the case of a particular generated surface are also included.

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NT02
Choosing the optimal order within reconfigurable manufacturing systems based on the Earning Power value

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Abstract: In this paper will be presented the method of choosing an optimal order within a Reconfigurable Manufacturing System (RMS). The reconfigurable manufacturing systems for which we perform the analysis of optimal management belong to make-to-order (MTO) production companies. These companies start the manufacturing process based on the needs of the customers. After the content of the customers orders has been known and accepted they will deliver personalized products, provided that the cost of the production is minimum. A Virtual Workshop will be created associated with each manufacturing order with well-specified requirements (DD - DeadDate, TTF - TimeToFinish, EP - Earning Power). The workshops and orders will be transposed into a Petri net based on the new created three-dimensional model RPD3D [2]. The 3D network will be used to simulate the products manufacturing included in the orders in the virtual workshops and then the optimal order that will actually be produced on RMS from several possible orders based on the evaluation of the indicator called specific profit rate "earning power "- EP will be choosen. In this paper, we aim also to calculate the EP value of the RMS, as the most important evaluation criterion, if a certain command or a combination of commands is accepted. A study case is presented.

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NT03
Numerical analysis of hydroforming process control using variable blankholder force

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Abstract. Hydroforming was developed to provide a cost effective means to produce relatively small quantities of drawn parts or parts with asymmetrical or irregular contours that are difficult to obtain by conventional stamping. This paper presents a study of hydroforming process with variable blankholder force in order to assure the parts quality. The main idea is to decompose the blankholder function of the elementary zone of the part contour corresponding to the linear and curvilinear zone. For each zone different blankholder force is applied in correlation with the hydrostatic pressure. A numerical analysis using finite element modelisation is performed considering different sets of blankholder forces and hydrostatic pressures, as process parameters. An optimum is determined in order to avoid parts defects (thickness reduction, wrinkles, fracture) for such types of parts.

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NT04

Influence of some process input factors on the main dimensions of the grooves generated during the ball vibroburnishing

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Abstract. The ball vibroburnishing is a processing method based on the plastic deformation of the workpiece surface layer, as a result of a vibration movement achieved by the ball pressed with a known force on the workpiece surface. The surface obtained by ball vibroburnishing includes grooves with different directions and partially overlapped. To know better the influence exerted by the ball vibroburnishing conditions on the main dimensional characteristics of the grooves, an experimental research was designed and materialized. As the process input factors, the diameter of the ball, the force, and the workpiece rotation speed were used. The depth and width of the groves generated by the moving balls on the workpiece surface layer were measured. By mathematical processing of the experimental results, empirical mathematical models were determined. These models highlight the intensity of the influence exerted by the ball vibroburnishing process input factors on the main dimensions of the grooves.

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NT05
Influence of marine corrosion on the roughness of MAG welded joint surfaces

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Abstract. The paper presents in the first part the behavior of EH 36 steel in mechanized MAG welding of butt-welded joints from the naval field. Further, corrosion of the marine environment is analyzed by the electrochemical method. The paper is completed with the corrosion influence on the roughness of the welded joints surfaces.

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NT06
Influence of marine corrosion on the roughness of the dry hyperbaric underwater MAG welding joints

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Abstract. The first part of the study covers the behavior of the EH 36 shipbuilding steel subjected to MAG dry hyperbaric underwater mechanized welding. Hereinafter, the authors analyze, by using the electrochemical method, the behavior of the welded joints to marine corrosion. At the end of the article, the corrosion influence on the roughness of the test bars' surfaces depending on the potentiodynamic polarization curves is approached. With the increase of pressure, these curves indicate an increase in corrosion resistance and the decrease of the roughness of the test bars' surfaces.

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NT07
A Python and Java software approach for 2.5 axes, self-adaptive stretch forming process and IoT solution

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Abstract. Stretch forming is a metal forming process that implies bending and stretching a sheet of metal over a die, with the sheet being plastically deformed into the desired shape. The purpose is to obtain large parts. One of the main aspects is that the metal sheet is locked into position by gripping jaws. A hydraulic ram is raised into the metal sheet, therefore increasing the tensile forces. This process is used to draw intro shape materials like aluminium, magnesium, titanium alloys, stainless steel, Inconel. These materials have in common the fact that they have poor formability or the elastic spring-back has unacceptable values. Taking this into consideration, the nature of the materials along with the fact that the metal sheet can crack, due to excessive strain, we propose a self-adaptive stretch forming process. Underlining this process is the stress-strain curve, that has three inputs: force, sample section area and strain. For each of these factors, our method uses a particular approach, as in a Python-based software and Android-based IoT solution, that uses stress and strain data. Furthermore, it controls, in real-time the hydraulic press to the point at which the material is stretch close to its ultimate yield strength.

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NT08
Basic mechanical analysis of biodegradable materials

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Abstract. The field of polymeric materials and manufacturing technologies is constantly evolving, offering the possibility to prototype 3D products in a responsible and ecological way, thus aiming to replace on a large scale the filaments of nonbiodegradable synthetic polymers (from fossil resources) with filaments of biodegradable materials, obtained from renewable resources. The paper supports the development mentioned above and follows to characterize biodegradable materials from the mechanical behaviour point of view, tensile, bending, and impact tests. Also, the study reflects the influence of the technological parameters on the tensile test obtained results and also aims to optimize the obtained results. The studied materials were Extrudr Green-TEC Anthracite and Extrudr BDP Pearl, which according to the obtained basic mechanical results can successfully replace conventional polymers such as Flexible, HIPS, PP and other ones.

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NT09
Research on the optimization of stress relief holes applied in blanks used for body-in-white stamping parts with complex asymmetrical shapes

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Abstract. Increasing the degree of deformation when stamping body-in-white parts with complex asymmetrical shapes can be achieved by optimizing the discharge holes in the flange of the blank. For this purpose, the numerical simulation of the deep-drawing process with finite element is used. Considering the circular shape of the unloading hole, the expanded shape of this hole is determined using the FEM, taking into account the safety limit given by the final shape of the stamped part. To check that the deformation that occurs at the edge of the expanded hole not cause cracks in the part the area with deformations whose values exceed the permissible limit is delimited. The arc that stretches this area along the contour of the expanded hole is divided into a convenient number of equal segments. The points at the end of each segment are then translated on the edge of unloading hole by measuring the distances between these points on the expanded blank hole. Using a mathematical modelling of the allocated points on the contour of the unloading orifice, the corrected shape of this orifice is determined, which is perforated in the flat blank.

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NT10
Experimental investigation and regression modelling to improve machinability in CNC turning of CALMAX® tool steel rods

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Abstract. This paper studies the effect of cutting conditions (spindle speed - rpm; feed rate - mm/rev and depth of cut - mm) on main cutting force and surface roughness during CNC turning of the commercial tool steel CALMAX® by Uddeholm (Sweden). Experiments have been designed using the Central composite design (CCD) approach. The experimental design involved twenty base runs with eight cube points, four center points in the cube, six axial points and two center points in axial direction. Statistical analysis to examine the effect of cutting conditions on the responses of main cutting force and surface roughness included ANOVA under the scope of generating a full quadratic model for predicting the responses. Finally, a feed-forward back-propagation neural network was applied to predict the responses of cutting force and surface roughness. It was found that regression models corresponding to the responses as well as the neural network developed can efficiently explain much of the variation in terms of main cutting force and surface roughness and thereby they may be implemented to practical applications either for predicting actual machinability parameter values or for setting up objective functions to be evaluated by intelligent algorithms for process optimization.

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NT11
Study on the influence of technological parameters on the friction stir butt welding process of pure copper plates

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Abstract. Friction stir welding - FSW is a relatively new welding process, which is increasingly used in industry, due to the advantages which it has in relation to conventional processes (by melting and adhesions). The advantages of the FSW welding process (as a solid phase welding process) are all the more obvious in the case of joining copper and its alloys, because they have a high melting temperature and high thermal diffusivity. The influence of the technological parameters of the process, the tool rotational speed and the welding feed, on the temperature and the axial force, as well as on the quality of the joint surface is presented. The study shows that the stabilization of the process takes place after a certain time from the beginning of the advance stage and highlighted the major influence of the tool rotational speed on the process temperature surface defects and the roughness of the joint surface.

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NT12
Methodology for improving production flows on an assembly line

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Abstract. Globalization of production and strong competition in the economic environment requires manufacturers from automotive industry to offer their customers a wide range of products, of the best quality and at lower prices. In order to achieve a competitive advantage, the automotive industry must to adapt their production systems to mass customisation, so that they can provide the variety demanded by the customers while limiting their costs and maintaining their profitability. In this context, research to increase the performance of assembly lines is increasingly numerous and use different techniques, as: layout design, mathematic modeling, dynamic simulation, Lean manufacturing etc. This paper presents a methodology for improving production flows on an assembly line, which was developed to provide the designer and manager of assembly lines in the automotive industry with a set of logically related steps and steps that would allow to achieve a high-performance assembly line. The stages and steps of this methodology consist in the use of methods from different fields, such as: layout design, modelling-simulation of production flows, labour study, lean manufacturing, and for their application different techniques and tools are used.

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NT13
Structural Identification of the Bearing Manufacturing Process – Case-Study

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Abstract. In the manufacturing industry, globalization, shorter life cycles of products and changing customer needs, leads to high competitive pressure on companies. In addition to product quality and variety, flexibility, shorter processing times, and high-level compliance with delivery times have become essential factors for market success through efficient, efficacious and continually manufacturing processes optimization. To be successful in a highly competitive global production environment, a company must be able to deliver products that customers request at the requested time. In this paper is developed a novel method of structural identification of the bearing manufacturing process. This method allows the structuring of its activities, at all levels involved (order acceptance, production planning, product design, processes planning, and product processing), by elaborating the tree of the specific activities. The relations between the manufacturing process stages and related information circuit are revealed and the identification of the manufacturing process variants, at the level of each manufacturing activity is performed. Following the selection of the best alternatives from each level of the manufacturing activity, the optimal technological path is obtained for taking over an order for the bearing manufacture.

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NT14
Tool`s profiling for rotational volumetric deformation - analytical study

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Abstract. The paper develops in an analytical form an algorithm for the profiling of the active elements of the upper half-die forming which generates by means of plastic rotary volumetric deformation of the frontal teeth. The half die has the revolving axis inclined with respect to the axis of the deformed blank, which rotates around its own axis of symmetry. In the generation process, the generating half die also performs a movement of the blank. The constitutive surfaces of the tooth flanks to be generated are complex surfaces, formed of circular arcs with variable radius and disposed on a conical base surface, on the same axis with the half-die axis. Such teeth are used for front blades in the textile industry or drilling machines which performs, besides the rotational movement of the tool and an alternate rectilinear motion thereof, creating a percussion effect on the work piece. The surfaces of the upper half and the half die teeth may be regarded as reciprocal wrapping surfaces, so that the entire generation process is based on the analytical principles of surface winding. Starting from the constructive shape of the frontal tooth plate, in a classical scheme of the structure of the oscillating motion mechanism of the upper half matrix, the shape of the deformation teeth is determined based on a specific algorithm, based on the general theory of surface winding, and dedicated software products for it.

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NT15
Modern circle-segment end mills analysed by new developed software for processing and analysing of the cutting forces records

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Abstract. At present, 5-axis machining is often realized with ball end mills that do not achieve the advantages of the modern circle-segment end mills. In recent studies, these tools have been compared concerning the quality of the machined surfaces, machining times and cutting forces. An essential part of the research was an analysis of the force loading of the used tools. To get accurate data about force acting during the machining process, it was necessary to undergo experimental measuring using a cutting force dynamometer. For a force records analysis, the new software was developed based on the MATLAB platform. Evaluated results obtained by the new software are presented in the paper and compared with recent studies.

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NT16
Analysis of the influence of the hydrostatic ball burnishing pressure in the surface hardness and roughness of medium carbon steels

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Abstract. Standing sectors in the industry such as railroad or plastic injection moulds presents many challenges for manufacturing complex components in terms of finishing requirements and mechanical properties. Because of that, hydrostatic ball burnishing is considered an optimal solution since it reduces surface roughness and generate hardened surfaces and compressive residual stresses, increasing the performance and lifespan of this parts in terms of resistance and mechanical fatigue. Additionally, this technology could be integrated directly into the machining centres, what reduces times and dimensional errors arising from mooring changes. Therefore, lead times and production costs can be drastically reduced in comparison with other finishing techniques. The aim of this project is to analyse the use of the ball burnishing process to improve the final quality of medium carbon steel surfaces, minimizing surface roughness and improving hardness. In order to achieve significant results, different working pressures are analysed in terms of surface roughness and hardness in AISI 1045 and AISI P20 steels. The results showed a reduction in roughness parameters of more than 89% for both materials using a pressure of 10 MPa. Moreover, at a pressure of 30 MPa, the surface hardness has been increased by 15% and 34% respectively.

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NT17
Influence of aluminium alloys relative positioning on dissimilar friction stir lap welds properties

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Abstract. Very thin sheets of heat treatable (AA6082-T6) and non-heat treatable (AA5754-H22) aluminium alloys were used to produce dissimilar joints by friction stir lap welding. Joint strength and mechanical heterogeneity were assessed by performing lap tensile-shear and microhardness testing, respectively. Optical microscopy was used to analyse the weld morphology. Welding machine outputs, such as torque and axial force, were analysed in order to capture differences in the alloys strength during dissimilar welding. From the process outputs analysis, it was concluded that higher Z-Forces were necessary while positioning the AA5754 alloy at the top of lap configuration, indicating that this alloy offered higher resistance to the tool stirring than the AA6082 alloy. These results were associated with the flow softening of the AA6082 alloy during welding, which was explained using finite element analysis to illustrate the welding thermal cycles and the precipitation behaviour of this alloy. The lap welds defect formation was also related to the base materials plastic properties at high temperatures, which was inferred from process outputs data analysis. Based on the results it was shown that the lap welds defects might be supressed by a proper positioning the dissimilar base materials in the lap joint.

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NT18
Feasibility analysis of Ceramic cutting tools for manufacturing Austempered Ductile Iron (ADI)

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Abstract. The Austempered Ductile Iron (ADI) is a ferrous cast material that presents high design flexibility, elevated resistance against weight, good tenacity, fatigue, and wear resistance, and additionally, cost-effective solution. Besides, the use of these material is found in many industrial sectors as the automotive or critical safety. However, this material presents many challenges to be manufactured in terms of low machinability compared with cast materials. The most common technique used is reducing manufacturing steps before performing the heat treatment, what it is not possible with tough dimensional requirements and complex geometries. Ceramic cutting tools are presented as a possible solution to obtain a more productive process manufacturing ADI materials. Their main characteristic consists of being hard and resistant at high temperatures but with low tenacity. Therefore, their performance is optimal applied to continuous processes as turning. This work presents a feasibility analysis of turning ADI material using ceramic inserts and a comparison with the commonly used of carbide inserts. For this purpose, an experimental campaign is performed to obtain optimal cutting parameters. Finally, cutting forces are analysed. Finally, these cutting tools perform a dry manufacturing process, aligned with an eco-friendly solution.

NT19
Regression Functions For Determining the Expression of Surface Roughness at Plane Grinding of Ceramic

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Abstract. The aim of the work is to determine, through mathematical modelling using regression functions, the dependency expression between the surface roughness Ra at grinding with diamond wheels of aluminum oxide ceramic (Al2O3) for plain grinding with longitudinal advance, and the values of the grinding processing.

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NT20
Influence of vertical step on forces and dimensional accuracy of SPIF parts – a numerical investigation

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Abstract. Single point incremental forming (SPIF) is a new flexible sheet metal forming process characterized by low costs and the possibility to produce prototype parts without the need for a specific die. This is one of the reasons why this process is nowadays used for manufacturing of highly customized small series parts. The process involves the usage of a hemispherical punch which gradually deforms the sheet metal blank fixed by two simple clamping rings, by following a path until the final shape of the product is obtained. The aim of this paper is to investigate and analyse the influence of the vertical step over forces involved in the process and obtained geometrical accuracy, which is one of the main drawbacks for large scale implementation of the process. A numerical analysis was carried out through finite element method with different step size for frustrum pyramid shaped parts made from the same material. In this way, the most appropriate vertical step can be chosen for further experimental research in order to obtain the most accurate parts and with as little stress as possible on the equipment involved in the process.

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NT21
Creating an ethernet communication between a Simatic S7-1200 PLC and Arduino Mega for an omnidirectional mobile platform and industrial equipment

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Abstract. The degree of automation in the industry increases more and more every year, trying to make equipment that collaborates less and less or not at all with the human operator. The basis of all automatic industrial equipment is PLCs. This paper presents a method of extending the number of inputs and outputs of a Siemens Simatic S7-1200 PLC, using an Arduino Mega development board, using an ethernet communication. Following the realization of this communication, the number of inputs and outputs will increase considerably, being able to connect various sensors used for the construction of an omnidirectional mobile platform, but also for equipment for industry. The advantages of using this communication are multiple both financially and in terms of flexibility and integration of robotic systems in industrial equipment.

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NT22
Tool-holder working unit used for robot-based incremental sheet forming

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Abstract. The diversity of industrial robot applications is constantly growing, and their use in manufacturing processes is increasing year by year. One of the most flexible sheet metal forming process, used mainly for rapid prototyping or small series production, is represented by the single point incremental forming (SPIF). Usually, incremental sheet forming processes are performed by means of CNC milling machines or industrial robots, both having advantages and disadvantages. Due to the superior number of axes, especially when compared with 3-axis CNC milling machines, one of the most obvious advantage of the industrial robots rely upon their superior kinematic. The approach of this paper tackles the problem of designing a tool-holder working unit for SPIF process performed through a KUKA KR 210-2 industrial robot. After designing of the working unit, and simulating the tool path, the generated program code was used afterwards to successfully control the robot to obtain a truncated cone-shape part.

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NT23
Using open source software CNC controllers and modular multi-axis mechanical structure as integrated teaching environment for CAD/CAM/CAE training

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Abstract. Open source CNC controllers, such as Linux CNC are used more and more because they are open source projects and consequently are available for free. Moreover, these controllers are highly customizable, and their capabilities are close to the commercial solutions. The paper presents how using Linux CNC controller and a modular structure of a multi-axis CNC machine-tools, built by a commercial company, an integrated environment for training students in implementing CAM techniques was developed. Aside the CNC controller and the machine-tool, a CAM software package was used for programming complex machining operations. The kinematic model of the machine was built, for the user to be able to simulate, in a realistic way the multi-axes machining operations. The integrated teaching environment enable the users to be trained in CNC programming for three to five axes machining operations. Advanced programming strategies, such as tool center point management (TCPM) can also be tested.

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NT24
Conceptual solutions for digital hydraulic pumps

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Abstract. One of the methods by which specialists in the field of hydraulic drives try to increase the efficiency of the systems is the use of digital hydraulics. Digital hydraulics is a system with one or more digital components that actively controls the output of the system. One of the basic elements of such a system is the digital hydraulic pump. The first proposed and recognized variant was the one with digital pumping element; from this solution, it was possible to produce digital hydraulic pumps on an industrial scale. In this article we present some solutions regarding the creation of digital hydraulic pumps starting from several fixed flow hydraulic pumps that can ensure the variation of the flow through a special selection of them. The displacement of each pump is different and chosen taking into account the binary criterion. The article gives an overview of several such systems developed within the institute.

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NT25
Simulation of Ball Bearings Static Structural Analysis

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Abstract. FEM analysis is a very efficient method for achieving results of stresses at different loading conditions according to forces and boundary conditions applied to the component from the static analysis. The purpose of the study was to collect data's using two different software and after to compare them with mathematical results. This work aims at analysing the behaviour of the ball bearings under a static load, with Solidworks, ANSYS and MESYS software. The comparison was done between the analytical results using the Hertzian theory, ANSYS and MESYS, for two different cases of loading.

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NT26
PLM as a sequential round of the technological revolution

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Abstract. The fourth industrial revolution is actively developing in the world. Since 2011 it has become widespread. Affecting all areas of life activity, economy, which manifests itself in the qualitative reorganization of its mechanisms, creates new adapted management models, changes the nature of production processes. The digital revolution opens up new opportunities for using digital networks, agile production systems, and new business models for all stages of production. The faster the company makes this transition, the better its chances of succeeding and outperforming its competitors. Product lifecycle management (PLM) refers to the management of data and processes used in the design, engineering, manufacturing, sales, and service of a product across its entire lifecycle. The introduction of digital technologies occurs at all stages of the product lifecycle: product development, technology development, preparation and launch of production, product production, its operation and maintenance. PLM affects the ideology of creating a new product: to reduce the time to market and save resources, the system pushes to shift the labor intensity from the "production" stage to the "design" stage. The purpose of this study is to analyze product lifecycle management in agile management and to relate it to the current state of the Russian industrial development. Theoretical and practical aspects of this concept are given. The example of PLM implementation in the Russian industrial sector is presented. The Kalashnikov concern has built a product lifecycle management system. Today, the development of production of an industrial enterprise is impossible without a clear understanding of all stages of life cycle management of the product that it produces. Summarizing, PLM is offered as a promising concept for Russian economy.

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NT27
Condition Monitoring of Rolling Element Bearings: Benchmarking of Data-Driven Methods

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Abstract. Condition-based maintenance (CBM) is a maintenance strategy used to gain updated information about equipment condition and are today considered a natural part of the engineering filed. The replacement of the traditional scheduled maintenance strategy in favour of CBM has the potential to significantly improve the safety of the system operating in harsh environments of the operation and increase in productivity by prolonging the life of an asset and prevent costly breakdowns. For many years CBM remained the subject of vigorous research and discussions. Increasing the level of automation and the number of sensors in industries allowed obtaining and collecting data in large amounts. The current level of computational power allows us to process and analyse this large amount of data, which has given a new leap in the development of industrial analytics. Rather than in the case of classical physics-based modelling tools, data-driven methods propose modelling and forecasting frameworks based on data analysis. Consequently, the transition to the data-driven modelling gave a leap in CBM research and has recently drawn increasing attention, providing new case studies, algorithms and results. However, technical challenges remain. Despite great flexibility and good forecasting performances there are several limitations of data-driven algorithms. This paper provides an extensive overview of the most widely used data-driven failure algorithms for rolling element bearing monitoring. Bearings have played a pivotal role for industrial machinery to operate with high efficiency and safety and they are considered to be one of the most common machine elements of precision rotating machinery e.g. actuators robot grasping, jet engines, gas and wind turbines and machine tool spindle units. An extensive benchmarking of various predictive and descriptive algorithms was performed. The analysis was carried out on a dataset from the run-to-failure experiments on bearings from NASA´s Data Repository. This paper also summarizes the current trends and highlights the limitations with respect to traditional physics-based modelling. Special attention is paid in identifying research gaps and promising research directions.

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NT28
Algorithm for screws profiling of a trilobed compressor

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Abstract. Screw compressors are characterized by high compression ratio of working fluids. Their role is to reduce the volume of working gas by increasing its pressure. The active elements of this type of compressor consist of two helical rotors, with lobes, mounted in the compressor housing. The front profile of each rotor is composed of complex curves, including, in turn, elementary curves such as arcs, linear segments, cycloidal curves and sometimes non analytic curves. The design of the front profile of the rotors is aimed at reducing the friction between the rotors and improving the sealing between their profiles during rolling. This paper presents a study of the possibility of making a conical helical rotor, multilobed, which is part of the construction of a compressor type Z, Z + 1. This type of compressor is characterized in that the number of lobes of the driven rotor is one unit higher than the number of lobes of the driving rotor. The paper proposes a profiling algorithm based on "virtual focal points theorem" as an approach to the study of the winding between the conical helical surfaces of the two rotors. The algorithm is based on the observation that the two helical surfaces form, in cross section on the axis of the driving rotor, profiles in plane gear. This allows the determining of the specific enwrapping condition and therefore the determination of one of the two profiles under the conditions in which the other profile is known. The known profile can be expressed analytically or in discrete form, obtained by measurement.

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NT29
Tribological Performance of Graphene and Graphene Oxide Films as Solid Lubricant Layers on Tool Steel Surfaces

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Abstract. Some high productive processes induce a use of effective cooling and lubricating of forming and cutting tools today. Apart of various fluids, foams, oils and emulsions with EP (extreme pressures) additives some very effective means based on graphene or graphene oxide show excellent performance in solid phase. In this study, a very effective way to enhance the tribological performance of graphene layers on tool steel surfaces is studied. The solid lubricants based on graphene and graphene oxide flakes showed a very good thermal stability, low coefficient of friction; high wear resistance, and controllable thickness, if required. However, some technological conditions and topographies of surfaces for their successful applications should be made in advance as prerequisites. The research work deals with optimization of the parameters for a high productive forming of metals.

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NT29
Data-driven Decision Model Based on Machine Learning Algorithms for Welding Areas Environmental Parameters Prediction

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Abstract: The industrial manufacturing processes are producing risk factors and potentially dangerous agents that harms directly the working operators, particularly for the case of welding engineering areas. The European Union introduced two directives, the European Council Directive 89/391/EEC and the European Parliament Directive 2012/18/, reinforced by the wider ISO 45001:2018 standard for occupational health and safety. These directives and standards provide measures to encourage improvements in the safety and health of workers and the control of major-accident hazards involving dangerous substances. However, there are many independent research projects that develops new systems for the monitoring of the industrial environmental parameters, that aim to find solutions for reducing the health risks resulting from the manufacturing processes, specifically for welding areas. In this paper, a system based on Industrial Internet of Things (IIoT) fixed and mobile sensors networks is presented, that is used for acquiring environmental data from the welding areas. The proposed solution represents a dynamic and viable way of communication, both for monitoring of the operating conditions and for the safety of workers found in hazardous environments. The interoperability of IIoT sensors and the complex real-time event monitoring, for the recognition and generation of digital industrial services, should be a prerequisite in the real-time processing and prediction of the acquired data. For achieving this goal, a data-driven decision model based on ML algorithms is proposed, that will provide prediction for the industrial environmental parameters, allowing the identification of risky situations, setting-up alarms of the personnel in case of imminent threats, and leading to a proper occupational health and safety management in welding field.

NT30
Selection of product and optimal capacity utilization in manufacturing. Application of methods to cover the costs as an important factor in increasing the competitiveness of firms

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Abstract. The target parameters in a manufacturing company are turnover, reduce costs and profits from the activity. Depending on the evolution of costs it can contribute to better financial results or lead to a loss so the costs cover in manufacturing is an important factor for increasing the competitiveness of firms The article presents the Technological preparation of production (TPP) method and the simplex algorithm for obtaining the optimal results. Based on this method four examples for selecting the product and optimum capacity utilization in the production with various production costs are presented. In view of the expected profit, the most profitable deployment of the third example, second and fourth have the same potential, and the first of no interest to production based on available capacity in the company.

NT31
Cyber manufacturing metrology

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Abstract. The Cyber Physical Manufacturing Metrology (CP2M) is based on integration of the Cyber Physical Manufacturing (CPM) and connection between Internet of Things (IoT) and Cloud technology (CT). These are high-level methodologies for development of new generation manufacturing metrology systems, which are more intelligent, flexible and self-adaptable. CP2M generates Big Data, horizontally by integration (network of machines/CMMs, processes and sensors) and vertically by control (usually defined over five levels) which should be analytically processed and managed by the CP2M. In this paper was given, a detailed analysis of the current framework of development the CP2M. A brief overview of the concept CP2M research, particularly in Serbia is given as well.

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NT32
Computational framework concerning the formulation of maximum work principle used in plasticity, materials forming and tribology as a consequence of a variational optimization problem defined from the constructal law

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Abstract. This scientific research proposes a fundamental application of the Constructal Theory developed by Prof. Adrian BEJAN of Duke University (USA) to prove on a mathematical point of view the "Principle" of Maximum Work, used by the theory of plasticity, material forming and tribology, as a consequence of the global solution defining a constrained variational optimization problem. According to the first and second law of thermodynamics, the principal law of Constructal Theory try to complete them with a quantitative prediction of the natural tendency of any finite size system to evolve towards an optimal space-time configuration minimizing the losses and the entropy generation simultaneously with a required maximum of the global entropy. In this sense, regarding a material plastic deformation characterising the forming processes, among all possible and admissible flow undergoing well-specified boundary conditions and loadings, the real one is the one who minimizes the sum of the dissipated power of volume deformation and surfaces friction. Thus, all the mechanical variables defining the real mechanical state (velocities, stresses, strain, strain rate) are those ones which minimize the total dissipated power. A variational minimization problem under a lot of defined constraints is then obtained. Using the Principle of Virtual Powers it can be shown finally that the "Principle" of Maximum Work, used particularly in metals plasticity, is obtained as a consequence of a minimization problem under constraints based on the Constructal Theory. This generalizes its application to any type of continuous media (metals, polymers, fluid, mushy state) and allows proving an equivalent form for the friction stresses occurring on contact interfaces. The convexity properties of both the plastic and the friction potential together with their normal rule properties can be also proven using the proposed mathematical framework. It is concluded that only the rheological and tribological flow laws associated with a potential become to satisfy the second thermodynamics principle completed with the constructal law. Analytical computations concerning plane and cylindrical crushing show the feasibility of the proposed minimization problem formulation to define material flow giving accurate approximate solutions. In order to valid the whole presented theory, comparisons are made using classical analyses based on the upper and lower bound theorems (obtained as consequences of the proposed optimization variational problem), the well-known slices method and a finite element modelling (FEM). A second application concerning the anisotropic formulation of a Coulomb friction law from a quadratic convex tribologic potential will be presented to define contact evolution during rectilinear sliding of a circular pion on a plane laminated thick plate surface along different orientations..

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