# Book of Abstracts

## 6th INTERNATIONAL CONFERENCE ON MECHANICAL ENGINEERING

# ICOME 2022

**CRAIOVA, May 18-20, 2022**

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**Lucian MATEI, Laurențiu Daniel RACILĂ**

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# Preface

The 6th International Conference of Mechanical Engineering is a high scientific event, periodically organized by the Faculty of Mechanics, University of Craiova every two years.

Starting with the first edition in 2010, the main purpose of the conference was to bring together researchers and specialists from the country and abroad, so that the conference has become the place where the scientists, researchers and industry professionals changes their experiences, ideas and the latest developments activities in the field of mechanical engineering.

The main purpose of the ICOME Conference is to offer to all researchers and specialists in mechanical field from all around the world a large discussion environment, a place to present the newest achievements in research and innovation activities, within the topics:

- Applied Mechanics, Modeling and Simulation in Mechanical Engineering
- Automotive, Transportation and Traffic
- Production Systems, Management and Materials
- Civil Engineering

Like all the past editions, prominent invited speakers from well-known and recognized academic and research institutions and business companies presented the latest achievements in the field of mechanical engineering.

We would like to express our most deep gratitude to all authors for their papers and participation on different topics covering many fields in Mechanical Engineering, and to the reviewers for their time and effort, for sharing their knowledge in order to improve the papers' quality.

With Best Regards,
Editors

UNIVERSITY OF CRAIOVA - FACULTY OF MECHANICS
International COnference on Mechanical Engineering
18th - 20th MAY 2022

# Applied Mechanics, Modeling and Simulation in Mechanical Engineering

# Ellipse's versier –structure and kinematics of the generator mechanism

Alina Duta[1] [0000-0002-8698-1334], Iulian Popescu, Ludmila Sass, Mirela Cherciu and Ionut Daniel Geonea

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**Abstract.** The structural and kinematic analyses of a mechanism presented in the specialty literature are performed. The mechanism is used to plot versiers of ellipses and ellipses. From the structural point of view, the type of the studied mechanism is P-RRP-RPR-RPP-RPP. The positions are determined by using the contour method. The mechanism is represented in a start position along with successive positions. The resulting curve has 2 branches. The top branche is obtained when the sign plus is used before a square root whilest the bottom one is obtained when the sign minus is used. When the distance between two fixed lines is modified over a certain limit, other curves are obtained: the Size concoide and curves with egg shape.

**Keywords:** Mechanism of Type P-RRP-RPR-RPP-RPP, Versier of Ellipse.

University of Craiova – Faculty of Mechanics

# Dynamic Optimization of the Controller for the Active Suspension System of a Race Car

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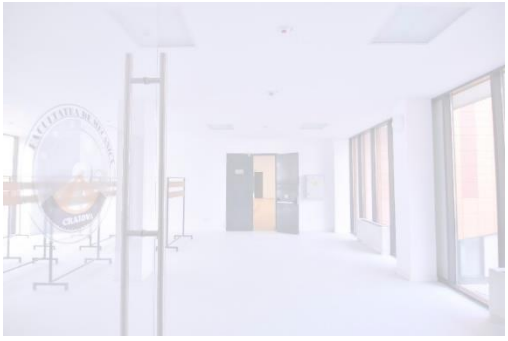
**Abstract.** This work deals with the dynamic optimization of the control system for the active suspension system of a single-seater race car. The suspension mechanism in study is an innovative one, in its design starting from the requirement to eliminate the contradictory variations of some movement parameters in the case of the classic suspension with four-bar mechanism. The suspension system is approached in a mechatronic concept, by using a virtual prototyping platform that integrates MBS (Multi-Body Systems) and DFC (Design for Control) software solutions. The optimization aims at determining the tuning parameters of the controller so that to minimize the wheel track variation.

**Keywords:** Race Car, Suspension, Control System, Optimization, Dynamics.



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# Joints friction in a mobile transversal coupling

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**Abstract.** The mobile transversal couplings are mainly used in movement and torque transmission between two main shafts having parallel axis, with the possibility to undertake misalignments that could appear in the transversal plane. These misalignments between main shafts are usually named transversal movements. Due to this characteristic, the mobile transversal coupling type have a large application in railway transportation systems, as locomotives. Structural, the studied coupling, type Oerlikon, consists by three main components: the input semi coupling, the intermediary element and the output semi coupling. The coupling translation and rotation joints are disposed between these main parts. Starting from some kinematic aspects regarding relative movements between the mobile transversal coupling parts, the paper presents the kinematic equations useful in determining position of the intermediary elements, depending by the transversal misalignments. Following this, using the inside relative movement in both translational and rotation joints between parts and considering corresponding adequate materials, the friction coefficient is studied. The friction which appears in coupling's joints between the involved parts has an important influence on their dynamic behavior, wear and lifetime. The most significant friction and also wear is given by the translational movements between parts and, also, by the alternant rotation movements in corresponding joints between parts, at the ends of their angular stroke. Due to this, the study of the friction between involved materials to be used in coupling parts manufacturing is required, but also difficult because of some particularities, as reduced translation and rotation in joints, for reduced transversal misalignments between the main shafts. The paper final part presents the results and conclusions.

**Keywords:** Coupling, Joints, Friction.

# Design of a Parameterized Mannequin Using Rapid Prototyping Technology

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**Abstract.** This research addresses to a mannequin design in a parameterized mode similar to a four years old child. The designed mechanical system will be integrated in an active exoskeleton, especially designed for children with locomotion problems. Thus there will be performed measurements for a four years old child, in order to acquire the anthropometric data which will be used for mannequin segments design. The mannequin will have a similar design with the ones used in automotive industry at Euro NCAP tests. The finalized prototype will be obtained based on 3D- printing technology.

**Keywords:** rapid prototyping, 3D printing technology, mannequin, exoskeleton.

## Acknowledgement

This work was supported by the European Social Fund within the Sectorial Operational Program Human Capital 2014 – 2020 and by the grant of the Romanian Ministry of Education and Research, CCCDI – UEFISCDI, project number PN-III-P2-2.1-PED-2019-0937, within PNCDI.

# Kinematic and dynamic analysis of a mechanism for assisting human locomotion

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**Abstract.** In this paper we will present a new robotic system designed to assist human locomotion. The purpose of using this exoskeleton is to rehabilitate people with locomotor disabilities. We will present the cinematic diagram of a new mechanism used as the leg of an exoskeleton for rehabilitation. We performed a kinematic analysis of the robotic system. The kinematic study is completed with a 3D design of the exoskeleton, based on which we will perform a dynamic simulation with the multibody analysis program MSC.ADAMS. The data obtained by dynamic analysis are also presented and commented, in order to highlight the performances of this new robotic system proposed.

**Keywords:** robotic system, exoskeleton, rehabilitation, kinematics, dynamic simulation.

University of Craiova – Faculty of Mechanics

# Selective Laser Sintering of Ti Alloy Powders for Hip Implants

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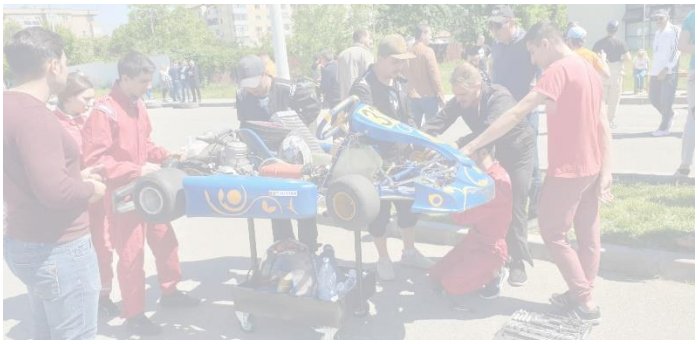
**Abstract.** Selective Laser Sintering, SLS, is a rapid prototyping technique, based on additive manufacturing. It enables fast, flexible, and efficient manufacturing of complex parts, customized according to the requirements of users. Research results on SLS additive manufacturing technique and its specific materials, like Ti alloy powders (Ti-6Al-4V) for hip implants are presented in this paper. The study is focused on various parameters values for the SLS process (laser power, focal diameter of the laser beam, number and direction of laser beam passes) and their influence on mechanical characteristics (strength resistance and fracture surface) of the sintered samples. Some metallographic tests and the electron microscopy evidence the influence of laser spot direction on the sintering process of Ti alloy powders.

**Keywords:** selective laser sintering, Ti powders, strength, hip implants.



University of Craiova – Faculty of Mechanics

# Stresses in Prosthetic Elbow Joint During Flexion-Extension Movement

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**Abstract.** The present paper aims to study the virtual behavior of a prosthetic elbow joint. The values and distribution of stresses in the prosthetic elbow joint by using FEA on the 3D virtual model during flexion-extension movement under the solicitation of a vertical external force are obtained. They are compared with those developed on the human healthy elbow joint. Solid Works software is used in order to obtain the virtual model and Visual Nastran to obtain the von Mises stress by finite element analysis. The maximum stresses values in metallic components of prosthetic elbow are about 4-5 times higher than those obtained in healthy elbow, for a flexion angle equal to 90 degrees.

**Keywords:** Virtual prosthetic elbow, von Mises stress, finite element analysis

## Acknowledgment

This research is supported by the funds of Project 546/2020, code PN-III-P2-2.1-PED-2019-3022, "Innovative modular robotic system for medical recovery of brachial monoparesis-NeuroAssist" funded by UEFISCDI.

# About obtaining a personalized three-dimensional model of a patient using CT images

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**Abstract.** In order to obtain a personalized three-dimensional model of a patient based on CT images, the InVesalius program was initially used, which performs the initial conversion of the analyzed tissues into a specific engineering file composed of the so-called "point cloud". This "point cloud" was imported into the Geomagic program, in which, using reverse engineering techniques, the "point cloud" was initially transformed into elementary triangular surfaces. These primary geometric structures have been edited, transformed, adapted so that, in the end, perfectly closed surfaces are obtained. It was done in this way, both for the bone structure of the head, but also for the dental structure. These complex geometries were loaded into SolidWorks, where they were originally transformed into virtual solids. These geometric structures were loaded and assembled into SolidWorks and interference solids were removed. Finally, a customized three-dimensional model was obtained on which different normal or pathological situations can be analyzed using kinematic simulations or using the finite element method.

**Keywords:** Reverse Engineering, Computer Aided Design, Personalized Human 3D Model.

# Modeling and simulation of an orthodontic system of a real patient starting from CBCT images

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**Abstract.** The paper first presented the stages of obtaining a virtual model of a female patient, aged 13 years and who had multiple dental malpositions. The patient underwent a CT scan, and CT images were initially processed using the InVesalius program and three-dimensional geometries were obtained, both for the mandible and jaw, but also for the dental structure. These primary geometries were processed, edited and transformed using Reverse Engineering techniques in the Geomagic program. Dental alveoli were obtained in SolidWorks using CAD methods and techniques. Bracket elements and orthodontic wires were also generated in SolidWorks. Interference solids have been removed by various processes so that the model is geometrically accurate. Finally, these structures formed of virtual solids recomposed the orthodontic system of the analyzed patient. The custom model was exported to Ansys, where it was analyzed and result maps were obtained. Finally, interesting conclusions and some clinical observations were highlighted.

**Keywords:** Computer Aided Design, Orthodontic System, Finite Elements Method.