

**Innovation Center of
Faculty of Mechanical
Engineering**



**Faculty of Mechanical
Engineering, University
of Belgrade**



**Center for Business
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**„International Conference of Experimental and
Numerical Investigations and New Technologies“**

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**MINISTRY OF EDUCATION, SCIENCE AND TECHNICAL DEVELOPMENT
OF THE REPUBLIC OF SERBIA**

Programme and The Book of Abstracts

29 June – 02 July 2020

Zlatibor, Serbia

**„International Conference of Experimental and Numerical
Investigations and New Technologies“**

CNN TECH 2020

29 June – 02 July 2020

Hotel Mona, Miladina Pecinara 26, Zlatibor, Serbia

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Programme and The Book of Abstracts

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Faculty of Mechanical Engineering, University of Belgrade
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CNN TECH 2020

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We particularly wish to thank our sponsor, **The Ministry of Education, Science and Technological development**, Government of the Republic of Serbia.

PREFACE

Dear Friends and Colleagues, Welcome to CNN Tech 2020 Conference and the fabulous mountain of Zlatibor!

With 70 papers (14 by international authors) and contributions by authors from 13 different countries, International Conference of Experimental and Numerical Investigations and New Technologies CNN Tech 2020 successfully sets the high level for the future conferences. Participation of a large number of domestic and international authors, as well as the diversity of topics, justifies our efforts to organize this conference and contribute to exchange of knowledge, research results and experience of industry experts, research institutions and faculties which all share a common interest in the field in experimental and numerical investigations.

This year CNN Tech 2020 focuses on the following topics:

- Mechanical Engineering,
- Materials Science,
- Chemical and Process Engineering,
- Experimental Techniques,
- Numerical Methods,
- New Technologies
- Clear sky
- Dental Materials and Structuresand
- Sustainable Design and New Technologies.

Apart from a plenty of interesting lectures, the participants will have a chance to lighten up and communicate in friendly and relaxed settings.

Organizing committee of CNN Tech 2020 would like to express gratitude to Ministry of Education, Science and Technological development for financial support of the Conference.

On behalf of the Innovation center of Faculty of Mechanical Engineering, Faculty of Mechanical Engineering and Center for Business Trainings, we wish this to be splendid CNN Tech conference filled with many memorable moments.

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PROGRAMME

Monday, June 29, 2020

19:00 to 21:00 | Registration and Welcome cocktail

Tuesday, June 30, 2020

13:00 to 14:00 | Registration

14:00 to 14:30 | Opening Ceremony

KEYNOTE LECTURES

Chairman: dr Aleksandar Sedmak, Aleksandra Dragicevic

Jovan Tanaskovic – RESEARCH WORK IN THE FIELD OF PASSIVE SAFETY OF RAILWAY VEHICLES IN SERBIA

Ivan Tanasic – EXPERIMENTAL INVESTIGATIONS IN PROSTHETIC DENTISTRY

14:30 to 15:30 | Viktor Stojmanovski – EXAMINATION OF LAMINATIONS IN THE BASE MATERIAL OF HIGH-PRESSURE GAS SUPPLY PIPELINE SECTION

Marko Ristic – IMPLEMENTATION OF MULTIDISCIPLINARY RESEARCH IN REVITALIZATION OF COMPLEX THERMOENERGETIC FACILITIES

COMPANY PRESENTATION

TEHNOLOGIKA

TROKUT TEST

15:30 to 16:00 | Coffee break

MINI SYMPOSIA - SUSTAINABLE DESIGN AND NEW TECHNOLOGIES

Chairman: dr Vojkan Lucanin, dr Marina Stamenovic, dr Aleksandra Mitrovic

16:00 to 17:00 | **Oral presentations**

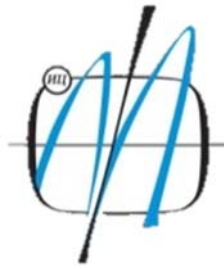
Duško Radaković - BRIDGING SCIENCE-TECHNOLOGY-ART WITH GENERATIVE DESIGN

Poster presentations

17:00 to 18:00	MINI SYMPOSIA - CLEAR SKY	
	Poster presentations	
18:00 to 20:00	Free time	
20:00 to 23:00	Gala dinner	
Wednesday, July 01, 2020		
09:00 to 10:00	Registration	
10:00 to 10:30	Opening Ceremony	
	<i>dr Milos Milosevic – Innovation Center of Faculty of Mechanical Engineering</i>	
	<i>dr Nenad Mitrovic – Faculty of Mechanical Engineering</i>	
	<i>dr Ivan Rakonjac – director of Innovation Fund</i>	
	WORKSHOP - REGIONAL INNOVATION FORUM 2020	
	<i>Chairman: dr Zarko Miskovic</i>	
10:30 to 12:30	<ul style="list-style-type: none"> • Sources of finance for business improvements of SMEs, Development Agency of Serbia • Mechanisms for financing of innovation, Innovation Fond of Serbia • Club of open innovation - collaboration for development of innovative products, Chamber of Commerce and Industry of Serbia • European Enterprise Network Can Help!, Innovation centre of Faculty of Mechanical Engineering in Belgrade 	
12:30 to 13:00	Coffee break	
13:00 to 15:00	SESSION III <i>Chairman: dr Martina Balac, dr Goran Mladenovic</i> Oral presentations <u>Aleksandar Sedmak</u> , Snezana Kirin, Igor Martic, Lazar Jeremic, Ivana Vucetic, Tamara Golubovic, Simon Sedmak - STRUCTURAL INTEGRITY AND LIFE ASSESSMENT OF PRESSURE VESSELS - RISK BASED APPROACH <u>Ivana Vasović Maksimović</u> , Mirko Maksimović, Katarina Maksimović - BUCKLING OF LAYERED COMPOSITE PANELS: COMPUTATION AND EXPERIMENTAL RESULTS <u>Postic Srdjan</u> , Ekatarina Dzigurski, Mladenovic Goran, Milovanovic Aleksa, Mitrovic Nenad, Trajkovic Isaak, Milosevic Milos COMPRESSION STRAINS	B2B MEETINGS

	<p>AND DISPLACEMENTS OF SELECTED COPINGS ON REMAINING TEETH FOR DENTURE SUPPORT</p> <p>Poster presentations</p>	
15:00 to 18:00	Free time	
18:00 to 21:00	Dinner	
Thursday, July 02 2020		
From 10:00	Zlatibor excursion (optional)	

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30 REPUBLIKA
POSTANI DRŽAVLJANIN

ABSTRACTS

Mechanical Engineering

Invited lecture

IMPLEMENTATION OF MULTIDISCIPLINARY RESEARCH IN REVITALIZATION OF COMPLEX THERMOENERGETIC FACILITIES

Marko Ristic¹

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Abstract

The aim of this research is to focus on optimisation system for production electrical energy and possibilities of improving and extending existing production capacities. It is estimated that in the next 20 years, global energy needs will be largely obtained by the combustion of fossil fuel.

In recent years, significant research has been done caused by concern about the extension of the remaining life of thermal energetic facilities. As known, complex equipment in thermal power plants is exposed to long-term effect of high temperatures and pressure, abrasion and load cycle counting. The main focus of this research is analysing, optimisation and improving the work of thermopower plant. Idea is to create a model for optimization which can be applied in various types of thermoenergetic facilities.

In these circumstances, the different causes can lead to damages and individual components such as the wear and tear of working parts. The consequences of the reduction in production capacity and ventilation effect of the mill compared to the projected value, as well as frequent delays due to the replacement of parts, have significant affects to productivity, profitability and energy efficiency of thermal power plants.

The main idea of this research is to detect the critical elements and processes in thermoenergetic facilities and analyse the process of damaging system, which can lead to critical dysfunctions.

By using the software package ANSYS FLUENT 12 it was analysed multiphase flow and speed of the mixture with precisely identify critical areas in which will appear the breakdown of the ventilation mill. Try this research it will be present usages of Thermography for identification critical elements in the system. By analysing working condition, damages of elements by numerical simulation and thermography, it will select the possible coating material for reducing wear in working elements. Besides coating process, results will be also used for analysing the possibility of redesign some elements by changing the geometry and positions in systems. Recommendations obtained by this analysis are tested in experimental condition and also in real exploitation condition in ventilation mill in Thermopower plant Kostolac B. Result shown significant increasing remaining working life and wear resistance of components in system ventilation mill dust channel.

Keywords

Wear, extending remain working life, ventilation mill, numerical simulation, coating

Acknowledgement

Research described in this paper are financed from Ministry of Education, science and technological development Republic of Serbia

SCADA CONTROL FOR CRUDE OIL TRANSPORT SOLUTION SYSTEMS FOR REFINERIES

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Abstract

Developing the industries are demand constant improving tools and methods for following the process of production transport and etc. The main focus of this research is modeling and previewing processes with standardized graphical notation by using SCADA application. SCADA (Supervisory Control And Data Acquisition) have wide application in the management and monitoring of the operation of industrial plants and equipment in telecommunications, oil and gas industry, energy, wastewater systems and other fields. The main aim of this paper is to present SCADA as a tank management system at refineries. SCADA represents a system for monitoring, monitoring, archiving and control of industrial systems with parameter display, with the availability and reliability of such a system at a high level. The example presented in this paper are used form industry for modelling tank management and crude oil transport solution includes tank management, oil transport control and management, some procedures and measurement control and implementation of pump station control. Please rephrase your sentence or divide into two simpler. In this paper, it will be shown and explained a part of this whole process named as a Transaction „Pre-start checking “. The proposed transaction model is studied using of metrological conditions and other acts of Republic of Serbia, which is referring to this area. For that reason, proposed model ensures the accurate, credible and economical crude oil transportation.

Keywords

SCADA, Tank Management System, BPMN, oil, gas industry

Acknowledgement

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BIPEDAL ROBOT: SYSTEM AND CONTROL DESIGN BY USING ARDUINO BOARD

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Abstract

In this paper we propose system and control design of bipedal robot that is able to walk or dance. We use frame with two wheels and Arduino line of electrical components, like Arduino Nano board with microcontroller, wireless HC-12 or Bluetooth HC-05 card for receiving and sending control signals, and two servo motors SG90 with motor control drivers. Parts of bipedal robot can be 3D printed upon design. Remote control can be joystick or smart phone. Program for microcontroller is written in Arduino IDE software environment. It is the aim of the paper to show procedure for designing bipedal robot that enables functions of walk or dance, by using CAD/CAM technology for design and manufacturing, 3D printing, electronic scheme design using Fritzing software, and wireless control and board from Arduino line of electronic components, with adequate motors choice to enable walking or dancing.

Keywords

Bipedal robot, system and control design, Arduino Nano board, Wireless HC-12 module, Bluetooth HC-05 module, motors SG90

FURTHER RESULTS ON FINITE-TIME STABILITY OF CONTINUOUS SINGULAR TIME DELAY SYSTEMS: A DECOMPOSITION METHOD APPROACH

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Abstract

This paper provides novel additional sufficient conditions for finite-time stability of the linear continuous singular time delay systems. In this study linear continuous singular system with state delay is analyzed: $E \dot{x}(t) = A_0 x(t) + A_1 x(t - \tau)$ with the compatible vector valued function over the subspace of initial conditions, given by: $x(t) = \varphi(t)$, $-\tau \leq t \leq 0$.

A novel method was used to derive new delay dependent conditions. First of all, the system under consideration has been decomposed to its slow and fast subsystems: $\dot{x}_1(t) = A_0 x_1(t) + A_1 x_2(t - \tau)$ and $\dot{x}_2(t) = \bar{A}_0 x_1(t) + \bar{A}_1 x_2(t - \tau)$. Then, the well-known Tseng-Kokotovic's equation: $\dot{x}_2(t) = \bar{L} x_1(t)$ was applied establishing the natural connection between slow and fast variables.

The derived conditions were applied in the system stability analysis. Finite-time stability was analyzed using the novel conditions derived in this paper, which guarantees that the states of the systems do not exceed the predefined boundaries over a finite-time interval.

Moreover, potential domain of finite time (practical) stability was, also, determined under the same assumptions.

Keywords

Continuous systems; Finite-time and practical stability; Singular systems; Time delay systems; Domain of practical stability

FURTHER RESULTS ON FINITE-TIME STABILITY OF DISCRETE DESCRIPTOR TIME DELAY SYSTEMS: A DECOMPOSITION METHOD APPROACH

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Abstract

This paper provides novel additional sufficient conditions for finite-time stability of the linear discrete descriptor time delay systems. In this study linear discrete descriptor system with state delay is analyzed: $E\mathbf{x}(k+1) = A_0\mathbf{x}(k) + A_1\mathbf{x}(k-h)$. with the compatible vector valued function over the subspace of initial conditions, given by: $\mathbf{x}(k) = \boldsymbol{\psi}(k)$, $-h \leq k \leq 0$, $h = \text{const}$.

A novel method was used to derive new delay dependent conditions.

First of all, the system under consideration has been decomposed to its slow and fast subsystems $\mathbf{x}_1(k+1) = A_0\mathbf{x}_1(k) + A_1\mathbf{x}_2(k-h)$ and $\mathbf{x}_2(k) = \bar{A}_0\mathbf{x}_1(k) + \bar{A}_1\mathbf{x}_2(k-h)$. Then, the very well known Tseng, Kokotovic's equation: $\mathbf{x}_2(k) = \bar{L}\mathbf{x}_1(k)$ was applied establishing the natural connection between slow and fast variables.

The derived conditions were applied in the system stability analysis. Finite-time stability was analyzed using the novel conditions derived in this paper, which guarantees that the states of the systems do not exceed the predefined boundaries over a finite-time interval.

Moreover, potential domain of finite time (practical) stability was, also, determined under the same assumptions.

Keywords

Discrete time systems; Finite-time and practical stability, Descriptor systems; Time delay systems; Domain of practical stability

WORK INTEGRATED LEARNING IN SERBIA

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Abstract

Work integrated learning is a modern approach for engineering practical education based on real needs for a competent workforce in the industrial sector. Also, it enables grate opportunities for continuous professional development of employees and improvement of cooperation between high education institutions and business sector in order to modernize teaching and training processes on novel technical and technological solutions. In this paper the results of the ongoing international project, which aims to implement work integrated learning in Serbia, will be analysed and discussed in details. So far, two generations of students have already participated in the realisation of this project. Beside traditional knowledge, obtained at the technical faculties of the University of Belgrade, students have acquired specific practical skills in relevant international companies. Taking in account current state of the project realization, it is planned to involve more companies which already expressed their interest in work integrated learning in future period.

Keywords

Work integrated learning, education of engineers, practical skills

Acknowledgement

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3D-DIC METHOD IN STRUCTURAL HEALTH MONITORING OF PRESSURE VESSELS

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Abstract

Structural Health Monitoring (SHM) technologies are an important part of the system for detection and characterization of any type of damages of engineering structures. Various technologies have been applied in different engineering sectors in last several decades – strain gauges, acoustic emission, fibre optic sensors, etc. One of the methods that has a high potential for application in sector of pressure vessels, especially on complex geometrical parts, is 3D Digital Image Correlation (3D-DIC) method. 3D-DIC method enables full-field displacement and strain measurement. The aim of this paper was to investigate the possibilities of application of the Aramis system (GOM, Germany) based on 3D-DIC method on several cases typical for pressure vessels and its influence on structural health – crack detection and crack propagation monitoring and stress concentration areas of complex structures in the vessel-nozzle joint (sphere to cylinder and cylinder to cylinder connections). Aramis software was used to measuring von Mises strain fields and displacements. The results showed that 3D-DIC method is suitable for structural health monitoring of pressure vessels during their lifespan.

Keywords

Digital Image Correlation method, Aramis system, Structural Health Monitoring, Pressure Vessels

Acknowledgement

This research was supported by Ministry of Education, Science and Technological Development of Republic of Serbia under Project TR35031.

EXPERIMENTAL AND NUMERICAL INTEGRITY ASSESSMENT OF HOME WINDOW PROFILES AND FRAMES

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Abstract

Modern home windows include new approaches in their design and new material utilization to achieve best resistance to harsh weather conditions and to achieve best possible thermal insulation. Chosen internal structure of window frame and selected material affect on structural life. Integrity assessment of home window frames covers experimental and numerical approaches, including experimental DIC method (Digital Image Correlation-DIC) and FEA (Finite Element Analysis) numerical method. The aim of this research is to find the matching between both techniques and to use only numerical method in future to assess the structural life of home window frames with different internal structures in the design and different materials. Experimental testing is performed on the Universal tensile testing machine "Shimadzu AGS-X" with 100kN load capacity, which is sufficient for home window frame testing. DIC cameras are used for recording of the experimental technique and the output are displacements and deformations on observed structure. FEA simulation accepts the before experimental conditions, i.e. maximal load, material characteristics and geometry. Matching of experimental results and attained FEA simulation will allow for easier Integrity assessment using only numerical simulations for future tests. Therefore, with mentioned technique new internal structures of windows and different materials can be simulated and the obtained results will show if the chosen home window frame structure and material selection is sufficient enough for practical use.

Keywords

Home Window, Window Frames, Integrity Assessment, Experimental Methods, Numerical Analysis

Acknowledgement

This research is financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia, project numbers TR35006 and TR35040

SETTING THE CONCEPT OF THE SMP- SENSORIMOTOR POLYGON

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Abstract

Sensorimotor polygon (SMP) is a room equipped with carefully designed set of sensors (pressure sensors, switches, cameras, etc.) and other elements (springs, locks, bolts, etc.), with the ability to monitor all parameters and changes that occur within the polygon. SMP consists of elements that stimulate the senses of hearing, sight, touch, and smell. The application of the SMP provides the possibility of working with different groups, adults, and children, in order the patient to overcoming of anxiety disorders, conditions after stroke, dementia, but also the prevention of stressful situations in everyday life activities. This program contributes to a flexible approach to work, which frames the range of operations in different situations, not just stressful situations. By implementing the SMP program, patient can achieve successful coping with everyday problems, acquiring knowledge and skills that are of great importance for a better understanding of everyday situations, other people, and the community in which people live and work. The goal and the significance of the topic stem from the fact that our country is exposed to frequent changes and crisis situations, and the establishment of SMP program as a community based therapeutic model at the system level will greatly facilitate and contribute to the prevention mentioned conditions. The results that can be seen after the use and application of SMP relate primarily to the improvement of the mental status of a person, as well as motor functions.

Keywords

Sensors; polygon; prevention

NEW CLAMPING CONCEPT DEVELOPMENT AND ANALYSIS

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Abstract

Clamping accessories are a necessary element of the tool-machine-workpiece machining system. When designing clamping accessories, in addition to its functionality, reliability, manufacturability, economy, and ease of handling should be respected. Classical clamping methods can restrict tool access during machining. This paper will present a new concept of clamping accessories with the possibility of clamping the workpiece using four clamping plugs. The idea is to drill four technological holes on the surface of the workpiece, which will later be used for contact between the workpiece and the clamping element. Clamping of the workpiece provides the rigidity of small parts, as well as the possibility of machining in 5 axes with one clamping of the part. In addition to the design of clamping accessories, the paper will also analyze potential problems. In order to support the theoretical model and conceptual solution, numerical analyzes were performed. The displacements of the clamping elements depending on the clamping force were analyzed in the FEMAP software.

Keywords

Workpiece clamping accessories, FEMAP software analysis

PIPE RING SPECIMEN TEST PROCEDURE USING DIC METHOD WITH THREE CAMERAS

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Abstract

Pipe material propertise test is very important for quality investigate of pipe construction. Many studies that have been conducted are based on use ring shape specimens. Previous research has used weaker pipe materials and larger diameters, which facilitates tool making. This state of the art has led to the development of a new approach to testing pipe rings of larger thicknesses and smaller diameters ($e = 6.32\text{mm}$, DN32) as well as defining a better test procedure. Using DIC cameras (Digital Image Corelation), stress state analysis was performed and deformations on the outer surface and side of the ring (pipe wall) were analyzed. The outer surface of the ring and the thinning of the test tube in the axial direction as well as the elongation of the measuring part of the test tube were recorded with two cameras. With the third camera, the lateral side of the specimen was recorded so that the change in the thickness of the ring as well as the occurrence of bending in the radial plane during the test were analyzed. The test results are based on data on deformation, thickness reduction in the axial and radial directions. The test results enable the assessment of the condition of the pipe material and the assessment of its service life. The use of ring-shaped test tubes facilitates production and provides better results compared to the flattening method.

Keywords

Ring shaped specimen, D block, DIC camera, correlation, pipe life, assessment.

EXPERIMENTAL PROCEDURE FOR EVALUATION OF EVAPORATION RATES CORRELATIONS FROM FREE WATER SURFACES

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Abstract

Indoor swimming pool buildings consume a lot of energy for heating and ventilation. Energy in swimming pool halls is used for maintaining thermal comfort conditions in the swimming pool hall and for maintaining the pool water at desired temperature. In indoor swimming pool buildings 45% of energy is used for pool hall ventilation, and 33% for heating pool water. Water evaporation from the swimming pool water surface increases humidity in the pool hall air, and therefore the consumption of energy for heating and ventilation of the swimming pool and the hall increases, especially in the scenario of more strict humidity control of the pool hall air. Mathematical correlations for predicting the evaporation rates from free water surfaces can be found in literature, but not all of them were designed specifically for indoor swimming pools. The properties of indoor swimming pool water, pool hall air and evaporation rates are measured in a real indoor swimming pool building and measurement results are analyzed in this paper. The measured results are confronted to the evaporation rates calculated by applying literature mathematical correlations for determination of evaporation rates. Using the original measured results, a mathematical correlation for estimation of evaporation rates of indoor swimming pools is created by the least square method.

Keywords

Evaporation, measurement, free water surface, swimming pool

Acknowledgement

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3D DIGITAL IMAGE CORRELATION ANALYSIS OF THE MODELLED BOILER ELEMENT

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Abstract

Hot water boilers, especially boilers with fire tube where the combustion takes place, are widely used in process industry. Elements of the boiler are exposed to high pressures and temperatures during boiler operation. Exploitation experience indicates constant and permanent breakdowns occurring as a result of accidental states of individual boiler elements. Studies done before in this field indicate certain critical boiler elements that may have influence on the reliability and safety of the entire unit. In order to avoid this state, certain investigation should be made that would examine the influence of different regimes on the boiler structure. Lack of available data concerning the temperature as well as stress-strain field in boiler elements led us to perform such kind of experiment. This paper presents results of numerical analysis performed on the modelled boiler. Validation of the numerical model was performed based on experimental results obtained using 3D Digital Image Correlation analysis. This paper analyses critical elements of the hot water boiler by experimental data obtained from its model and improved numerical model in order to analyze constrains and loads the model is exposed to and to have fully-covered stress-strain field obtained from experimental data.

Keywords

Hot Water Boiler, Finite Element Method, Digital Image Correlation.

Acknowledgement

This research was financially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

DEVELOPMENT AND CALCULATION OF BASE FOR INSTALLATION OF ELECTRIC POWER EQUIPMENT THAT POWERS AND MANAGES MINING EQUIPMENT

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Abstract

Development and calculation the base used in mining is the aim of this paper. The base is intended for installaton of electronic communication and electric power equipment and devices that supply and manage mining equipment. In the first part of the paper, the existing solutions are presented, and in the second part of the paper, the development of a new solution is presented. The paper presents the design of a new base solution, the calculation of the base according to the valid standards and regulations and the numerical determination of the equivalent stress and strain in the Abaqus software. The finished product is shown at the end of the paper.

Keywords

Mining equipment, base, equivalent stress, finite element, deformation

Engineering Materials

ON AN INTRODUCTION OF ACOUSTIC EMISSION ANALYSIS AS A TOOL FOR SOLID WOOD CUTTING PROCESS MONITORING

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Abstract

The cutting tool interaction with solid wood during cutting process, results in various input energy dissipation, such as heat, vibration and corresponding acoustic emission. Different cutting parameters and various solid wood species with distinguishing properties interact in a many diverse ways. The latter is very important when talking of cutting power consumption. Variations in cutting power magnitude indicates possible offset of actual cutting parameters values and could cause damage to a working peace or potentially dangerous impacts for machining system. Possible reasons for this could be wood irregularities or tool wear.

For the purpose of this research a circular saw blade (producer CMT orange tools 259) with diameter of $D = 25$ cm, body thickness of 2.2 mm, cut width of 3.2 mm and 24 teeth, was used.

The measurements took part with three different feeding rates (8, 10 and 12 m/min.), three different tool overrides (10, 20 and 30 mm) and two tool weariness conditions (just after sharpening and after 800 m of cutting in grain along direction).

*Cutting power and acoustic emission spectra were measured simultaneously in order to compare acquired data and give possible relationship that could lead to new, alternative monitoring process in wood machining. The wood of beech (*Fagus silvatica* L) as a most common species in Republic of Serbia was used in this research. The results obtained during investigation indicate obvious relationship between cutting power consumption and peaks in certain acoustic spectrum peaks variations.*

Specific frequency areas presented are generally from 20 Hz to 5 KHz. The spectrum area above 5 KHz as so called fingerprint. The specific peaks at 1.5 (between 1.5 and 2) KHz, at 3 KHz and at frequencies between 200 and 500 Hz were investigated. Also it was noticed that there is an absence of peak at exactly 5 KHz, noticed in previous researches using laminated particleboard.

Beside possible implementation in cutting process monitoring and control, results obtained in this research could possibly be used in making sharpening schedule therefore extending tool lifecycle.

Keywords

Acoustic emission, cutting power, circular saw blade, feed rate, tool wear, tool override

EXPERIMENTAL ANALYSIS OF WELDED JOINTS OBTAINED BY FSW

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Abstract

Friction stir welding (FSW) is a solid-state welding technology which is frequently used for welding of metallic alloys and thermoplastic materials in many industries, especially the automotive and aerospace industries. Aluminium alloys contain alloying elements such as copper, magnesium, manganese, silicon, tin and zinc. Beside Al alloys, thermoplastic materials can be also welded by FSW. Therefore, high-density polyethylene (HDPE), as a material with wide application in mechanical industry, was also tested in this paper. The aim of this study was to investigate welding parameters and mechanical characteristics of Al alloys and HDPE. For each experiment special tools were constructed. Aluminium alloys 6061 Al and 6082 Al, with 6 mm and 8 mm thickness, were welded with a tool tilt angle of 2°. HDPE sheets with 5 mm thickness were welded with a tool tilt angle of 1°. Welding parameters for Al alloys were: tool rotational speed at 230 rpm, translation welding speed at 270 mm/min. Experimental analysis of mechanical characteristics had shown that Al alloys specimens haven't fractured at welded joints and tensile strength was 250 MPa. Experiments with HDPE were done with different parameters: tool rotational speed at 1600 rpm, 2300 rpm and 3100 rpm; translation welding speed at 45 mm/min, 115 mm/min and 75 mm/min. The best results were obtained with combination of 3100 rpm tool rotational speed and 75 mm/min translational welding speed. Tensile strength of HDPE welded joints was 19 MPa.

Keywords

FSW, welding parameters, Al alloys, HDPE sheets, mechanical characteristics

APPLICATION OF LASERS TO IMPROVE MECHANICAL CHARACTERISTICS OF METAL MATERIALS

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Abstract

The research presented in this paper is focused on examining the surface characteristics of metallic materials before and after the application of mechanical laser treatment. The Ti-6Al-4V alloy, T-alloy whose main alloying elements are aluminum (5.5-6.5% by weight) and vanadium (3.5-4.5% by weight), was chosen for experimental tests. Compared to stainless steel and cobalt-chromium alloys, titanium has better strength but poorer tribological properties. The main advantage of titanium in relation to other metallic materials is its extraordinary specific strength, but the relatively low hardness of titanium alloys affects their weak resistance to wear. Ti-6Al-4V is a typical, widely used two-phase alloy, and the structure of the alloy largely depends on the method of production and heat treatment. As part of the research presented in this paper, experimental tests of samples made of Ti-6Al-4V alloy were performed. The chemical composition of the samples used in this experimental analysis was determined by gravimetric analysis, and the results confirmed that it was an alloy of typical Ti-6Al-4V composition, but with a higher proportion of impurities in the material. The samples were strengthened using a mechanical laser treatment method, and Nd: YAG EXPLA device was applied. Further experimental investigations included a profilometric analysis of the topography of the surface examined by an optical microscope. The results of the microstructure of the base and strengthen material are presented. The results show that on the surface layer, after mechanical laser treatment, dense dislocation networks are formed due to compressive residual stresses. Experimental measurements of microhardness were performed using the Vickers method, and the results indicate that due to mechanical processing, there was an increase in microhardness.

Keywords

Titanium alloys, mechanical laser treatment, microstructure, optical profilometry.

Acknowledgement

We acknowledge the support for this investigation by the Ministry for Education, Science and Technological Development, project TR 35040.

TOXICOLOGICAL CHARACTERISTICS OF RESORBABLE MEMBRANES BASED ON POLYVINYL ALCOHOL WITH THE ADDITION OF C₆₀ FULLERENES.

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Abstract:

The results of a study of the toxicological characteristics of resorbable membranes based on polyvinyl alcohol with the addition of C₆₀ fullerenes and their effect on osteogenesis are presented.

Key words:

Targeted bone regeneration, polyvinyl alcohol, fullerenes.

Relevance:

The technique of targeted bone tissue regeneration is currently widely used in maxillofacial surgery and surgical dentistry [3,4]. Known developments for its implementation in traumatology [7]. Membranes in this technique are used in periodontal, dental preservation, implantological operations. However, their disadvantages are well known. Non-resorbable membranes require repeated surgery. Resorbable membranes are more convenient, but they are toxic. The decay products of polymers of lactic acid, on the basis of which modern synthetic resorbable membranes are created, tend to inhibit osteogenesis [2, 3, 4]. Despite the appearance of a large number of different membranes, the dependence of their properties on toxicological characteristics remains poorly understood [5].

Polyvinyl alcohol (PVA) is well known in medicine. However, only non-resorbable products from them, porous plastics, found real application. Introduction to the composition of PVA of varying degrees of hydration of fullerenes made it possible to create resorbable membranes based on it [5,6].

Purpose of work:

To study the toxicological characteristics of resorbable membranes based on polyvinyl alcohol with the addition of C₆₀ fullerenes (PVSF) and their effect on osteogenesis.

Materials and methods.

Toxicological characteristics were studied by conducting non-lethal experiments on white rats (20 animals), albino rabbits (25 animals) and guinea pigs (50 animals). The content of toxic substances was determined by physicochemical methods.

The study of the effect on osteogenesis was conducted on 10 outbred white rats in accordance with the rules adopted by the European Convention for the Protection of Vertebrate Animals for Experimental and Other Purposes (Council of the European Communities Directive 86/609 / EES, Strasbourg, 1986). An effective model of a bone defect was created in the femurs of rats in the form of a critical cut of 1.0 x 1.5 cm. A resorbable PVSF membrane [1] was placed on one thigh, and a dipole membrane based on polylactic acid with the introduction of methacrylate and polybutyrol layers was placed on the opposite thigh.

After deducing from the experiment, a fragment of a bone with an implant and surrounding soft tissues were taken for morphological examination. Microscopic examination was performed using a Nikon 50i light microscope with an increase of 40, 100, 200 and 400 times. Bone tissue and osteoplastic material were assessed.

The integrity, maturity of the cortical layer regenerate, and the presence of inclusions in it were evaluated.

Research results

The study of cytotoxicity, irritating effect on the skin and conjunctiva of the eye, hemolytic effect and acute toxicity showed negative results in all categories in 100% of experimental animals. Physico-chemical studies on the content of toxic substances - formaldehyde, ethylene glycol and heavy metals showed values below the reference.

When comparing bone defect remodulation on day 42 when laying the resorbable PVSF and Diplen membranes based on polyglucin and polyvinyl alcohol, the following: in the first case, the newly formed regeneration of the cortical layer is mature, whole, with an architectonic structure. There is a dense connection of the edge of its own bone and callus. When laying on the bone defect of the Diplen resorbable membrane, the regenerate of the newly formed cortical layer was layered, split, containing crystals inside. Bone callus was loose, heterogeneous (Fig. 1).

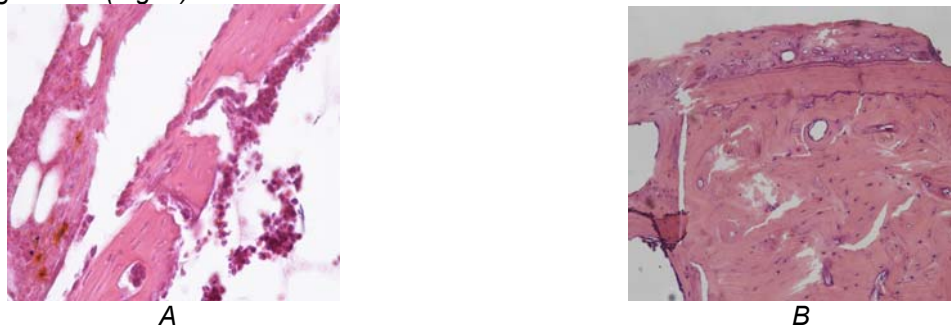


Fig. 1. Comparison of the regenerate of the newly formed cortical layer when laying the resorbable membrane based on PVAF and the resorbable membrane based on polylactic acid ("Diplen").

A. Cortical plate of the femur when laying on the bone defect of PVSF. Hematoxylin-eosin. x 40.

B. Cortical plate of the femur when laying on a bone defect of a resorbable membrane based on a lactic acid polymer ("Diplen").

Thus, a comparison of the regeneration of the cortical plate when creating an effective model of bone defect shows that when laying a resorbable membrane based on PVSF on a given bone defect, osteogenesis proceeds more fully, bone tissue regenerates faster than when using a resorbable membrane based on a lactic acid polymer (Diplen).

Выводы

1. The synthetic resorbable membrane based on PVSF does not have a toxic and sensitizing effect on biological tissues.
2. The effect of the resorbable membrane based on PVSF is positive and more pronounced compared with the resorbable membrane membrane based on polylactides.

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Chemical and Process Engineering

Invited lecture

EXAMINATION OF LAMINATIONS IN THE BASE MATERIAL OF HIGH PRESSURE GAS SUPPLY PIPELINE SECTION

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Abstract

During the installation works of high pressure gas supply pipeline (working pressure 54bar, pipe diameter Ø508mm, wall thickness 6,4/7,9/9,53 mm, material X60M according to API5L, PSL2) at the performance of the in-field welding, appeared indications that in the base material of the pipe exist laminations. They are one of the most severe defects that cannot be tolerated in this kind of structures. That fact imposed the need for additional investigations in order to confirm and evaluate the severity of these defects before performing the 81 bar hydro test. Considering the fact that the entire section of the pipeline (cca 36km) was already installed and buried under the ground, UT inspection of the section had to be done with special equipment that was moving inside the pipeline filled with water. Only by this manner it can be achieved to have inspection of the entire internal surface of the pipeline, in its full length of cca 36km. With this inspection all the defects in the pipe wall were discovered at their exact location. On particular critical locations, to find out the exact dimensions and characteristics of the imperfections, additional examinations were performed with NDT methods. These findings in the critical locations of the entire 36km pipeline obliged to be performed reparations. This paper covers the categorization of the defects on the critical locations (discovered by the UT examination and additional NDT testing with classical methods), the specifications and causes of their appearance. The proposed reparations on the entire gas supply section, due to these defects, are presented too.

Keywords

Laminations, UT inspection, NDT inspection, Gas supply pipeline inspection, imperfections, defects, anomalies

SYNTHESIS, CHARACTERIZATION AND ADSORPTION PROPERTIES OF MAGNETITE/3D-PRINTED WOLLASTONITE FOR WATER PURIFICATION

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Abstract

Considering the harmful effects of arsenic on the environment and human health, the maximal allowed concentration for As(V) ions in water decreased to 10 µg/l. In order to achieve the established rigorous requirements, it is necessary to develop new materials and design new adsorbents that can reduce the existing concentration of arsenic in drinking water. The synthesized magnetite/3D-printed wollastonite hybrid sorbent was used to remove As(V) ions from aqueous solutions. 3D-printed wollastonite was obtained using the 3D-printing technique from methylhydrocyclosiloxane and calcium carbonate as precursors. Synthesis of adsorption material was carried out by depositing magnetite from an iron(II)-sulfate solution by potassium hydroxide on 3D-printed wollastonite. Characterization of the obtained material was performed using XRD, SEM and TG-DTA. The adsorption properties of the hybrid adsorbent depend on the properties of magnetite and its porosity. Determination of adsorption parameters was performed by applying Langmuir, Freundlich and Dubinin-Radushkevich equations. Kinetics, using pseudo-first, pseudo-second and second order equations, as well as diffusion rate, were determined using Veber-Moris and HSDM models. Determination of kinetics and adhesion parameters at three different temperatures enabled the calculation of thermodynamic and activation parameters of the adsorption process, which contributed to a better understanding of the adsorption mechanism. Based on the obtained results, we concluded that adsorption of As(V) ions from water could be best defined by Freundlich isotherm model, indicating at multiple layer adsorption mechanism. Furthermore, the highest capacity of 10 mg/g was obtained at 45°C.

Keywords

Wollastonite, 3D-printing, adsorption, water purification

PHYTOCHEMICAL AND BIOLOGICAL INVESTIGATION ON LEAVES OF *POGOSTEMON BENGHALENSIS* (BURM. F.) KUNTZE.

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Abstract

The objective of the study was to find out the phytochemicals present on the leaves of Pogostemon benghalensis and also to measure the total phenolic/ flavonoid/ sugar contents present on the leaves, which play vital roles as a source of many things for living beings. Also the study was done to find out the bacterial resistance of the extracts towards some bacteria.

*Leaves of benghalensis were extracted successively with Petroleum ether, Chloroform, Ethyl acetate, Methanol and 50% aqueous methanol. The extracts were subjected to phytochemical screening. The total phenolic content (TPC) was measured spectrophotometrically by using Folin-Ciocalteu reagent, was found to be higher in Methanol (111.56 ± 1.74 mg GAE/g) than other extracts. The total flavonoid content (TFC) was found to be greater in Methanol extract (99.75 ± 2.43 mg CE/g) of benghalensis which was estimated by using aluminium chloride colorimetric assay. Similarly, the total sugar content in the leaf was determined by using Anthrone reagent based colorimetric assay that showed higher sugar content in methanol extract, 83.45 ± 1.69 mg GE/g. The antioxidant activity of Methanol and 50% Methanol extract of *P. benghalensis* was determined in terms of radical scavenging activity using stable radical DPPH. Percentage inhibition of DPPH radical against the samples were found out and IC_{50} values were measured. IC_{50} value for standard Ascorbic acid was found to be 72.99 μ g/ml, and that of methanol and 50% methanol extracts were found to be 91.57 μ g/ml and 126.26 μ g/ml.*

*The antibacterial activity of *P. benghalensis* leaf extracts were studied against two bacteria, Staphylococcus aureus (Gram-positive) and Escherichia coli (Gram-negative) by agar well diffusion method and result did not show any clear zone of inhibition (ZOI) after the incubation period, towards the concentration range of 2.5-30 mg of extracts (Petroleum ether, Chloroform, Ethyl acetate and Methanol extracts).*

Keywords

Phytochemical screening, Antimicrobial test, Total phenolic content, IC_{50}

Acknowledgement

I would like to acknowledge Prof. Dr. Meena Rajbhandari (Research centre for Applied Science and Technology), Tribhuvan University, Nepal.

CHARACTERIZATION OF RELEVANT PROPERTIES OF CARTRIDGE FILTERS

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Abstract

Determination of the optimal filtration system for purposes of given application demands knowledge of input data, as also knowledge of precise characteristics of filter elements which can be applied in that process. There is a large number of significant parameters of filtration process which can be taken into account and brought in correlation with characteristics of filter elements. Many methods is available for determining the input parameters of filtration process, and from their accuracy depends the quality of data acquired. For measuring the performances of cartridge filters there are different methods whose accuracy determines level of accordance with real data in praxis. Procedure of defining the filtration process means defining the each filtration step and represents significant part of such technological process.

This paper deals with the characterization of the relevant characteristics of cartridge filters that best correlate the filtration performance of cartridge filters with filtration requirements in order to achieve optimal results of each filtration step and the filtration process as a whole. A real practical example of three-stage filtration of drinking water shows the correctness of the procedure of characterization of the relevant properties of cartridge filters.

Keywords

Cartridge filters, filtration, characterization, process defining.

Experimental Techniques

AUTOMATION OF CUP FILLING MACHINE BY INSERTING PLC CONTROL UNIT FOR EDUCATIONAL PURPOSE

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Abstract

In this paper it is presented the automation of cup filling machine by inserting PLC unit for educational purpose. The smaller filling machine has been constructed, that has the ability to recognize two cup sizes and sort them after filling. The machine charger works independently at 220V, the sizes of the glasses it fills are 0.2l and 0.1l, and it has its own liquid tank with level sensor and compressor and bottle with pressure sensors and automatic on and off button. The conditions for starting the machine, are that the air pressure is above 2 bar, and the level of liquid in the vessel is sufficient to fill one whole glass after signalling the disappearance of liquid. The required width of the conveyor belt is 10 cm, and it is driven by a 12 V electric motor. The cups are sorted using a pneumatic piston, and the liquid circulation pump is of constant flow. In the operation of the machine, it is necessary to provide protection against incompletely filled cups due to liquid loss, and protection against incorrect sorting due to loss of air pressure, and light alarm in case of loss of conditions. The alteration of machine's control units is shown by replacing specific components with the programmable logic controller SIEMENS S7 300. A detailed description of the installation wiring and programming of PLC is described, as well as the programme execution using PLC SIM software. The final phase involved program testing, and testing of particular system operations.

Keywords

Automation, PLC controller, sensors, education, filling machine

DEVELOPMENT OF CONCEPTUAL SOLUTION OF EXPERIMENTAL SETTING FOR CONTROLLED APPLICATION OF IMPACT FORCE ON THE HEAD MODEL USING DIC

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Abstract

After noting that head and neck injuries are very common in martial arts sports, a growing need for developing helmet materials and models appeared. In addition to the problems that arise in terms of design, there are also problems in terms of developing the material from which the helmets are made. In terms of design, the helmet must interfere as little as possible with the mobility of the head and neck and visibility, while in terms of material development, it is necessary to ensure optimal mechanical properties of the material from which the helmet is made, which is simultaneously the biggest challenge for helmet manufacturers. In the process of developing models and materials of helmets, there was a need for research in which the development of experimental settings will credibly simulate the blows that are exchanged during a sports fight. The aim of this paper is to make an experimental setup to enable testing of helmets from different manufacturers as well as testing of newer generation helmets. This paper presents a conceptual solution of an experimental setup in which impacts are simulated in controlled conditions, taking into account that the impact image applied to the head model is controlled, so that it is possible to simulate different types of impacts while maintaining the same boundary conditions.

Keywords

DIC, Experimental techniques, helmet, injuries, deformation

STATIC STRENGTH ANALYSIS OF CONSTRUCTION OF MOBILE LIFTING PLATFORM

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Abstract

Manufacturing of railway vehicles require use of many different special support tools which have a role to simplify production process and to increase productivity. Beside, design of these elements requires a special care about worker safety. Subject of this paper is static strength analysis of the mobile lifting platform designed for railway industry. This type of mobile platform is used for worker outside of the wagon body and can provide operation up to 4000 mm. Platform was designed from steel tubes, square and circular cross section joined by welding and moving joints. Hydraulic cylinder, with adequate and controlled initial force, is used for platform lifting and lowering platform. Static strength analysis was done using finite element method by SolidWorks software package. Bearing in mind very complex construction of mobile platform, simplification of numerical model was done. Platform structure was divided in three subassemblies: working platform, folding scissors and lower chassis, and for each of them numerical analyses were performed. In accordance with purchaser requests loads were applied on the working platform, while the reaction force was measured at constraints located on the lower chassis and at the joint between the piston of hydraulic cylinder and scissors structure. Next to primary analysis of the main platform structure, static strength analyses were carried out for fences and stairs. All analyses were accomplished in accordance to valid standards. Obtained results showed that the assemblies of mobile platform, including fences and stairs, are able to withstand load of workers and required equipment without permanent deformation.

Keywords

Railway Industry, Mobile Lifting Platform, Finite Element Model, Wagon Body

Acknowledgement

The research work is funded by the Ministry of Education, Science and Technological Development of Republic of Serbia through national projects TR35045 and TR35006.

INFLUENCE OF THE PART COOLING DURING THE PRINTING PROCESS ON THE QUALITY OF POLYMER PARTS PRODUCED BY FFF/FFD METHOD

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Abstract

Experimental investigation of the influence of the part cooling direction on the printed part quality was carried out, as well as intensity of the wind flow. One of the key reasons for this kind of experiment is that most widely used commercial 3D printers produce parts that have uneven quality along its geometry when using out of the box air deflector. Experiments were carried out on the Anycubic i3 3D printer using PLA filament that requires adequate air flow for proper curing of the part. During printing process, custom made air deflectors were used. In addition to the original air deflector, which is in the direction of one axis (+X), three other constructions of the deflector were used, which were previously printed on the printer itself. First air deflector direct air flow in two directions (+Y and -Y). Other two were ring-shaped made therefore directed air flow all around the printing zone with 12 and 30 holes equally distributed in a circle. The experiments were performed on the test part using identical values of print parameters in order to minimize additional factors that causes variability of the print quality (nozzle temperature = 200 °C, bed temperature = 60 °C, printing speed = 80 mm/s, layer height 0.2 mm). The experiments showed that best results can be achieved using a ring-shaped air deflector with 12 holes and with 100% air flow. This type of air deflector is recommended to use in further works, instead of out of the box air deflector.

Keywords

Fused Filament Fabrication, Air deflector, Air flow, PLA, Print quality

Acknowledgement

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VARIABLE LAYERS THICKNESS OPTIMIZATION OF THE PLA PARTS FORMED BY FFF/FFD METHOD

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Abstract

This work presents experimental study of the influence of layer thickness on surface quality and printing time using FFF/FFD method. Better surface quality of the printed part is achieved using thinner layers. Print time and achieved surface quality are in indirect correlation, on what basis, in order to satisfy both goals, detailed study needs to be done. Implementation variable layer thickness along Z axes can led to significantly reduction of printing time, but in the same way maintaining desired surface quality of the printing part. By applying in the variable thickness of the layers, mostly benefits were obtained in zones where is a large change in the geometry in the part between the layers, such as spherical, conical, curved, and other shapes of complex surfaces. Constant and variable layer thickness experiments were conducted with bio-based polymer PLA on benchmark specimens. Constant thickness of the layers was 0.1, 0.2 and 0.3 mm, while variable values of the layer's thicknesses were form 0.1 up to 0.3 mm in steps of 0.04. Four specimens were produced on 3D printer with same printing speed of 60 mm/min, nozzle temperature of 205 °C and bed temperature 60 °C. After detailed microscopic study of the printed benchmark specimens, can be concluded that from the aspect of printing time and surface quality, optimal results can be expected when using variable layers thickness. In this way, good balance between printing time and surface quality is achieved.

Keywords

FFF/FFD, Variable layers, PLA, Surface quality, Print time

Acknowledgement

The author wishes to thank the Ministry of Education, Science and Technological Development of the Republic of Serbia for providing financial support that made this work possible (by the contract: 451-03-68/2020-14/200105).

Numerical Methods

Invited lecture

RESEARCH WORK IN THE FIELD OF PASSIVE SAFETY OF RAILWAY VEHICLES IN SERBIA

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Abstract

Joint Stock Company for Passenger Railway Transport “Srbija Voz“ and for Freight Railway Transport “Serbia Cargo” has a different types of passenger wagons, freight wagons, electric-multiple units (EMU) and diesel-multiple unit (DMU) as well as locomotives that are not equipped with passive safety elements. With the aim to increase safety of these railway vehicles, with respect of requests defined by valid standards EN15227 and EN12663 directed to the modern concept of the bearing structure, intensive research work in the field of passive safety on different types of absorption elements was realized. Experimental and numerical investigations were realized on the following types of energy absorbers: tubes of square cross section which use folding process for energy absorption, circular seamless steel tubes which use expanding and shrinking deformation process as a ways for energy absorption, combination of two deformation processes at the same time (shrinking-folding and shrinking-splitting) and shrinking circular steel tube filled by rigid polyurethane foam. Experimental investigations were performed in a laboratory conditions as well as in the real environment by collision of two passenger coaches. Numerical models were formed for mentioned types of absorber by using ANSYS software package and validations of them were done by experimental results. Developed numerical models were used for additional analyses of the impact of main parameters to absorption characteristics, as well as for dimensioning of absorption elements. As results of investigations shown that the shrinking circular tube absorber has most acceptable absorption characteristics, the one of possible mounting way of this type of absorber in the bearing structure of passenger wagon was suggested.

Keywords

Energy Absorber, Experimental Investigation, Numerical Model, Shrinking Tube Absorber

Acknowledgement

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BUCKLING OF LAYERED COMPOSITE PANELS: COMPUTATION AND EXPERIMENTAL RESULTS

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Abstract

Attention in this work is focused on buckling load and post-buckling behaviour of an axially compressed the carbon epoxy composite (CFC) layered panel. A description of test specimens, testing equipment and instrumentation is given. The problem of deriving the buckling load from the test data is discussed. A comparison between experimental and computation results is made for buckling load and post-buckling behaviour of the layered composite panel. In this work the buckling behaviour of axially compressed layered composite panels is studied by means of Finite Element Method (FEM). For this purpose and for the investigation of the failure responses improved 4-node layered shell finite elements based on Higher Order Shear deformation Theory (HOST) is used. A series of experiments were conducted to verify the FEA-results. Test results are compared with computation results using Finite Element Method (FEM). To determine buckling load of axially compressed composite panel here strain gauges are used. Strain gauges were applied on both sides of the layered composite plate in loading direction. The composite plates were tested in a special tool that was attached to an «SCHRENK» test machine. To determine stability behaviour of composite panel here non-linear finite element analysis is used to determine buckling load and post-buckling behaviour. In this investigation the complete methodology for buckling and post-buckling behaviour of the axially compressed composite panel is illustrated. Methodology is based on using strain gauges for strains detection or transducers for displacements detection. Experimental results are compared with experiments. Good agreement between experimental and non-linear finite element results is obtained.

Keywords

Composite Panels, Buckling Behavior, Finite Elements, HOST

Acknowledgement

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NUMERICAL SIMULATION OF AIRCRAFT WINDSHIELD SUBJECTED TO BIRD IMPACT

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Abstract

This work considers numerical simulation of aircraft windshield structures subjected to bird impact. These events are usually simulated through numerical approaches due mainly to the technical difficulties and high costs associated with experimental tests. The consequences of bird impact can be severe and, therefore, the aircraft components have to be certified for a proven level of bird impact resistance before being put into service. Bird impact poses serious threats to military and civilian aircrafts as they lead to fatal structural damage to critical aircraft components.

Among a large number of structural tests an aircraft structure needs a certification requirement for a proven level of impact resistance against bird impacts. Bird strike experiments are very expensive and henceforth explicit numerical modeling techniques have grown importance. The theoretical approach and results of numerical simulations of dynamic response of aircraft windshield loaded by the bird impact are presented. The finite element model of bird impact on the windshield was established to predict the damage initiation and propagation of the windshield after bird impact via the nonlinear finite element method,

The numerical simulation is carried out using smooth particle hydrodynamics (SPH) method running in the nonlinear explicit finite element code ANSYS AUTODYN. The focus is given to the validation of the stress, strain and deflection of aircraft windshield on the impact zone. The dependency of given parameters on the variation of ellipsoidal bird aspect ratio, impact velocity and aircraft windshield design details was discussed. As well, some results of experimental data were given.

Keywords

Aircraft wingshield structure, impact birds, numerical simulations, SPH model, finite element method

Acknowledgement

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MATHEMATICAL MODEL OF SPREADING DISEASE IN WUHAN CORONAVIRUS

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Abstract

In this paper is developed mathematical model of spreading disease in novel coronavirus, named COVID-19 that emerged in Wuhan, province Hubei, China. New virus from coronavirus family is third one, following SARS in 2003 in China, and MERS in 2013 in Saudi Arabia. As of may 2020 about 4.2 million people were infected with more that 284.000 deaths around the world. Majority of countries were infected, where emergency measures are employed to limit the number of infected persons and deaths. Here we develop mathematical model of spreading disease based on source, host, reservoir and people model. It is assumed that source of infection are bats, and that virus is transmitted to intermediate host that is assumed to be wild animal like snake or pangulines, and reservoir is assumed to be sea and wild animal market in Wuhan where people are infected. Mathematical model gives the commonly used function that serves for estimation of virus duration and phases, and expectancy of infected, dead and recovered people. Statistical data fit well in mathematical model. Less infection appear if duration period and the peak of function is lower, or function is more flattered. Analysis of mathematical model is given.

Keywords

Mathematical model, Wuhan coronavirus, spreading disease, mathematical model analyse

STRUCTURAL INTEGRITY AND LIFE ASSESSMENT OF PRESSURE VESSELS - RISK BASED APPROACH

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Abstract

Risk based approach to assess structural integrity and life of pressure vessel has been presented, starting from EU PED 2014/68 and API 581, ending with use of basic fracture mechanics parameters. In the scope of risk matrix, structural integrity has been tackled by use of the Failure Assessment Diagram (FAD), while structural life was assessed by means of Paris law, using fatigue crack growth rate as relevant parameter. Several case studies have been provided to illustrate this comprehensive approach, including penstock and air storage tanks in Reversible Hydro Power Plant, and two spherical storage tanks, one for vinyl chloride monomer (VCM), the other for ammonia. Besides the assessment of integrity and life, including some important issue like over-pressurizing, roles of engineers and managers in this process is defined and explained.

Keywords

Structural integrity and life, pressure vessels, risk based approach

STRENGTH CALCULATION AND OPTIMIZATION OF BOAT CRANE

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Abstract

By inspecting the existing constructional designs of boat cranes and the requirements which need to be fulfilled, the new constructional design of the boat crane is made. After determining the critical position of the crane in the form of a load, calculation of the inside diameters of cylinders is made and optimized depending on the maximum axial force. Numeric calculation of the stresses and total deformations in software ANSYS Workbench has proved that the design of crane has met all the requirements imposed on the strength. After designing the boat crane and performing the strength calculations, it is necessary to analyze the motion of the designed crane construction. Boat crane is designed with hydraulic cylinders and rotation around the shaft using a hydraulic motor. Therefore, it is necessary to create a scheme of a hydraulic system of the crane. During the designing and strength analysis, no material exploitation was taken into account and reinforcements were added only to reduce the equivalent stresses and the maximum total deformation of the crane. Due to the possible oversizing of the reinforcements, the optimization was performed by the response surface optimization method. Optimization was performed to minimize the mass and it has been found that the construction was oversized and the mass was reduced by almost 14 kg.

Keywords

Strength, Optimization, Boat Crane.

New Technologies

REVERSE ENGINEERING OF MACHINES AND EQUIPMENT AS AN OBJECT OF PATTERN RECOGNITION THEORY

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Abstract

The analysis of the concepts used for engineering analysis of existing product samples is given: Repair, Reverse engineering, Redesign, Repurposing. In all cases, there is a decryption phase consisting analysis of technical state and identification. The identification involves the analysis of a design, the identification of units that make it up, the definition of technical specifications and the complete reproduction a technical documentation of existing product. The analysis of technical state and identification are presented as a pattern recognition process. The problem of further use of the product after identifying the causes of destruction and studying the design and functionality is presented as the process of recognizing the project type: Repair, Redesign, Repurposing, etc. The decision rules for identification, technical state analysis and recognizing the project type has been developed. The real case of a granulator accident is considered. The cause of the accident was damage to the transmission. The nature of the damage has been described. The developed approach was used to analyze the technical state and identification the transmission parameters. The design structure matrix and the morphological map of damage were used to determine the root causes of the transmission failure and the damage scenario. The type of reverse engineering project has been determined in accordance with the proposed classification it was "Copy assemble". The design of the transmission unit with the same functionality and mounting dimensions, but higher durability has been developed. The new transmission unit design has been manufactured and successfully tested.

Keywords

Decision rule, transmission design, damage morphological map

CONFERENCE REGISTRATION MANAGEMENT APPLICATION

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Abstract

In this paper is developed application for conference management registration, built in programming language #C, in programming environment Visual Studio 2017, as Windows Form application. Aim is to develop application in order to manage and obtain necessary data in electronic form about participants, conference papers, and other requested information for further processing and archive. To build the application, necessary forms and database with tables are explained and designed, and program code in #C is written. Today it is a must to have electronic conference registration management application. The aim of the paper is also to provide open access code for conference registration.

Keywords

conference registration management, application, programming, #C, Visual Studio

CAI VERIFICATION OF THE MEASURING PATH FOR CMM INSPECTION

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Abstract

Coordinate measuring machine (CMMs) are recognized as a flexible element of production metrology, and they are applicable for inspection planning and measurement of a wide range of metrological tasks (tolerance). From the other side, metrological tasks depend on geometrical and metrological complexity, desired quality and number of tolerance, etc. of workpiece and it is very important to verify measuring process before execution of measuring path on CMM. Verification of the measuring path for inspection planning of workpiece is important in order to visualize collision check between main elements of the measurement systems (measuring sensor, workpiece and fixture). In this paper, a proposed concept for verification of the measuring path through simulation is realized on the configured virtual CMM in the CAD/CAM environment for inspection of prismatic measuring parts which consists of the basic geometric features. The generated measuring path for inspection planning at the CMM consists of three sets of points. On the basis of these three sets of points, the total measuring path without collision is generated and verified by simulations on a configured virtual CMM through several examples of standard forms of tolerance-tasks. The verification of measuring path is first visualized in MATLAB and then through simulations in CMM module of PTC Creo. Output from the simulation on virtual CMM, i.e. generated measuring path, is saved in CL file (DMIS program). When CL file is generated, development of a postprocessors leave the possibility for creation of control data list for different CMMs. Proposed concept for CMM simulation and its output could be useful for other CMMs producer.

Keywords

CMM, CAI, Simulation, Inspection Planning, Measuring Path

Acknowledgement

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CONCEPT DEVELOPMENT FOR ROUGH MILLING OF FREE FORM SURFACES

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Abstract

A new research was made in the field of free form surfaces machining at the Faculty of Mechanical Engineering in Belgrade, focused this time on rough machining of free form surfaces. This paper describes the development of this concept which is used when machining is not possible to be performed in one pass with ball end cutter. Based on a loaded CAD model of the workpiece and part, the developed system makes a machining simulation for ball end mill in one pass. In certain cases, when removing material in one pass is not possible, the system will provide two options for rough machining. The first option obtains an approximate shape of the free form surface for machining with end mill cutter in case the generated stock allowed parameter has an appropriate value for machining in one pass with a ball end cutter. The second option for rough machining with ball end mill performs two or more passes, maintaining the maximum allowed cut depth for the chosen tool in every single pass. After the final pass, the tool would be moved to next leading plane. The decision which option to choose out of these two depends heavily on the machining time generated by the machining simulation, which is supported by the developed system. By default, the system generates NC code for the strategy providing shortest possible machining time.

Keywords

CAD/CAM systems, Free form surfaces, Rough machining

Acknowledgement

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CIRCULAR FASHION MUST NOT BE LUXURY BUT LUXURY FASHION MUST BECOME CIRCULAR

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Abstract

Fashion may be presented in general public and media as a trivial and lightheaded discipline but it created new culture and trade routes such as Silk Road and went through many changes during time. Through ages one thing remained the same - fashion was never about the clothes. Since the dawn of fashion, it helped people define themselves and position in the society. Fashion today is a huge global industry that employs 60 million people worldwide and has a revenue of \$2.5 trillion in 2017 with prediction of doubling in the decade to come. The success and these numbers are not about the textiles and threads but about the idea of status and owning an object of desire.

This fast growing industry is an even faster and bigger polluter with 10% of global carbon footprint and 1.2 billion tones green gas and is the second largest polluter of fresh water. Another great problem of the fashion industry is its accelerating speed leaving behind a huge amount of unused and non-recycled clothes.

Even though many steps and ideas are suggested to suppress the problem – the real push forward would be to change the global outlook on the matter and make sustainable and circular clothes fashionable and objects of desire through media.

Keywords

Fashion design, circular design, circular fashion, new materials

COOPERATION IN DIGITAL DESIGN DRIVEN BY EMERGING INTERNATIONAL STANDARDS

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Abstract

The growing acceptance of BIM technologies in AEC companies has led to the development of numerous applications that address certain aspects of the profession. There is a need to regulate the management of various digital building formats that occur in this process. Recently, two international standards appeared that introduce a unified approach to this issue. Building Collaboration Format (BCF) provides a unified format that allows the exchange of information about the observed problems in the models, where only the data about the problem and its location on the basic BIM model are transmitted. Based on this format, the cloud service BIMcollab was developed, which enables centralized management of all issues on the BIM model. The ISO 19650 is the set of standards that regulate organization of information about construction work. The standard provides guidelines for both information organization and information management processes. The central theme of these standards is cooperation at all levels of BIM model development. All processes involve a circular cycle of adoption in which all stakeholders must agree with the proposals. The standard provides many concepts that help to regulate a process. Common Data Environment (CDE) defines that whole process must be carried in one agreed source of information that is central point for collecting, managing and disseminating each information. The project information is collected in federated models from information containers originating from different project stakeholders. ISO 19650 defines BIM as a collaborative process of information delivery in accordance with organisational, asset and project information requirements.

Keywords

BIM, Federated Model, Model Management, BCF, ISO 19650

Acknowledgement

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DECISION MAKING ON RADIOACTIVE IODINE TREATMENT FOR PAPILLARY THYROID CANCER USING NAÏVE BAYES CLASSIFIER

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Abstract

Introduction: The majority of patients who are diagnosed with papillary thyroid carcinoma (PTC) undergo total thyroidectomy followed by selective radioactive iodine (131) therapy (RAI) and/or thyroid-stimulating hormone suppression therapy. While a skilled physician may more reasonably determine whether a patient should undergo RAI therapy or not, this is still a complex task for those lacking experience. In this study, we proposed a Naïve Bayesian classifier (NBC) model that helps students and young physicians to decide if patients should be treated by RAI therapy or not.

Methods: This study was conducted on 210 PTC patients who had undergone total thyroidectomy at Institute for oncology and radiology of Serbia. All of them were classified based on demographic characteristics of patients and clinic-pathological characteristics of tumors. These variables were used to establish inputs of NBC. The whole set of data has been divided into two groups: training group (140 patients) and the group for testing (70 patients). These groups were generated by random splitting.

Results: By comparing the results acquired through the proposed NBC model with those resulting from the physician's decision, we determined that NBC showed identical decision in 65 of 70 patients in testing group. It has obtained different solution for five patients. The accuracy achieved during testing was 92,86 %.

Conclusion: Our research indicated that Naïve Bayesian classifier could support the decision making in RAI treatment of thyroid cancer patients.

Keywords

Naïve Bayesian classifier, papillary thyroid carcinoma, radioactive iodine (131) therapy

VIRTUAL LABORATORIES IN TEACHING

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Abstract

Virtual laboratories were created by the implementation of new IT in education and are integral part of the modern teaching environment. In the absence of real laboratories, in distance learning and due to multiple resource savings, specific platforms have emerged to simulate experiments from different scientific fields. Thus, artificial intelligence, computers and related equipment have become an important segment for performing the necessary testing and experimental procedures in schools and faculties, providing direct insight, interactivity and multimedia resources for both students and teachers. Although configuring virtual labs is complex because it requires resources, tools, time, and finances, in the future they are efficient and cost-effective. Virtual Reality technology allow the creation of virtual laboratories, in which will be simulated the processes and actions that could take place in real laboratories. For engineering disciplines, such as: electrical engineering, mechanical engineering, robotics, automatic control and mechatronics, the implementation of innovative and flexible virtual laboratories in the teaching process is purposeful. This paper presents and analyzes the most important characteristics for several online platforms of existing virtual laboratories. They are available over the internet and the appropriate device (computer, tablet, smartphone), or the use of their resources is paid for. By setting certain parameters, or by choosing the offered ones, simulation tests of components and assemblies in specific systems are realized. Such platforms are increasingly taking on the characteristics of laboratories for real testing, then constantly enriched and improved with new options, and they overall raise the quality of education.

Keywords

Keywords: virtual laboratories, teaching, experiment, simulation, software.

MEASURING THE IMPACT, OUTCOMES AND RESULTS OF THE INNOVATION SUPPORT PROGRAMS

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Abstract

As a driver of socio-economic change, innovation development is exceptionally dynamic. Economies face a major challenge to meet the demands of the innovation ecosystem and effectively support the development of innovation. Taking into consideration the different levels of maturity, a range of different innovation support mechanisms are available, all with the aim of strengthening knowledge-based economies. The question of the choice of support mechanisms arises that will provide effects in a short period of time, given the unpredictability of innovation development and the speed of change. On the other hand, perceiving the effects is a process that is only possible after a certain period of time and is highly dependent on numerous socio-economic factors. Defining a model for monitoring and evaluation requires clear setting of indicators and targets. The challenge lies in establishing a logical model and a quantitative approach to measuring the achieved results against a set of goals. In addition to contributing to economic development, innovations also often solve social problems, which needs to be kept in mind when defining models for monitoring and evaluation.

Keywords

monitoring and evaluation, innovation ecosystem, knowledge-based economies

Clear sky

TENSILE BEHAVIOR OF DIFFERENT COMMERCIAL FILAMENTS USED IN 3D PRINTED PARTS

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Abstract

Recent advancement in 3D printing technology has allowed cheap manufacturing of highly complex parts, especially for prototyping purposes. Aerospace industry accounts for 18.2% of the total AM market today and is considered one of the most promising fields in the future. Nowadays a lot of different 3D technologies are available on the market such as SLA, DLP, FDM etc., with Fused Deposition Modelling (FDM) of thermoplastic materials being one of the most widely used three-dimensional (3D) printing techniques. Therefore, it is essential to investigate the mechanical properties of such FDM processed materials. Most commonly used materials in the FDM process are PLA and ABS, although there are many other commercial filaments available on the market. The main objective of this paper is to investigate the tensile behaviour of PLA (Polylactic Acid), ABS (Acrylonitrile Butadiene Styrene), PET-G (Polyethylene Terephthalate with a glycol modification) and HIPS (High Impact Polystyrene). All specimens were prepared according to ISO 527-2 standard and printed with the same printing parameters where the infill density was set at 100%. SHIMADZU AGS-X 100 kN tensile testing machine was used to determine the tensile properties.

Keywords

3D Printer, FDM, Tensile Properties, Additive Manufacturing

EXPERIMENTAL INVESTIGATION OF MECHANICAL CHARACTERISTICS OF COMPOSITE PLATES UNDER TENSILE LOADING

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Abstract

Expansion of economic development also encourages the need for research, testing and application of new advanced materials. Bearing in mind the development of technology and market dynamics in renewable energy resources, especially wind potential, technology transfer in this field is very significant in all countries where this industry is insufficiently developed. The advancement of wind turbines, as high-tech products and components that require specific high quality characteristics, can influence the modernization of the mechanical industry. For this reason, the development, testing, production and application of advanced high-performance composite materials are of great importance.

The work presents the experimental testing and mechanical behaviour of composite structures under tensile loading. Two types of carbon-epoxy plates and two types of glass-epoxy plates, of the same dimensions but different ply lay-up sequences, were prepared and experimentally tested according to the procedure prescribed by the tensile test standard ASTM D3039. The performance of the samples were first simulated in ANSYS software in order to validate and verify the experimental set-up, and then experiments were performed under tensile loading at the universal electromechanical test frame SHIMADZU AGS-X 100 kN. The experimentally obtained modules of elasticity are presented. The measured values are also illustrated graphically in force-displacement and stress-strain diagrams. The presented results acquired by this test method are important in order to better understand the behaviour of composite structures under various load cases. The obtained information and performed analysis of the measured parameters can be used in further experimental investigations as well as in different comparative studies of conventional and unconventional empirical methods.

Keywords

Composite plate, Tensile test, Stress-strain, Experimental investigation, Displacement.

Acknowledgement

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NUMERICAL ANALYSIS OF SCREW JOINT TURN TABLE AND CHASSIS OF LOW-FLOOR ARTICULATED BUS IK218N

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Abstract

Rapid growth and development of modern technologies led to increased application of innovative solutions in conceptual design and modelling in all fields of engineering. In order to answer to the increased requirements for more efficient means of transport, it is necessary to pay special attention to public transport (meant for a large number of passengers) which is essential in large cities. Since daily frequency amounts to several thousands of passengers, appropriate maintenance and inspection of the most loaded parts have to be conducted regularly.

Low-floor articulated bus IK218N was analysed here. Prototype was completely developed and produced in the Factory of buses and special vehicles – IKARBUS. After years of exploitation in extreme working conditions in Belgrade, a systematic error in the form of screw joint failure at the connecting point between articulated joint and chassis rear part was established. Extreme working conditions imply overloaded vehicles, inadequate, damaged and bumpy roads as well as irregular maintenance. The whole bus was initially modelled in CATIA, which was followed by the numerical simulation of the connecting screw joint by finite element method in ANSYS. The results of structural analysis showed that the screw joints were the most loaded parts which led to their failure. The screws serve to connect the mount and the articulated joint itself. The following conclusion was made: during exploitation, the mount beam lost its initial mechanical characteristics, its deformations reached plasticity which reduced locking forces and led to additional shear load on the screw and its final failure. Consequently, the screw joint had to be redesigned and modified. New solution was applied to low-floor articulated bus IK218N.

Keywords

Low-floor articulated bus, Screw joint, Failure, FEM, Redesign.

Acknowledgement

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EFFECTS OF GROUND AND VELOCITY PROFILES ON AERODYNAMIC PERFORMANCES OF SMALL-SCALE VERTICAL-AXIS WIND TURBINES

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Abstract

The past few decades have been marked by an immense interest of the scientific community in making better use of renewable energy sources, particularly wind energy. One of the suggestions is to increase the number of small-scale vertical-axis wind turbines in urban environment. However, given that they mostly operate in adverse conditions (irregular wind speeds, Earth's boundary layer, vortex trail of surrounding objects), it is necessary to pay special attention to the numerical and experimental estimation of their performances. The conceptual design of small-scale wind turbines usually begins with detailed simulations of the encompassing flow field.

Considered medium-solidity wind turbine rotor comprises three straight blades. Its aerodynamic analysis is complex since blades undergo a wide range of angles-of-attack during every rotation. This induces numerous flow instabilities, separation and interaction between the oncoming blade and the vortex trail detached from the previous. Those are some of the main reasons for the decreased efficiency of this type of wind turbines. On the other hand, their main advantages include: structural simplicity, omnidirectional operability as well as operability in "dirty" winds.

Three-dimensional numerical simulations of fluid flow around a small-scale vertical-axis wind turbine have been completed for ten different working regimes. Transient computations of incompressible, viscous flow have been performed by finite volume method. Aerodynamic performances of the investigated rotor in idealized, uniform velocity stream and a power-law profile (corresponding to Earth's boundary layer) have also been compared. Computed values of power coefficient indicate that a performance reduction of 1-4 % can be expected in real working conditions.

Keywords

Vertical-axis wind turbines, Velocity profile, Ground effect, Finite volume method, Power coefficient.

Acknowledgement

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APPLICATION OF 3D PRINTING IN THE PRODUCTION OF MOLDS FOR THE MANUFACTURE OF COMPOSITE STRUCTURES

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Abstract

The development of AMT (Additive Manufacturing Technology) in the 1980s has contributed greatly to the manufacturing industry, especially in the prototyping process. Transforming a CAD model into a physical model using layer-by-layer stacking is what makes this technology recognizable and unique.

In recent years there has been a significant decline in price and therefore rise in the availability of this technology to the general public. This provided small R&D companies and enthusiasts with limited resources the possibility of designing and developing complex geometry prototypes. In this article, the possibility of applying 3D printing with the FDM (Fused Deposition Modelling) method in the production of a tool for the manufacturing of composite structures is considered.

Two-blade propeller mold which consists of two halves was produced by the FDM method with the goal of achieving dimensional accuracy as close as possible to the CAD model. Selection of printing materials and parameters are based on previous research in this field and were not considered in this article. The geometry of the mold was checked after printing and after the temperature treatment process and then lamination of a two-blade propeller was performed.

Economic and qualitative comparison between tool production by CNC machining and by 3D printing is given. The overall process of 3D printed mold production was analyzed and the application of AM technology in the manufacture of composite structures was confirmed.

Keywords

3D printing, FDM, Composite Structures, Mold production

Acknowledgement

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FRACTIONAL-ORDER PD CONTROL DESIGN FOR ACTIVE VIBRATION CONTROL OF SMART STRUCTURES

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Abstract

Smart structures are obtained by integration of actuators, sensors and controllers into conventional structures and they play an important role in the field of active vibration control, especially in aerospace engineering. Certain elements of a smart structure possess viscoelastic properties which can be modeled by using fractional calculus. The fractional-order model of a smart structure implies the necessity of using fractional order controllers instead of integer order controllers. This paper deals with design of the fractional-order proportional-derivative (PD) controller with robust stability and disturbance rejection. The transfer function of the fractional-order PD controller is parameterized, and these parameters are found by using of the Particle swarm optimization method minimizing a cost function related to the H_∞ norm. The fractional-order model of the smart structure is found by experimental identification by using the frequency response method. In order to represent the efficiency of the proposed controller, obtained results are compared with the corresponding results in the case when an integer-order PD controller is applied.

Keywords

Smart structures, Active vibration control, Fractional calculus, H_∞ control.

Acknowledgement

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ELECTRIC SUBSONIC RAMJET

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Abstract

Subsonic ramjet performances are well known. Due to lack of pressure, usage bellow Mach number 0.7 is practically not possible. Subsonic ramjet application was attractive in the '50s for tip jet applications. There was a study of Fan Augmented Ramjet (FARJ) where a fan was intended to be powered by a piston engine, both in subsonic and supersonic regimes. Finally, there was an attempt for the use of an Electric Ducted Fan with a combustor. Here a study of propulsion system which consists of a pitot intake, electrically powered compressor/fan, combustor and nozzle (Electrically Fan Augmented Ram Jet, EFARJ) is presented. The electric motor connection is direct, without gearbox, which implies usage of a high-speed brushless motor. The idea is to propose a propulsion system competitive to small expendable turbojets at subsonic speeds which would be competitive regarding costs, weight and thrust/consumption. For the numerical example, input parameters were chosen according to an existing small turbojet engine. Further, a direct comparison to a ramjet engine with the same input values is performed. The analysis show that the proposed propulsion system is feasible in certain sizes and that it provides a compromise between performance and simplicity. Finally, the proposed system is composed of available electric motor and existing axial compressor which means that it is practically feasible.

Keywords

Ramjet, electric propulsion, subsonic, turbojet

SURVEY OF UAV POSITIONING AND NAVIGATION METHODS AND METHODOLOGIES

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Abstract

Advances and emerging technologies and innovations in UAV applications improve its applicability in the various civilian and military operations. Unmanned aerial vehicles are becoming more and more the useful tool widening the range of possible applications. While spreading the range of UAV application the need for more efficient and accurate navigation and positioning of the UAV platforms are needed. Generating new solutions for this problem and improving existing ones are going to remain research and development challenges for quite of while in both rural and urban areas. This paper presents of a publicly available navigation and positioning methods and methodologies and compares their main characteristics presenting their most important advantages and disadvantages.

Keywords

Navigation, UAV, positioning, drone, surveillance

Acknowledgement

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PERFORMANCE ANALYSIS OF WIND TURBINES WITH DIFFERENT CHARACTERISTICS

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Abstract

Growing concerns about global warming, environmental pollution and the rise in the price of fossil fuels have led to an interest in developing renewable and environmentally friendly energy sources, such as wind, solar, geothermal, hydrogen and biomass as a replacement for fossil fuels. Therefore, the research of renewable energy, and wind energy in particular, is in constant expansion. Wind energy can provide appropriate solutions to the global climate and energy crisis. The use of wind energy basically eliminates the emission of harmful gases such as CO₂, SO₂ as in traditional coal-fired power stations or radioactive material waste in nuclear power plants.

There has been a tremendous increase in wind energy worldwide over the last three decades. In 2009, the global yearly installed wind power reached 37 GW, bringing the total wind capacity to 158 GW. As the most promising renewable, clean and most reliable source of clean energy, it is expected to occupy a much larger part in electricity distribution all over the world. Wind turbines are types of power plants that use renewable energy, wind, to generate electricity.

The purpose of this paper is to analyze wind turbine with vertical axis - VAWT, that have two or three blades. Two methods were used for preliminary aerodynamic studies and they are BEM - Blade Element Momentum and DMS - Double Multiple Streamtube, usually adopted for early turbine design and rating. The program used in this work is QBlade. Obtained results enable the comparison of computed power curves of different geometries.

Keywords

Renewable energy, Wind energy, Wind turbines, QBlade

Acknowledgement

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THE USAGE OF 3D PRINTING IN THE ANALYSIS OF THE PRODUCT DESIGNING: CASE – ELECTRONICS ENCLOSURE BOX

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Abstract

Additive manufacturing technology has helped many organizations to save time in the design process, in faster decision-making and in reducing prototype costs. The idea of this paper is to design an electronics enclosure box, for a SMART pressure transmitter, using additive technology. All enclosure elements are made on a 3D printer WANHAO duplicator i3 plus, using PLA material. The completely realization of the enclosure, from CAD drawings to the finished model, enables designers to correct existing mistakes or make certain modifications as required by users. A procedure is described where designers can review their procedures at any stage of product realization, which gives bigger freedom and manipulation in rapid prototyping. The advantages and disadvantages of additive manufacturing over conventional production are outlined in this example. The observed deficiencies, are reflected in: mechanical damage to the surface, burning-surface, fracture of printed surface and getting the enormous roughness surface. In order to mitigate the irregularities described, a mechanical and chemical finishing method was used. It is confirmed that the finishing of the samples completely affects the final dimensions and shape of the enclosure.

Further development of prototypes should focus more on print quality, which depends on the shape of the surfaces being realized, the accuracy of the geometry, the uniformity of structure and shape, the material density and the resolution of details.

Keywords

Electronic enclosure, Transmitter, 3D printing, Quality Control

Acknowledgement

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CHALLENGES OF THE ALL ELECTRIC AIRCRAFT

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Abstract

In order to reduce aviation combustion emission air pollution contribution, all electric aircraft is seen as the promising solution. Emerging technologies and research and development efforts are steadily making feasible path toward the goal of the all electrical aircraft widely used in air traffic transport of passenger and goods. Although there are significant number of all-electrical experimental concepts and all-electrical models on the market these are still limited to light aircraft platforms. The challenge remains to achieve the goal of larger aircraft to be all-electrical in order to achieve significant reduction of the emission per passenger or per weight of good transported. Presented research is dealing with identifying the main issues on the issue.

Keywords

Electric, aircraft, battery, hybrid

Acknowledgement

Presented results are part of the research funded and supported by the Ministry of Education, Science and Technological Development of Republic of Serbia.

STATIC ISOGEOMETRIC ANALYSIS OF LAMINATED COMPOSITE PLATES BASED ON DIFFERENT EQUIVALENT LAYER THEORIES

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Abstract

Isogeometric analysis (IGA) is an extension to conventional Finite Element Method (FEM) developed with the idea of unifying Computer Aided Design (CAD) and Computer Aided Analysis (CAE) into an efficient methodology for structural design and optimization. The isogeometric formulation of finite elements is based on NURBS (non-uniform rational B-splines) basis functions of varying degree, the same functions that are used in CAD for geometry definition. In this way, operation of mesh generation in IGA is unnecessary since the geometry that is defined as parametric representation of NURBS is used for representation of field variables.

Behavior of laminated plate elements based on isogeometric formulation and different kinematic models is presented and different aspects of implementation are discussed. Chosen numerical examples highlight the advantages of the isogeometric laminated plate elements over the conventional finite element formulation of laminated plates.

Keywords

Isogeometric Analysis, Laminated Composite Plates, Interlaminar Stresses

Acknowledgement

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DESIGN IN MULTIPLE STAGES OF THE UAV AERODYNAMICS

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Abstract

Unmanned aerial vehicles have found multiple applications in recent years such as surveillance of agricultural and unexplored terrain, postal services, as well as in the delivery of essential medical products to people in the developing world. This paper presents methods for aerodynamic optimization of a compact UAV with VTOL capabilities. Aircrafts such as these usually fly at relatively low speeds and due to that low Reynolds numbers can be expected. The friction drag is highly dependent on the quality of the production process so unless special measures are undertaken, high friction drag coefficients can be expected as well while the changes of the geometrical parameters influence not only the induced drag of the wing, but also the distribution of the base drag. It was of authors interest to analyse the aircraft during a loop so by calculating the specific thrust necessary at the beginning of the loop for each wing load and adding it to the initial performance analysis, optimal wing load was determined. In order to determine the optimal geometrical parameters of the wing, a code for a wide range of performance analysis was written. All necessary factors were calculated by utilizing the Glauert's solution of the Prandtl's equation for multi-segmented wings. By including experimental data of numerous airfoils optimized for low Reynolds numbers, the base drag distribution, along with the induced drag of the wings were calculated for a wide range of angles-of-attack. The obtained results are presented through diagrams and methodology for the selection of the highest efficiency wing is described. The design of the T-shaped stabilizer was achieved by utilizing analytical methods while the Vortex Lattice Method, DATCOM and CFD were used for validation purposes.

Keywords

UAV design, VTOL, Aerodynamic design methods

Acknowledgement

The research work is funded by the Ministry of Education, Science, and Technological Development of Republic of Serbia

OBSERVATIONS FROM LDA RESEARCH OF THE TURBULENT SWIRL FLOW ON THE AXIAL FAN PRESSURE SIDE

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Abstract

Some aspects of the laser Doppler anemometry (LDA) investigation of the turbulent swirl flow behind axial fans in pipes, diffusers and jets are presented in this paper. All three installations have profiled bell mouth inlet, while the fans are built-in in different ways. Namely, in the first case axial fan is built-in into the pipe approximately $27.74D$ long, where D is average inner diameter $D = 0.4$ m. In the second case axial fan is built-in into the straight conical diffuser with the inlet diameter 0.4 m and total divergence angle 8.6° , while in the third case turbulent swirl jet flow behind the axial was observed. In all cases fan impeller rotation number is varied. One-, as well as, two- and three-component LDA systems were applied. Thermal fog seeding was applied in all cases. Time averaged velocity profiles are analysed, as well as the statistical moments of the second till the fourth order. In addition, distributions of the Reynolds stresses are also presented and discussed. Investigations reveal structures, as well as complexity of the three-dimensional, non-homogenous, anisotropic turbulent swirl flows. This stochastic character on the instantaneous level was shown for all three cases. Kolmogorov “-5/3 law” is shown in the case of the circumferential velocity distribution for the turbulent swirl flow in the pipe for various measuring points. Phenomenon of the non-local turbulent transfer and non-gradient turbulent diffusion is studied. The influence of the axial fan duty point on the generated turbulence structure is studied.

Keywords

Turbulent swirl flow, axial fan, diffuser, pipe, jet.

Acknowledgement

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Dental Materials and Structures

Invited lecture

EXPERIMENTAL INVESTIGATIONS IN PROSTHETIC DENTISTRY

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Abstract

Several experimental studies using the Digital Image Correlation Method have shown its' application in prosthodontics research field. Beside scientifically confirmed FEA-mathematical modelling, prepared experimental models were subjected to various extents of loads and successfully utilized for visualisation of DIC virtual models. This paper is aimed to explore the possibilities of the DIC in strain analysing of experimental models restored with contemporary treatment modalities used in prosthetic dentistry so far. This paper showed the possible biomechanical relations between materials and samples during loading. Technologically, different materials/biomaterials were utilized when conducting research investigations: cadaveric bone with and without teeth, dental implants, metal-ceramics, all-ceramics, alloys for RPDs and polymers. Each modality presented in this paper has showed different strategy for load distribution through supporting structures of samples. As previously known, load distribution is depended on the presence/absence of teeth, the design of treatment modality, the materials properties and the relations between treatment modality and supporting structures. The level of structural rigidity of prosthetic construction changed strain rate, strain amount and strain distribution considering different restorations, thus favoured the best treatment choice for specific edentulousness, which is confirmed in this paper. Joining all remaining adjacent teeth in Kennedy class 1 partial edentulism in one single unit using cantilevered metal-ceramics caused different strain distribution compared to hybrid RPDs. Certain amount of strain was found beneath free-end-saddle RPDs and CDs. Preferable axial loading distribution in implant models is depended on the position of the load and angle between implant body and abutment.

Keywords

Metal-ceramics; All-ceramics; Polymers; RPDs; Dental implants; Digital Image Correlation Method

Acknowledgement

I would like to Thank Faculty of Mechanical Engineering for technical support in carrying out the research.

COMPRESSION STRAINS AND DISPLACEMENTS OF SELECTED COPINGS ON REMAINING TEETH FOR DENTURE SUPPORT

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Abstract

The stresses generated to the supporting tissues during occlusal loading significantly influence on design of denture and overdenture copings. The aim of this study is to compare the distribution of strains and displacements on two different designs of copings of the partially edentulous mandible. The method for full field measurement of strains and displacements is three-dimensional image correlation system ARAMIS, that provides a synchronized stereo view of the specimen. The experimental models were partially edentulous mandibles fabricated with SLA 3D printer Formlabs Form2 (Formlabs, Somerville, MA) using standard grey dental model resin – the 1st one with conventional oval design of the copings and the 2nd one with experimental design of circumferential milled copings. The most intensive deformations were under working force of the maximum intensity of up to 1000 N. The crack of the less displaced tooth model was recorded at 500 N. Displacement values of conventional oval copings ranged from -0.45 to +7.07 mm and for experimental copings displacements ranged from -0.01 to +0.54 mm. Strains have shown that the maximum applied force at the final stage for conventional oval copings on supporting surfaces resulted in maximal deformation for remaining incisor with 3.392% value, for canine-0,515% and for premolar-3.391%, but experimental milled copings of remained incisor have maximal deformation of 0.126% value, canine-0.102% and premolar-0.125%. Strains within the remaining teeth roots were influenced by vertical displacement of the caps with particular sentence at the joint site of the cap and the tooth substance.

Keywords

Copings, Overdenture, Dentures, Partially edentulous mandible

POSSIBILITIES OF APPLICATION OF 3D PRINTING IN CONTEMPORARY DENTISTRY

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Abstract

Development of 3D printing in medical and dental applications has advanced significantly in recent years. 3D technologies are commercially available, i.e. 3D printing and 3D scanning, allowing dentists to easily scan and record state of hard and soft tissues following 3D printing of dental models or supporting structures-like surgical guides and aligners. Thereafter, dental technicians work with these 3D printed dental models of upper and lower jaw, as they previously have been working with plaster models, and because of attainable high dimensional accuracy of these dental models 3D printing technology found its way in dentistry and will improve both in today's application and will expand the range of possible applications in dentistry.

The aim of this paper is to present stereolithography (SLA) 3D printing technology of dental working models. SLA technology is mainly applied in rapid prototyping, but due to exceptional dimensional accuracy it easily found its application in dentistry, where accuracy is of utmost importance. SLA technology works in layer-by-layer manner, using UV lasers to polymerize, i.e. solidify, liquid photopolymer resin placed in a vat. Only accuracy issue of this technology occurs when using more layers to build a model, i.e. if an error appears at a certain layer it will stack on succeeding layers and will create notable dimensional mismatch. Materials used in this research are grey standard resin, dental model resin, long-term biocompatible clear resin and biocompatible photopolymer resin. Created dental models are used for planning and making dental crowns and bridges.

Keywords

3D printing, 3D scanning, stereolithography, dental applications.

Acknowledgement

This research is supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, project numbers III41006, III45009, TR 35040 and TR 35006.

FRAME - FOR SIMULTANEOUS SELECTION OF THE TOOTH COLOR AND THE ALVEOLAR PROJECT MUCOUS MEMBRANE.

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Abstract:

Determining the color of a future artificial tooth crown is a very complex and responsible procedure. It depends on the physiological characteristics of the determining and changes in a number of physical factors that change the color saturation and, together with this, the color of the tooth. The mistake made affects the unnaturalness of the artificial tooth crown in the oral cavity, which greatly spoils the aesthetic smile area of the patient. This requires improving methods and methods for determining tooth color in patients, creating new methods and devices to simplify the work of an orthopedic dentist.

Key words:

Color, device, tooth crown.

Relevance:

With the improvement of the quality of medical care, the requirements for the medical manipulations provided also increase.

Most doctors determine the color of the tooth crown using standard color samples of tooth colors. However, the following factors influence the correctness in the choice of color: these are the features of color perception by a doctor and a dental technician, the color of the mucous membrane of the alveolar ridge, lipstick; sanitary and hygienic working conditions (lighting, humidity) [3,4], and other factors [2].

Shofu Dental offers a Gumy mask for choosing the color of the tooth with three colors of the mucosa of the alveolar process.

Due to these factors, difficulties arise when repairing a tooth crown defect with orthopedic structures in important esthetic areas of the patient's smile and choosing the color of the tooth crown [1], which needs to be studied and resolved.

Purpose of the study:

Improve the quality of orthopedic treatment by improving the definition of color, tooth crowns and the mucous membrane of the alveolar process.

Materials and research methods:

1) Make a comparative analysis of determining the color of the crown of the teeth by orthopedic surgeons and dental technicians using available standard samples of tooth colors.

2) Develop a device - to simultaneously determine the color of the tooth crown and the color of the mucous membrane of the alveolar process.

The color of teeth was evaluated for incisors, canines, premolars and molars using standard tooth color samples from different companies (VITA Lumin VACUUM, VITA SYSTE 3D - MASTER, SPOFADENT,

IVOCRYL, VIVADENT TETRIC, VITA classical). The data obtained were recorded in a table and then checked with the data obtained by VITA Easyshade.

Results and discussion:

The obtained data for determining the color of teeth by orthopedic surgeons and dental technicians (Fig. 1) revealed that when working with standard samples of tooth colors, the disadvantages are, the inability to:

- simultaneous comparison of the color of the mucous membrane of the alveolar process in the area of the defect in the dentition of the patient with different color samples of the mucous membrane of the alveolar processes,
- comparison of the color of standard samples of tooth colors and the selected color of the mucous membrane of the alveolar process of the patient,
- simultaneous comparison of the color of standard samples of the patient's teeth colors located on the defect side with the color of two or three adjacent teeth,
- simultaneous comparison of the color of standard samples of the patient's teeth colors located on the defect side with the color of the teeth of the same group (for example premolar) of the opposite side.

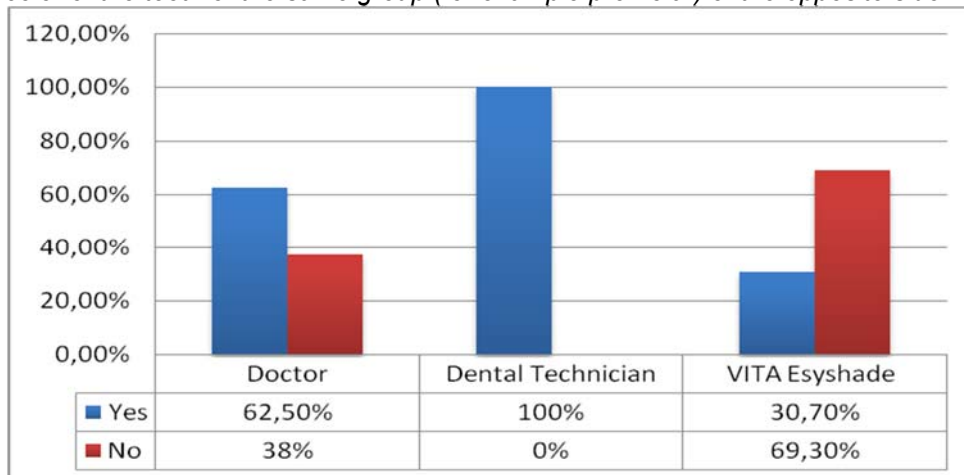


Fig. 1. Comparative analysis of determining the color of the crown of the teeth by orthopedic surgeons and dental technicians are available standard samples of tooth colors.

Doctors, when evaluating tooth color (tone) using standard samples of tooth colors, the match was 62.5%. Due to the fact that the dental technicians chose the color of the future tooth crown, according to the data received from the doctor, using standard samples of tooth colors, the match was 100%. When comparing the color of the tooth crown obtained using standard samples of tooth colors with the data of the VITA Easyshade spectrophotometer, there were only 30.7% matches.

The above disadvantages reduce the reliability in choosing the color of the tooth and the mucous membrane of the alveolar process for the replacement orthopedic design.

The disadvantages of using standard samples of tooth colors when determining tooth color are the duration, insufficiently accurate selection of tooth color for a denture, as well as the inconvenience associated with the inability to select tooth color in comparison with the color of the mucous membrane of the alveolar ridge. When using a Gumy mask, an orthopedic surgeon needs an assistant. A significant drawback of the previously mentioned devices is their use only on the one hand, without taking into account the physiological characteristics of people's vision and color perception.

We decided to eliminate the aforementioned shortcomings, which we developed - a Device for selecting the color of the tooth and the mucous membrane of the alveolar process, used in the manufacture of a denture (patent No. 183678).

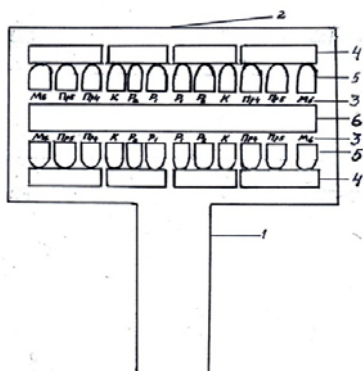


Fig. 2. A device for selecting the color of the tooth and mucous membrane of the alveolar ridge, used in the manufacture of a denture (5).

1. - holder handle. 2. - holder. 3.- inscriptions corresponding to the group of teeth. M1.6 Pr1.5 Pr1.4 K1.3 P1.2 P1.1; R 2.1 P2.2 K2.3 Pr2.4 Pr2.5 M2.6-; M4.6 Pr4.5 Pr4.4 K4.3 P4.2 P 4.1; R 3.1 R3.2 K3.3 Pr3.4 Pr3.5 M3.6;
4. - 4 holes located above 12 through holes of the upper row or under 12 through holes of the lower row. 5.- 12 through holes in the top row or bottom row. 6. - through hole.

The operation of the device consists of the following four main stages, depending on the clinical situation. The doctor fixes the handle of the holder in the hand and in the holder determines the group membership of the missing tooth of the patient according to the inscription corresponding to the group of teeth. Then color samples of the mucous membrane of the alveolar processes are alternately inserted into one hole of 4 located above 12 through holes of the upper row or under 12 through holes of the lower row and corresponding to the designated group of teeth, and compared with the color of the mucous membrane of the alveolar processes of the patient, while looking through : 3 free holes of 4 holes located above or below 12 through holes of the upper or lower row; 12 through holes of the upper or lower row, through hole.

Selecting a color sample of the mucous membrane of the alveolar process, which is most identical to the color of the mucous membrane of the alveolar processes in the area of the defect in the patient's dentition, the color of the tooth crown is selected and its correspondence is compared with the adjacent tooth or the same group of teeth from the opposite side.

Conclusion:

Improving the reliability in choosing the color of the tooth and the mucous membrane of the alveolar bone when using this invention is achieved by three points:

1. the simultaneous comparison of different stains of the mucous membrane of the alveolar process, while changing standard samples of tooth colors;
2. comparison of standard samples of tooth colors and the color of the mucous membrane of the alveolar ridge, located on the side, without the participation of assistants,
3. comparing the colors of standard samples of tooth colors located on the defect side with the color of two or three adjacent teeth of the same group belonging on the opposite side,
4. The high percentage of coincidence of the selected color of the artificial tooth crown by the dental technician is explained by the fact that the dental technician selects the color of the material of the future artificial tooth crown according to the requirements of the orthopedic surgeon.

Currently available methods and methods for assessing tooth color are not perfect and universal. The developed device (Device for selecting the color of the tooth and the mucous membrane of the alveolar ridge used in the manufacture of the denture name 183678) allows simultaneous reliable diagnosis of the color of the tooth and mucous membranes of the alveolar ridge of the jaw, with the possibility of fixing color standard samples of the colors of the teeth of different companies, which indicates its versatility in the working practice of an orthopedic dentist and a dental technician.

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Sustainable Design and New Technologies

BRIDGING SCIENCE-TECHNOLOGY-ART WITH GENERATIVE DESIGN

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Abstract

Since their evolution, human beings designed things by observing nature. Most art and engineering solutions can be traced to nature. Innovative product design is an increasingly demanding task as more and more technology, science, and art are integrated into the product. Collaboration between designers and engineers increases, as more suppliers get involved in the development process. Deadlines become shorter. Overwhelmed by the multitude of responsibilities, engineers hardly have time to find a feasible design, or even less to improve it. Artists find an appealing use of new 3D modelling tools (organic design, organic form, organic structure) that even more complicates the whole design cycle. Unfortunately, most designers lack the knowledge to consider specific functional, structural and technical requirements resulting in unachievable designs. Such a gap creates many difficulties in later product development. Applying generative design as a possible aid provides some optimism in this regard, but it has some downfalls also. Several alternative designs can be produced using algorithms such as topological optimization, morphogenesis, and biomimicry, likewise other algorithms found in nature. As a result, many more alternatives can be considered than it was previously possible.

This paper aims to present some design issues, accelerate product development, and shorten the time to market. The review covers the limitations of today's engineers and the effects they have on design quality. Research on the generative design presents some details of its use, technical considerations, and how to apply such algorithms to design form, structure, or/and function.

Keywords

Generative design, 3D modeling, 3D printing, software tools, biomimicry

SAWDUST BASED HYDROTHERMAL CARBON AS ADSORBENT FOR REMOVAL OF STEROLS FROM WATER

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Abstract

Nowadays, various types of inexpensive, sustainable and renewable lignocellulosic waste materials are increasingly being utilized as precursors for carbon adsorbents production. The usage of the lignocellulosic wastes for production of carbon materials is very attractive from the point of decreasing waste disposal costs and improving environment protection through the waste recycling and producing useful products. In this work, carbon adsorbents were obtained starting from beech sawdust (a waste from the wood industry), and using hydrothermal carbonization, followed by activation in the presence of KOH as an activating agent. By varying the activation parameters, activated hydrothermal carbon (AcHTC) samples with different characteristics were obtained. The specific surface area of AcHTC samples was examined by N₂ adsorption, while the nature and thermal stability of the surface oxygen groups was investigated by Fourier transform infrared spectroscopy and temperature programmed desorption method. The possibility of using AcHTC samples as adsorbents was tested using water solution of eleven sterols belonging to the different classes (human/animal and plant sterols). These sterols, usually present at a very high concentrations in wastewater influent and effluent samples, can cause numerous endocrine disorders and therefore should be removed from the aquatic environment. Obtained results showed that activated carbons based on hydrothermally treated sawdust were highly efficient adsorbents, completely removing all tested sterols from water.

Keywords

Waste beech sawdust, activated hydrothermal carbon, adsorption, sterols

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ADVANTAGES OF USING NEW TECHNOLOGY IN TEXTILE AND FASHION DESIGN

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Abstract

New technology has transformed traditional approaches to contemporary art and design and has led to a completely new forms in the creative world. 3D technologies enable the production process to accelerate. Digital arts are increasingly being used by artists to express their ideas. With the application of CAD/CAM technology, today, the design solutions of designers are realized faster. Advantage of using 3D printing relies in its ability to produce directly based on the CAD model, whose file is the source of information for generating the incremental control file. The specific features of 3D printing can be developed with CAM software based on CAD model, which adapts to the capabilities of this technique. Today the Innovation in the textile and fashion design is in an upward trajectory. Additive production is increasingly available especially with FDM Technology (Fused Deposition Modeling), production on the principle of melting deposit modeling by heating and extruding thermoplastic filaments, proved to be very affordable and efficient. Textile and fashion design is developing not only in the aesthetic sense, but also software programs in which products of textile design and fashion are designed. Textile design in the industry is necessary to return to a sustainable production model. This involves more localized production, and also allowing small design and production houses to be competitive in the market production. With new technologies this is possible.

Keywords

Innovation, 3D technologies, textile and fashion design, FDM method, CAD/CAM technology.

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Bronze medal and Plaques at the 20th International Exhibition of the RS Innovators' Union held in Banja Luka, entitled "Inost Youth" 2019; 35-International Exhibition, Inventory, Belgrade 2018, Gold Plaque and Medal, Air Force Home, Zemun, 2018; Silver medal and Innovation Plaques at the 20th International Exhibition of the RS Innovators' Union held in Banja Luka, entitled "INOST YOUTH" 2018; Silver award, International Fair of Fashion, 1996; Silver award, International Shoes and Footwear, Belgrade, 1997; Plaque for Innovation in International Salon of Comics, 2010; Special award of International Salon of Comics, 2010; ULUPUDS Plaque, May Salon, Belgrade, Serbia, 2010.

FROM BIOMASS TO ECO-FRIENDLY AND SUSTAINABLE FOOD PACKAGING

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Abstract

*New food packaging technologies have been developing as a response to consumer demands and industrial production trends towards mildly preserved, fresh, tasty and convenient food products with prolonged shelf-life and controlled quality. For a long time, polymers have been used as a common packaging materials because they have several desired features like softness, lightness, transparency and good printing characteristics. However, the increased use of polymers has led to serious ecological problems due to their non-biodegradability. Although their complete replacement in the area of food packaging with eco-friendly packaging films is not quite possible to achieve, the use of bioplastics should be the future challenge. The growing use of cellulose nanomaterials (CNMs) for design of new, high performance packaging materials is mainly due to economical availability of the raw materials (in terms of both price and quantity) and advanced knowledge on the chemistry of cellulosic biopolymers. Double-layered thin films (polyethylene layered CNMs/ grey alder (*Alnus Incana* (L.) Moensch) bark) have been manufactured. Cellulose nanofibrils and white grey alder bark extractives are chosen to prepare a strong, sustainable packaging material. Cellulose nanofibrils improved physical and mechanical requirements, while the grey alder bark extractives are used due to its antioxidant and antibacterial properties. The extractives incorporated into a cellulose film improves both, density and surface hydrophobicity. The enhancements in the air-barrier, mechanical, antibacterial and antioxidant properties of the produced thin films have also been observed.*

Keywords

Packaging, cellulose nanofibrils, polyethylene, extractives.

EFFECT OF VARIOUS PLASTICIZERS AND CONCENTRATION ON THE PHYSICAL AND STRUCTURAL PROPERTIES OF BIODEGRADABLE STARCH-BASED FILMS

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Abstract

The development and research of biodegradable plastics is essential for both industrial and commercial applications due to the negative impact of plastics on the environment. About half of commercially exploited bioplastics are made from starch. In this paper, the properties of different types of bioplastics obtained from rice, cassava, corn, and wheat starch were investigated for packaging purposes. Different samples of biodegradable starch-based films (BSF) were made with the addition of plasticizers based on polyhydroxyl alcohols, polycarboxylic acids and gelatin. In the construction of biodegradable plastic films, a greater amount of plasticizer (up to 40%) was added to starch samples that contained a higher concentration of amylose (rice and corn), while lower concentration of plasticizer (up to 30%) was added to those with a lower content. Subsequently, the effect of the type of starch and the type and concentration of plasticizer on the physical properties of the biodegradable films (moisture content, water solubility, and moisture absorption) was examined. FT-IR spectroscopy was used to investigate molecular structure changes and possible starch-plasticizer interactions. Film samples were prepared using casting methods. After testing BSF, it was shown that films without plasticizer adsorb less water than plasticized ones, while water solubility and moisture content depend on the type of added plasticizer. The results of this work show that the type and concentration of plasticizers significantly affect the properties of the starch-based film.

Keywords

Starch; biodegradable plastics; plasticizers

DIGITAL MONDRIAN: THE ARTISTIC COMPOSITION OF AN INTERACTIVE DREAM IN THREE COLORS

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Abstract

This Spatial Installation DIGITAL MONDRIAN: THE ARTISTIC COMPOSITION OF AN INTERACTIVE DREAM IN THREE COLORS is primarily conceived as an artistic educational interactive platform aimed to introduce students and visitors with the artist's creativity, through the unique user experience using this platform. For its base this conceptual multi-media art platform takes the famous Mondrian painting "Composition II in red, blue and yellow", created in 1929 in Paris. In his work, Mondrian used visual elements such as - straight lines, where the horizontal and vertical lines intersect at right angles, thus expressing absolute balance which inspired this installation. User of this platform by walking is changing colors of cubes surfaces and line directions. In the simulation of this spatial installation, users or students have the opportunity to be digital artists for a while, and manage elements by themselves of this legendary work of art, and create their own personal visual and musical composition through lines, directionality, harmony & contrast, repetition, basic colors and all the other elements that make this famous Mondrian master piece so unique. By walking around, in the spatial composition interactive cubes are associated with special Arduino sensors. User is able to change the colors of the cubes to yellow, blue or red, to change the layout and thickness of the lines, as well as the entire spatial geometry. The resulting video file with the process of creating digital Mondrian, and later can be viewed via VR reality technology, where the Interaction with "Composition II" continued in a virtual 3D environment which is one of the goals of this paper.

Keywords

Mondrian, digital, artistic, education, experience, multi-media

PRODUCTION OF SUSTAINABLE DOUBLE LAYERED FOOD PACKAGING MATERIAL

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Abstract

The new generation of packaging materials have been designed in order to meet consumer requirements for eco-friendly, biodegradable, sustainable packaging, containing valuable information about packaged products. Composites and multi layered materials, due to its superior properties, have been replacing conventional packaging. Combination of multiple layers enables preservation of packaged items by combining inherent properties of each compositional material. Use of composite in packaging appears as a compromise toward complete replacement of polymers with biodegradable materials. Some properties of biodegradable polymers (i.e. low mechanical properties) do not allow complete replacement. Cellulose nanomaterials (CNM) have been chosen due to its biodegradability, simple procedure to obtain high amounts of nanoparticles starting from raw material and advanced knowledge on the cellulose chemistry. Amino functionalized multi-walled carbon nanotubes (MWCNT) have attracted great attention due to their unique properties. Covalent functionalization by amino groups increases dispersibility and biocompatibility of MWCNT, and also enables further linkage (through amino groups) of complex molecules that can serve as a biosensor in production of active and intelligent packaging. Besides, MWCNT significantly contributed to the increase of mechanical strength of biodegradable layer. Cellulose nanomaterials (CNM) modified with amino functionalized multi-wall carbon nanotubes (MWCNT) have been incorporated inside biodegradable polymer polycaprolactone (PCL) and placed in a layer on top of polyethylene packaging film. The improvements in the barrier, mechanical and antimicrobial features of such a produced double layered packaging material have been achieved.

Keywords

Packaging, cellulose, polyethylene, MWCNT.

DISPLACEMENT MEASUREMENT OF MEDICAL TEXTILE SPECIMENS USING 2D DIGITAL IMAGE CORRELATION METHOD

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Abstract

Medical textile plays an important role in the technical textiles sector as one of the most rapidly growing sectors in the technical textile market. The textile materials should have some adequate mechanical properties to be useful as medical textile. Tensile strength presents one of the basic mechanical properties used to describe textile specimens. Standardized tensile testing procedures on textile specimens were commonly used in the past. The aim of this paper is to measure in-plane displacement field on the tensile textile specimen using 2D Digital Image Correlation method (2D-DIC). 2D-DIC is a non-contact optical method for accurate displacement and strain full-field measurement. In this study, two medical cotton textiles, with density 120 and 130 g/m², were used to create three specimens for each material. Each specimen was placed in the tensile testing machine and measured until the break. During the tensile testing, camera was automatically recording full-field displacement in X and Y directions. The results showed that materials has similar displacement values. Also, it has been showed that 2D-DIC can play significant role for measurement of textile mechanical properties.

Keywords

Medical textile, 2D Digital Image Correlation method, tensile testing, displacement field

Acknowledgement

This research was supported by Ministry of Education, Science and Technological Development of Republic of Serbia under Project TR35031.

EFFECTS OF DISPERSION AND PARTICLE-MATRIX INTERACTIONS ON MECHANICAL AND THERMAL PROPERTIES OF HNT/EPOXY NANOCOMPOSITE MATERIALS

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Abstract

Halloysite nanotubes (HNT), naturally occurring aluminosilicate nanoclay mineral, have recently emerged as a possible nanomaterial for countless applications due to their specific chemical structure, tubular shape, high aspect ratio, biocompatibility, and low toxicity. In this study, HNT was incorporated into the epoxy resin matrix to improve its mechanical properties and thermal stability. However, heterogenous size, surface charge and surface hydrogen bond formation, result in aggregation of HNT in epoxies to a certain extent. Three specific techniques were used to integrate HNT into neat epoxy resin (NE). The structure and morphology of the embedded nanotubes were confirmed by Fourier-transform infrared (FTIR) spectroscopy and X-ray diffraction (XRD). Tensile testing was carried out and the fractured surface of the tested specimen was analysed using scanning electron microscopy (SEM). The thermal stability of the prepared nanocomposite materials was investigated by thermogravimetric (TG) and derivative thermogravimetry (DTG) studies. The obtained results indicated that improved properties of HNT/epoxy nanocomposite materials were related to the unique properties of well-dispersed HNT, agglomerate scale, and reduced void presence, and could be controlled by the manufacturing processes.

Keywords

Halloysite; Nanocomposites; Mechanical properties; TGA/DTG; SEM

Acknowledgement

This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Contract No. 451-03-68/2020-14/ 200287).

POTENTIALS FOR DESIGNING OUT WASTE WITHIN CIRCULAR CITIES

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Abstract

According to the United Nations report, two-thirds of the world's population will be living in cities by 2050. As contemporary cities play a central role in the global economy, there is a strong need for its transformation towards more sustainable consumption and production patterns, with focus on conserving resources and eliminating waste generation in order to avoid negative effects related to current linear economic system. Incorporation of circular economy concepts into urban life cycles, through new business models, redesigning concept of waste, and with the support of digital technologies, can foster development towards more resilient cities. Several interrelated elements can be discussed in order to prevent city waste generation as: proper collection of product life cycle data (to allow full visibility of product throughout its entire lifespan), bridging of different circular economy business models relied on data of product life cycle at the same time having in mind the material driven sustainable design approach, and process optimization by digital infrastructure for further calibrating waste management systems (e.g. on-time collection and upstream waste separation). This paper highlights the current gaps of existing waste management practices in urban areas, and gives conceptual framework for designing out waste in order to develop sustainable cities in line with circular economy principles.

Keywords

Waste management, circular cities, circular economy.

Business section

TEHNOLOGIKA D.O.O. BEOGRAD

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Abstract

***Tehnologika d.o.o.** Belgrade, as a part of TechnoLogica and DiTra, which represents its CAD / CAM center, over 25 years and with more than 200 employees, has been developing a wide range of services in the field of information technology, systems implementation, software development, consulting and specialized trainings. We are general resellers for Solidworks, Autodesk exDelcam and Creaform software and 3D scanners.*

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GALEN FOKUS

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Abstract

New technologies are becoming a bigger and more important part of our lives every day. Medicine is an area that is constantly looking for new answers and the development of technology enables that search for solutions never stops. Galen-Fokus is a company founded in 1990, based in Belgrade, specializing in the import and distribution of equipment for health care institutions. Galen-Fokus operate with great success in the markets of Serbia, Montenegro, Bosnia and Herzegovina, and Macedonia. Mision of Galen-Fokus is to serve the highest quality and latest equipment from the world's largest manufacturers such as Phillips Respirationics, Leica Microsystems, Leica Biosystems, Vitrolife, etc..

The main activity of Galen-Fokus is the import and distribution of medical and laboratory equipment, primarily microscopes and equipment for the preparation of samples for microscopy, as well as diagnostic reagents and consumables. After decades of successful business scope of activities have been expanding to other areas. Accordingly, Galen-Fokus are present in the industry (quality control), in various scientific and production institutions where microscopes are used to study materials, detect various types of chips, and visually study microscopic preparations.

Keywords

Microscope, Industry, Medicine, New technology.

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