Program

of the Student's Conference

held on April 9, 2019
at Faculty of Mechanical Engineering
CTU in Prague

Registration of participants:	room no. 266	8^{00} – 8^{30}
Conference opening:	room no. 266	8^{30} – 8^{50}
Section proceedings:		9^{00} – 12^{30}
Undergraduate section S1	room no. 366	
Undergraduate section S2	room no. 334	
Undergraduate section S3	room no. 337	
Postgraduate section D1	room no. 133	
Postgraduate section D2	room no. 136	
Closing ceremony:	room no. 266	15^{00}

Undergraduate section S1

STRUCTURE AND MECHANICS

Chairman: doc. Ing. Lukáš Horný, Ph.D.

09:00 **Vrba Jan**

Návrh lisovaného spoje na nápravě hnacího dvojkolí elektrické lokomotivy a jeho pevnostní analýza

Design of the press fit of the hub wheel on drive wheelset axle of electric locomotive and its strength analysis

Supervisor: Kolář Josef, doc. Ing. CSc. (12120)

The thesis focuses on quasi-static load analysis of the drive wheelset of the high-powered electric locomotives, on the design of the press fit of the hub wheel on the drive wheelset axle. Physical factors, which occur in higher speeds of locomotives are also included in this design. Moreover, the analytical stress analysis of the designed press fit is done in this paper and the results are compared with the finite element method calculation.

09:15 **Petráš Jaroslav**

Konstrukce laboratorního modelu aktivního magnetického ložiska

Design of laboratory model of an active magnetic bearing

Supervisor: Novák Martin, doc. Ing. Ph.D. (12114,12911)

This paper deals with design of laboratory model of an active radial magnetic bearing, which is being developed in a student grant competition. The main design issue was positioning and attachment of optical displacement sensors of the shaft. Design consisting of two separate modules, one containing the sensors and the other containing electromagnets was developed. The goal of this project is to develop complex operational model, which will eventually be utilized for application combining electric motor with active magnetic bearings.

09:30 **Beňa Jan**

Návrh obrysu vačky pro zážehový motor

Design of cam shape for petrol engine

Supervisor: Tichánek Radek, Ing. Ph.D. (12201)

The content of the thesis is a change in the design of the valvetrain of produced petrol engine. The engine for modifications is choosen by the author of the thesis. The main activity is changing the valve lift curve and change of the engine timing. The thesis contains design of valve springs. The work deals with the possibilities of increasing the performance of the petrol engine.

09:45 **David Petr**

Analýza kompozitových nosníků s průřezem tvaru omega

Analysis of composite omega shaped beams

Supervisor: Padovec Zdeněk, Ing. Bc. Ph.D. (12111)

The main goal of this work is to provide a composite alternative to an already existing beam which has omega cross section. The main part of this work is focused on using the finite element method to solve and optimize the problem. Firstly, a duralumin version will be used to calibrate the computation, then the problem will be solved for different options of slightly adjusted geometry. The computation itself will include general static analysis as well as analysis of buckling.

10:00 **Matušů Martin**

Analýza kompozitové konzole pro leteckou konstrukci

Analysis of composite bracket for airplane construction

Supervisor: Padovec Zdeněk, Ing. Bc. Ph.D. (12111); Sedláček Radek, Ing. Ph.D. (12124)

In airplane constructions is a favor for using lightweight materials such as titan, composite or aluminum alloys. Main difference of replacing a homogenous material with a composite is a difficulty of stiffness and strength analysis. Composite materials have much bigger potential because of complex analysis and exact dimensioning for given load. Analyzed bracket are connecting keel beam of an airplane to ribs with tension bolts. Mainly due to the manufacturing costs composites are replacing the titan version of bracket. Two examples of composite bracets were analyzed - one with exact same dimensions as Ti version (which was analyzed also) and the other one with differently shaped profile. These two profiles are made from carbon reinforced polyphenylene sulfide resin (C/PPS). All analysis were done in FEM commercial software Abaqus.

10:15 **Kubášová Kristýna**

Hodnocení opotřebení fréz pro osteosyntézu dlouhých kostí

Evaluation of wear milling cutters for drilling of nail used for osteosynthesis of long bones of lower limbs

Supervisor: Sedláček Radek, Ing. Ph.D. (12124)

Presented work deals with wear of intramedullary milling cutters for the drilling of nail holes used for osteosynthesis of lower limbs long bones. After the physician's complaints about the increasing resistance and total change of its properties that are caused by the reuse the instrument, we have designed a suitable methodology to verify and quantify this problem. The experiment was carried out on three types of milling cutters, differing in their diameter. For comparison, we performed the experiment in two cycles, before (new instrument) and after wear (milling 100 holes to a depth of about 2 cm). Pressure force and torque were recorded during milling process. Then, using statistical methods, we evaluated the statistical significance of the differences. In most cases, the wear significantly increased the pressure force and torque.

10:30 **PŘESTÁVKA/COFFEE BREAK (C2-438)**

11:00 **Prachenský Jan**

Optická třídící linka pro zpracování vzorku olenatých semen

Oil Seeds Sample Optical Sorter

Supervisor: Hoidekr Jan, Ing. (12113)

The aim of this project is a design and assembly of the optical sorting machine for use as a member of a sorting test rig for analysis of output of oil seeds hulling machines. The machine should have smaller dimensions and cost than its industry counterparts. The machine works on the principle of guiding a carriage trough a contoured groove using a linear actuator. The control is realized by a Teensy board.

11:15 **Soukal Jan**

Konstrukce brýlí pro rozšířenou realitu

Construction of glass for augmented reality

Supervisor: Kovanda David, Ing. (12136)

This article deals with the creation of glasses for the use of extended reality. This glass is designed as an aid for people with a hearing impairment, take the surrounding sounds and convert them into a virtual picture. We describe basic requirements for construction and display principle with the analysis of manufacturing tolerances. The next parameters are good ergonomics, comfortable for using and weight of aid. On the basis of this requirement we describe manufacturing technology and the construction itself. The last chapter are FEM calculations, which are simulating condition during common using.

11:30 **Rytíř Michal**

Aktivní pohybová jednotka pro vyrovnání obrobku
Active positioning unit for workpiece automatic levelling

Supervisor: Fiala Štěpán, Ing. (12135)

This diploma thesis deals with optimization of the active positioning unit for workpiece automatic levelling. The unit is used for levelling of a workpiece in workspace of machine tool and works in automatic mode. It leads to reducing time-demanding manual setting. But nowadays capacity of the unit limits its application. The main disadvantages are low lifting capacity and requirement of supply of a high pressure hydraulic fluid. The goal of this thesis is to prepare a case study for increase a utility value of the unit.

11:45 **Vorlík Jan**

Badmintonový nastřelovací stroj a vybrané parametry letu badmintonového míčku
Badminton training machine and selected parameters of shuttlecock flight

Supervisor: Šafařík Pavel, prof. Ing. CSc. (12112)

Tato práce obsahuje výpočty vybraných parametrů letu badmintonového míčku, popis funkce a konstrukce badmintonového nastřelovacího stroje. V této práci jsou vypočítány tyto veličiny: polodráha letu, poločas letu, výška svislého výstřelu směrem vzhůru a asymptotická rychlost letu badmintonového míčku. U výpočtů jsou uvedeny všechny potřebné vzorce, jejich odvození i popsání. Kvůli tvaru badmintonového míčku je zvláštní i konstrukce badmintonového nastřelovacího stroje. V této práci jsou zde popsány oba hlavní mechanismy stroje, a to podávací a odpalovací. U podávacího mechanismu je zajímavé jeho provedení, které je i předmětem patentového řízení. Stroj je navržen tak, aby vystřelil míček rychlostí 100 km/h.

12:00 **Vodička David**

Teoretické odvození úhlové rychlosti Segnerova kola
Theoretical derivation of sprinkler's angular speed

Supervisor: Šafařík Pavel, prof. Ing. CSc. (12112)

Článek se zabývá dynamikou Segnerova kola. V první části je uveden postup užitý při výrobě kola, a to použití jednoduchých dílů a jejich spojením a technologie 3D tisku. Následuje odvození rovnice pro stanovení úhlových otáček a aplikování tohoto vztahu na dva různé případy provozu. Proudění je uvažováno jako jednorozměrné.

Undergraduate section S2

PROCESSES, TECHNOLOGY AND ECONOMICS

Chairman: prof. Ing. Pavel Šafařík, CSc.

09:00 **Balihar Ondřej**

Vliv způsobu řízení svařovacího procesu na kvalitu odporových svarů
Influence of welding process control on the quality of resistance welds

Supervisor: Kolaříková Marie, Ing. Ph.D. (12133,12911)

The aim of this work is to compare two methods of resistance welding process control and its influence on the quality of spot welded joints. As the base material, 22MnB5 hot-formed high strength manganese-boron steel with an AlSi coating was used for the body strength elements in the automotive industry. The steel sheets were heat treated prior to welding to simulate the heat cycle during hot forming. The heating temperature was 920 ° C and the holding time at 7 minutes, 11 minutes, 14 minutes and 5 minutes. A spot press from Dalex and an Elmatech adaptive control power source were used for spot welding. For the evaluation of welded joints, a mechanized shear test, a measurement of weld diameters was used lenses and metallographic tests.

09:15 **Boxanová Monika**

Přípravek pro navařování citlivých materiálů
Welding jig for sustainable materials

Supervisor: Rohan Pavel, Ing. Ph.D. (12133)

In order to create a high-quality coating of titanium and its alloys, it is necessary to ensure perfect gas protection of the bath from the effects of air oxygen. Inert gases such as argon or helium with a purity of 99.999% are used. Gas protection must be maintained until the temperature drops below 300 °C. If the protection is not good enough, there is an undesirable reaction with oxygen, to reduce the mechanical properties and to discolor around the weld. The paper presents a procedure for the preparation of a welding jig for the welding of titanium and other sensitive materials by the plasma welding (PTA) method. Manufacturing processes and subsequent surfacing are described. The aim of the paper is to create a functional welding jig that provides sufficient protection for the entire process of surfacing sensitive materials.

09:30 **Poloch Adam**

Hodnocení mechanických vlastností niklové superslitiny Inconel 718 připravené pokročilou technologií DMLS
Evaluation of mechanical properties of nickel superalloy Inconel 718 made with advanced DMLS technology

Supervisor: Sobotová Jana, doc. Ing. Ph.D. (12132,12911)

The paper is focused on analysis of mechanical properties and microstructure of nickel superalloy Inconel 718, which is prepared by advanced 3D Direct Metal Laser Sintering (DMLS) (X, Y, XY, Z). The resulting mechanical properties are compared to conventionally produced Inconel 718. Samples produced both in conventional manner and by 3D printing have undergone the same heat treatment method. Light and electron microscopy are used for microstructure analysis.

09:45 **Kment Tomáš**

Analýza struktury a mechanických vlastností slévárenské oceli G22NiMoCr5-6
Structure and properties of steel for castings G22NiMoCr5-6

Supervisor: Sobotová Jana, doc. Ing. Ph.D. (12132,12911)

Tato práce je věnována problematice slévárenské oceli G22NiMoCr5-6 s dobrou svařitelností se zaměřením na výrobu metodou vytavitelného modelu používanou ve firmě Kdynium a.s., kde autor práce působil v rámci praxe metalurga v technologickém oddělení. Je provedena analýza struktury a mechanických vlastností G22NiMoCr5-6 v závislosti na parametrech tepelného zpracování. Byla použita metalografická analýza pomocí světelného mikroskopu, měření tvrdosti, zkouška tahem a zkouška rázem v ohybu v rozsahu -40 °C až 100 °C. V první části vzorky byly kaleny z teploty 950 °C a dále popuštěny variantně při teplotách 560 °C, 580 °C a 610 °C. V druhé části práce je provedena analýza normalizovaného stavu a dále analýza vzorků normalizačně žíhaných při teplotě 940 °C a zušlechtěných za stejných podmínek jako v první části experimentu.

10:00 **Kaňák Michal**

Simulace výrobního systému digitálního modelu továrny využívající aditivní a konvenční technologie
Simulation of a production system of digital factory model using additive and conventional technologies

Supervisor: Kellner Tomáš, Ing. (12134); Kyncl Jiří, Ing. (12134); Kyncl Martin, Ing. (12134)

Nowadays the great emphasis is placed on making production as efficient as possible while reducing production costs. For this reason, before introducing new technologies into production, companies want to make sure that innovation will pay off and will remain competitive. The aim of the paper was to create a model of a digital factory and then to make several variants of simulations. This production system uses additive technologies (3D printing) along with conventional technologies. The simulations were done in Plant Simulation software from Siemens and they should identify bottlenecks in the production system and verify the correctness of capacity calculations. Subsequently all simulations were evaluated and compared with each other.

10:15 **Górecki Jan**

Univerzální nástroj pro analýzu kvality NC programů
Universal tool for analyzing NC programs quality

Supervisor: Vavruška Petr, Ing. Ph.D. (12135)

This article deals with the development of NC programs and parameters analysis of machining process. Software tool analyze from created NC program important parameters like length of linear increments, feedrate, increments in machine axes, reversing rotational axes etc. Mentionted parameters affect final surface quality and productivity of machining. Parameters are color-visualized on the toolpath points. Given color is assigned according to the parameter value. Based on results of analyzing tool and personal experienes the technologist can evaluate risk areas in machining process that leads to deterioration of the workpiece surface and change machining process strategy to improve the quality of the surface and reduce the machining process time.

10:30 **PŘESTÁVKA/COFFEE BREAK (C2-438)**

11:00 **Górski Szymon , Peret Patryk**

Srovnávací analýza odporu dvou modelů vlaků
Comparative analysis of drag force of two train models

Supervisor: Młynarczyk Przemysław, mgr. inż. (Cracow)

The purpose of presented work is the aerodynamic comparison, especially the generated drag force, of the two train models used in Poland. Another thing is the comparison of the resulting drag force for different turbulence models used in the CFD calculations. 3D geometries based on the real dimensions of Pendolino ED250 and Impuls 45WE trains are created in Autodesk Inventor. Numerical flow analysis are carried out in the Ansys Fluent software. This analysis contain comparison of the basic flow parameters and influence of mesh on the results.

11:15 **Sitko Krystian, Gajec Piotr**

Aerodynamická analýza konceptů nízkopodlažních vozidel s využitím softwaru CFD
Aerodynamic analysis of the low-drag vehicle concepts with the use of CFD software

Supervisor: Młynarczyk Przemysław, mgr. inż. (Cracow)

The purpose of this work is the numerical analysis of the vehicle shape influence on the air flow and drag coefficient. Authors proposed four car concepts which must meet special dimension criterions. In the structure must be provided place for a driver seat, steering system and all mechanical components. The all models was designed in 3D program Autodesk Inventor. First chapter present localization of the components and elements in the vehicle. Authors defined the boundary conditions to get the streamlined parameters. In the paper also the calculation methods are presented and described. CFD analysis are carried out for proposed geometries. The simulations are performed with the use of the ANSYS Fluent software. In succession was created comparative analysis. It was used to choose the optimal shape. Paper presents useful application of the CFD calculations for the preliminary elimination of inadequate shapes.

11:30 **Hladíková Libuše**

Charakteristiky letounu kategorie CS-23 s asymetrickým tahem
Characteristics of CS-23 Category Aircraft with Asymmetric Thrust

Supervisor: Klesa Jan, Ing. Ph.D. (12122)

This thesis is focused on computing performance of an aircraft with asymmetrical powerplants and on determining operational limitations of the aircraft caused by different thrust of both engines. The flying laboratory for the flight test is Beechcraft King Air 350. It is a twin Turboprop aircraft, on which one engine has been swapped with a more powerful experimental powerplant. The theory of the ideal propulsor was used to determine thrust and effectivity of the original powerplant, the P&W PT-6A-60A. Calculations of the experimental powerplant were based on a mathematical model matching the performance class of GE Catalyst.

11:45 **Hejna Jiří**

Měření charakteristik modelového dmychadla
Measurement of model fan characteristics

Supervisor: Klesa Jan, Ing. Ph.D. (12122)

The theoretical part summarizes the basic information and principles of compressors of aviation jet engines. The main aim is to explain to the readers the problematics of axial machines. The following chapters describe designing and construction of an experimental facility for testing and developing components of fan propulsion. The thesis evaluates the pros and cons of the used design, especially the manufactory and construction. This bachelor thesis is focused on measuring the characteristics of the model fan. The thesis compares the used methodology of measurement which has been done and tries to optimize it. The final result is the model fan characteristics.

12:00 **Mitrenga Ondřej**

Numerická metoda pravděpodobnosti četnosti větrného proudění a výpočet výroby elektrické energie pro různé druhy elektráren
Numerical method of wind flow frequency probability and electrical energy production calculation for different wind turbines

Supervisor: Dlouhý Tomáš, doc. Ing. CSc. (12115)

A presentation will focus on a theoretical design of the wind turbine for the unspecified location, called "Numerical method of the wind flow frequency probability and the electrical energy production calculation for different types of wind turbines". There will be discussed a program providing with a probability chart, which takes in consideration technical features of modern wind turbines, aiming to build a universal scheme for a wide range of efficient production and economical use, considering different geological and legislatively divergent locations. There will also be a focus on the strategy of wind flow prediction and exact definition of losses, considering both physical and surroundings conditions.

12:15 **Dobrovolschi Olga**

Hodnocení a řízení rizika při plánování vývojových projektů

Risk assessment in the planning of development projects

Supervisor: Beran Theodor, doc. Ing. Ph.D. (12138)

In today`s dynamic business world full of opportunities and business transformations, companies need to become more agile while managing their risk. Risk assessment gives to industrial companies a mechanism for identifying the risks, which can represent opportunities and which, in their way, can represent potential danger. With a smart conducted risk management, project managers take a deep perspective on identifying the risks that could cause a company to fail to meet its strategies and objectives. This study provides a background for future creation of a comprehensive quantitative approach to risk assessment in a project of engineering company. Into account are taken changes coming to traditional risk management process caused by implementing the Industry 4.0 in the automotive industry. The aim of the new proposed approach for risk analysis, is to provide a fertile ground for project managers during planning the development project on dealing with risks and reach the project success with the reduced costs.

Undergraduate section S3

CONTROL AND INSTRUMENTATION, PROGRAMMING, MATH

Chairman: doc. Ing. Jan Hošek, Ph.D.

09:00 **Nečas Martin, Syrový Petr**
Návrh kolaborativního pracoviště kontroly součástí
Collaborative Quality Control Workplace Design
Supervisor: Kellner Tomáš, Ing. (12134); Kyncl Jiří, Ing. (12134); Kyncl Martin, Ing. (12134)

This article treats about automation of dimensional control on Coordinate Measuring Machine using a collaborative robot. Thanks to the dimensional control automation, it is possible to save staff capacity as well as to increase the repeatability and productivity of component measurement in series production. Within the design and implementation of the workplace, the subject of inspection was chosen. Necessary equipment of workplace and variants of workplace layout were designed for the inspected part. The part of workplace realisation was also to create a robot program to fully automate the process, including product placement and placement after component inspection, depending on the measurement result. The result of the project was an automated inspection of components, which could be implemented with minimal modifications to the real manufacturing system.

09:15 **Kuchař Michal**
Vyhodnocení dat z dotykového víceparametrového měření ve strojírenské výrobě
Data evaluation of multiple-parameters measurement in industrial manufactory
Supervisor: Oswald Cyril, Ing. Ph.D. (12137)

This paper talks about evaluating and mathematical processing of data from measuring head made by Amest s.r.o. Solution was made based on real measured data from batched produced bearings. Head is set on straight at manufacture and in time cycle shorter than 5 seconds it measures and evaluates 8 parameters required by customer. On strict controlled measurements it runs with repeatability better than 2 micrometers.

09:30 **Peichl Adam**
Predikce silových a momentových korekčních faktorů pro válcování kovů pomocí AI
Prediction of force and moment correction factors for metal rolling using AI
Supervisor: Oswald Cyril, Ing. Ph.D. (12137)

This project focuses on prediction of force and torque correction factors for metal rolling, which increases accuracy of whole process. The goal is a proposition of a software solution, its implementation and tests on real data delivered by PTSW company. Considering the complexity of mathematical-physical model, we present the method consisting of preprocessing algorithms, neural networks and machine learning. Final module is written in C++ and nowadays it is part of the software packages of PTSW company, which should be deployed in rolling product line soon.

09:45 **Riedl Jan, Cahyna Martin**
Řešení konkurenčního přístupu řídicího HW k řízenému laboratornímu modelu
Solutions for concurrent access of control HW to a controlled laboratory model
Supervisor: Trnka Pavel, Ing. Ph.D. (12137)

This paper deals with the possibilities of solving the competitive approach of two control HWs to one controlled laboratory model. The essence of this work is input / output analog and digital signals routing from laboratory model to PLC and measuring card. We work on the task within the group of diploma theses dealing with the modernization of the automatic control laboratory at the department of instrumentation and control engineering.

10:00 **Mazurenko Nikita**

Netopýří algoritmus v prediktivním řízení dynamických systémů

Bat Algorithm in Model Predictive Control of Dynamic Systems

Supervisor: Hofreiter Milan, prof. Ing. CSc. (12137)

The project is devoted to design and realization of model predictive control algorithm for dynamic systems. The control system is based on a Bat algorithm, that is used for optimization and adjustment of the control variable. The algorithm was developed in MATLAB. Functionality of the control algorithm was verified on a real laboratory system.

10:15 **PŘESTÁVKA/COFFEE BREAK (C2-438)**

10:45 **Krofta Jan**

Návrh řízení aktivního magnetického ložiska

Control design of active magnetic bearing

Supervisor: Novák Martin, doc. Ing. Ph.D. (12114,12911)

This paper deals with control design of an active magnetic bearing. That includes the design of sensors with auxillary electronics, power electronics and robust control strategy. Control algorithm is developed in NI LabView and executed using NI CompactRIO platform. Main goal of the project is creating and testing operational model of an active magnetic bearing. The most significant benefits of such bearing systems include minimization of friction losses and optimization of maintenance expenses primarily in applications with high circumferential speeds.

11:00 **Novák Vítězslav**

Návrh a realizace laboratorní soustavy modelu kvadrokoptéry

Design and realization of laboratory system of quadrocopter model

Supervisor: Bušek Jaroslav, Ing (12110)

The aim is to design a suitable structure and sensorics of the quadrocopter model, which will have one degree of freedom. Weights will be attached to the device and the system will be driven by servo motors. A track-mounted trolley is used to move in one direction, propeller position sensor and trolley position sensor are magnetic, data acquisition is via the Arduino electronic platform and control is via Matlab Simulink. The project is designed for the first phase of quadcopter testing with balancing of suspended weights.

11:15 **Hovorková Vendula**

Simulační model a aplikace pokročilých algoritmů pro řízení kvadroptéry na pojezdu se zavěšeným břemenem

Simulation model and application of advanced algorithms for control of 1DoF quadcopter with suspended load

Supervisor: Vyhlídal Tomáš, prof. Ing. Ph.D. (12137)

The paper deals with control of 1DoF quadcopter with suspended load. The objective of control is to eliminate load oscillation during quadcopter move. To decrease degrees of freedom to single one, the quadcopter ASis attached to a cart, which moves on a linear frame. A dynamic model of the system is derived and then converted to state-space model. Using the linearized state-space model, dynamic analysis is carried out and pitch angle controller is designed. To compensate load oscillation, signal shaper is used. The system is simulated and visualized in Matlab/Simulink platform.

11:30 **Kráčmar František**

Návrh konstrukce a řízení dvoukolového autonomního robota

Frame and control design of two-wheeled autonomous robot

Supervisor: Bušek Jaroslav, Ing (12110)

The aim of this work is to realize the prototype of autonomous robot according to the rules of the competition ARLISS, which is supposed to simulate orbital missions on the planet Mars. The part of the work is an overview of existing approaches to solving the competition task. Subsequently, the development and production of own robot is described, containing chassis design, control electronics and algorithm for autonomous driving, as well as communication protocol for communication with remote location.

Houška David

Programové řešení releového řízení pro TECOMAT FOXTROT pomocí vývojového prostředí Mosaic

TECOMAT FOXTROT relay control program solution using the Mosaic development environment

Supervisor: Hofreiter Milan, prof. Ing. CSc. (12137)

The paper deals with the problems of relay control of thermal systems with passive cooling. In the course of the work, the software for relay control for TECOMAT FOXTROT programmable controllers is designed and simulated. Both the program itself and the simulation are performed in the Mosaic development environment. A system with asymmetric dynamics is considered for simulation. The output of the paper is the discussion of simulated results and the proposal of further procedure including experimental verification.

Postgraduate section D1

STRUCTRURE, MECHANICS, CONTROL AND INSTRUMENTATION

Chairman: prof. Ing. Ladislav Rus, DrSc.

09:00 **Hornychová Alžběta**
Reléová identifikace metodou posuvu s použitím PLC
Shifting method of relay feedback identification with use of PLC
Supervisor: Hofreiter Milan, prof. Ing. CSc. (12137)

This paper shows the use of the shifting method for relay feedback identification. An identification program using this method was created for the programmable logic controller Tecomat Foxtrot. The program finds two points of the Nyquist frequency characteristics from a single relay feedback test and calculates model parameters of the identified system. For this purpose it is assumed that the system is describable by the second order time delayed model. The code was written in the structured text language according to the standard IEC 61131-3. The program was tested on two simulated systems and on a laboratory controlled plant called "Air Aggregate". The obtained results show a good applicability of the proposed identification method for identification of time invariant aperiodic systems.

09:15 **Cejnek Matouš**
Sledování objektů promocí strojového vidění pro automatické stříhání plechů
Machine vision object tracking for automatic metal sheet cutting
Supervisor: Oswald Cyril, Ing. Ph.D. (12137)

Automation of metal sheet cutting increase the effectivity of the metal sheet manufacturing process. The goal of this project is object tracking algorithm that leads to optimalization of the metal sheet cutting process. The suggested object detection and tracking method is composed from multiple machine learning state of the art algorithms. The obtained results are close to the expert human operator guidelines.

09:30 **Dybala Vojtěch**
Simulace zvlnění elektromagnetického momentu asynchronního trakčního motoru lokomotivy napájeného ze střídače
Simulation of the electromagnetic torque ripple of an asynchronous locomotive traction motor power from an inverter
Supervisor: Kolář Josef, doc. Ing. CSc. (12120)

The contribution presents one of some intended steps oriented to improvement of the asynchronous motor calculation model, which is as a part of the bigger simulation whole utilized within PhD study programs and SGS grants to study electromechanical phenomenon in railway vehicles traction drive. The improvement is related to modeling and integration of a pulse-width modulator and inverter for powering of the mentioned motor. As it is supposed, the ripple of the motor electromagnetic torque, which is a result of power supply from the inverter, could have an effect on torsion dynamics of the drive.

09:45 **Hedar Mohammad**
Výběr komponent pro frekvenční měnič pro řízení vysokorychlostních elektrických strojů
Components selection for frequency inverter to control high speed electrical machines
Supervisor: Novák Martin, doc. Ing. Ph.D. (12114,12911)

This paper presents an overview for many ways of controlling high-speed electrical machines, Many topics are presented, new ways and many uses for the high-speed electrical machines and theoretical study of their limits are also presented. The main goal from this paper was to determine what are the best components to build a frequency inverter that can be used to control the High-Speed Electrical machines(mainly from 0 up to 100v) in the best way with the lowest losses, The results of some experiments for testing the best components to build the frequency inverter are reported, the losses for different kinds of components that can be used to design this inverter are also reported, and finally a new kind of these components is proposed to test and use for this inverter in the future work.

10:00 **Udumalpet Kannan Vinit**

Snížení hmotnosti sedadel prostřednictvím modulárního systému pro elektrické ovládání sedadel

Reduction of weight in seating systems using a modular system for power seat actuations

Supervisor: Achtenová Gabriela, doc. Dr. Ing. (12201)

The automotive industry as a whole is striving to breakthrough new grounds in producing environment-friendly vehicles without compromising on performance. The stringent constraints in relation to CO2 emissions from different governments all around the world have encouraged OEM's to adopt different solutions. Due to which in recent years a trend of cutting out weights of different sub-systems in the vehicles has been observed to be one among them. In this paper, the possibility of reducing the weight of the seating systems through a modular actuator system is discussed. On observing the seating systems as a whole it could be noted that the seating system as a whole has not changed much. On comparing the weights of an entry level manually actuated seating system with a high-end luxury motorized seating system, the difference in weight could be almost 100% in certain cases. The demand for luxury in seating systems gave way for motor powered seating systems. The OEM's kept on adding more and more actuators, wiring harnesses and control systems for every manually operated actuation rather than redesigning the seating structure owing to time and cost effects. This trend resulted in the seating systems to be one of the most complicated systems in a vehicle. Thus this paper will discuss a possible solution towards cutting down the weight of the seating system as a whole by introducing a modular actuator design.

10:15 **PŘESTÁVKA/COFFEE BREAK (C2-438)**

10:45 **Havlík Lukáš**

Interakce mezi obráběcím strojem a jeho základem

Interaction between the machine tool and its foundation

Supervisor: Souček Pavel, doc. Ing. DrSc. (12135); Novotný Lukáš, Ing. Ph.D. (12135)

The article deals with the interaction between the machine tool and its foundation. The main problem here is the possible factual uncertainty of this interaction, especially if the machine is placed a different way than in a statically certain way. Uncertainty is meant here, in particular, the ignorance of the actually transmitted forces between the machine and its foundation, and their change in time either by the machine (effects of its own operation) or foundation (transmission of vibrations from the surrounding, or consolidation of the subsoil). The present solution of this state is to directly measure these transmitted forces between the machine and its foundation, which can be performed during machine installation and the alignment of its internal geometry or during its real operation. The author assumes that this solution, together with other necessary prerequisites, will enable to create a generalizable procedure for unambiguous and repeatable alignment of the machine geometry during its installation, to record undesirable vibrations transmitted from the surrounding to the machine, or to capture the excessive vibration of the machine. This solution will allow design more efficiently the fundament or subsoil, and in the case of the development of machine prototypes, the knowledge gained will, for example, make it possible to optimize the number of machine leveling elements and their positioning.

11:00 **Okénka Martin**

Predikce vlivu tepelných změn na prostorovou přesnost obráběcích strojů

Prediction of thermal effects on machine tool volumetric error

Supervisor: Houša Jaromír, prof. Ing. DrSc. (12135); Horejš Otakar, Ing. Ph.D. (12135)

Since a significant and possibly major part of machine tool error is caused by thermal deformation, its compensation has high priority as an accuracy increasing tool. Various methods of compensation have been developed including a dynamic method using transfer functions. Such a method, with relatively minor calibration requirements, has proved to be reliable in the prediction of thermally induced error at one point of a machine tool workspace. This paper focuses on extending the method usability across the workspace. A possibility of extrapolating the predicted deviation of a tool in the direction of Z axis in the calibrated location to the whole workspace is examined. The concept verification on data provided by recently developed volumetric measurement method is presented. Furthermore, data obtained by volumetric measurement of kinematically different machine tools are introduced.

11:15 **Vodička Jan**

Predikce remodelačních změn po implantaci krátkého dříku totální náhrady kyčelního kloubu

Prediction of Remodeling Changes after Short Stem Total Hip Arthroplasty

Supervisor: Horný Lukáš, doc. Ing. Ph.D. (12124)

In this study, I deal with a description and evaluation of remodeling changes after implantation of the short stems. First postoperative image was used to create 2D model of proximal femur with the implant as a geometry for a boundary value problem describing mechanical interaction between bone tissue and hip stem. The problem was formulated by means of finite element method. To evaluate remodeling changes, FEM results were compared to two- years postoperative image. The comparison was based on changes in stress field and changes in principal stress directions. The results suggest, that short stem Proxima helps to restore the orientation of the main groups of trabeculae in the proximal femoral area and reduces the stress shielding effect after THA.

11:30 **Kratochvíl Adam**

Optimalizace systému pro sledování pohybových aktivit během běžného dne

Optimization of Motion Analysis System for Using in Daily Living

Supervisor: Daniel Matej, prof. RNDr. Ph.D. (12124)

Understanding the biomechanics of the human body is important for applications in healthcare, sport, and also in daily life. To optimize a rehabilitation or medical surgeries, improve sport results, or improve daily life of regular people, we need to effectively collect data of their movements during their activities and daily living. Effectively means sufficient amount and suitable types of data. For that purpose, we developed various types of wearable sensors. Started with bulky system placed in a case on a belt of a patient. The system used accelerometer attached to a limb and it was connected by wires to the system. Ended with small, lightweight, and affordable system attached directly to the body, what eliminates any distractions. The system consist of 9DOF sensor and can be extended by surface EMG. The battery has enough capacity for long-term monitoring.

Postgraduate section D2

PROCESSES, TECHNOLOGY AND ECONOMICS

Chairman: doc. Ing. Jiří Hemerka, CSc.

09:00 **Pelikán Lukáš**
Obrábění dílců připravených technologií DMLS
Machining of DMLS printed parts
Supervisor: Beránek Libor, Ing. Ph.D. (12134)

This article deals with technological possibilities of production of functional parts by means of additive technologies combined with chip cutting machining. DMLS technology (Direct Metal Laser Sintering) allows the production of components from different construction materials such as steel, stainless steel, aluminum, titanium and many others. This components offer full mechanical prop-erties after thermal treatment and therefore can be used as functional parts. However, in the case of precision mechanical parts, this technology does not allow production with sufficient dimensional accuracy and surface quality. For these reasons, additional machin-ing may be necessary. However, from a productivity and economy point of view, it is advisable to limit machining to the minimum amount of material taken and, above all, to the minimum machining time. For this purpose, the part should be designed from the be-ginning with regard to further processing.

09:15 **Gurčík Tomáš**
Ochranné atmosféry Air Products pro aditivní technologie
Air Products shielding gases for additive manufacturing
Supervisor: Rohan Pavel, Ing. Ph.D. (12133)

Additive manufacturing methods are considered suitable for technical processes in the manufacture of complex mechanical parts. WAAM together with 3D metal printing are the basic technologies used for additive production. WAAM (Wire and Arc Additive Manufacturing) technology is characterized using welding to create whole structure of mechanical part by cladding weld passes. The WAAM process is characterized by a number of variables, among others the MIG/MAG protective gas shields effects. The aim of this paper is to evaluate the influence of individual components of protective gases supplied by Air Products s.r.o. used for welding the whole structure. Especially both to the resulting component geometry and to the efficiency of the welding process.

09:30 **Mendová Katarína**
Výroba mikrofluidného zariadenia aditívnou metódou
Rapid development of microfluidic device using additive manufacturing
Supervisor: Daniel Matej, prof. RNDr. Ph.D. (12124)

The aim of our project is to create a biological cell model by microfluidics device. The current methods for production of microfluidic devices are complex and time-demanding. Therefore we have proposed, tested and verified a specific technology for the development of microfluidic device using stereolitography. We have produced several types of microfluidic devices: from simple one to devices with complex geometry. We have proved that it is possible to produce uniform unilamellar liposomes with controlled size and shape. The liposomes will serve as biological cell models to test mechanical properties living cells of various fenotypes.

09:45 **Valeš Michal**
Hodnocení vyrobitelnosti povrchových dílů automobilové karoserie z výšepevné oceli
Analysis of manufacturing outer car body parts made of HSS
Supervisor: Šanovec Jan, doc. Ing. CSc. (12133)

Car manufacturers are forced to fulfill strict production limits of carbon dioxide. Therefore, the weight of car body must be reduced. The subject of this article is use of dual phase steel with tensile strength higher than 500 MPa in production of outer car body parts. Stampings used in experiment are parts from current models of ŠKODA AUTO, inc. Attention was paid primarily on crack initiation, wrinkling and springback.

10:00 **Prajer Miroslav**

Metodika predikce transportních nákladů produktu během životního cyklu výrobního zařízení

Methodology for predicting the transport costs of a product during the life cycle of a production device

Supervisor: Freiberg František, prof. Ing. CSc. (12138)

As a result of the globalizing market is the product logistics becoming one of the important cost item within the whole lifecycle of production device. However, shipping costs are very difficult to predict because they can be affected by a number of factors. The objective of this article is to summarize the main factors influencing the transport costs of truck transport of the product and to introduce a propasal of methodology for estimation of transport costs of the product.

10:15 **Budský Patrik**

Jak hodnotit byznys modely

How to Evaluate Business Models

Supervisor: Beran Theodor, doc. Ing. Ph.D. (12138)

This paper deals with the theoretical elaboration of the method of evaluation of the benefits of business models. Its aim is to methodically design and describe the process of evaluating business models based on the analysis of the market value of the company calculated using the present value of future income.

10:30 **PŘESTÁVKA/COFFEE BREAK (C2-438)**

11:00 **Hladíková Martina**

Výroba potravinářských produktů s nízkým podílem laktózy

Production of food products with a low content of lactose

Supervisor: Štancl Jaromír, Ing. Ph.D. (12118)

The aim of the work is to design technologies suited for manufacturing plant-based coconut yoghurts and yoghurts made from hydrolyzed milk for an existing factory of milk products. Material and enthalpy balances are computed, economic evaluation of the projects including what-if analysis of selected parameter is carried out. Designed variants are compared.

11:15 **Jančík Petr**

Vyhodnocení tlaku a síly po kolapsu sloupce kapaliny užitím slabě stlačitelné metody SPH

Evaluation of pressure and force after dam break using weakly compressible SPH method

Supervisor: Šafařík Pavel, prof. Ing. CSc. (12112); Hyhlík Tomáš, doc. Ing. Ph.D. (12112)

This paper presents a solution of a dam collapse flow over a dry horizontal bed in two dimensions using the weakly compressible smoothed particle hydrodynamics (SPH) method. This work focuses mainly on the evaluation of pressure and forces exerted on the downstream vertical wall. First, a pressure evaluation technique suitable for weakly compressible SPH is described. Validation of the technique using experimental data follows, and finally, the total force on the vertical wall is evaluated. Analysis of pressure distribution and total force as a function of time is carried out. All physical quantities are converted into non-dimensional variables for simple comparison with other results.

11:30 **Devera Jakub**

Odpařování vodního filmu z vodorovné izotermální kuželové kavity

Evaporation of water film from horizontal isothermal cone cavity

Supervisor: Hyhlík Tomáš, doc. Ing. Ph.D. (12112)

Experiments on natural convective mass transfer adjacent to horizontal isothermal cone cavity were performed, the water film temperature was ranging from 35°C to 75°C. Water was evaporating to moist air. Analytical equation describing the depletion of mass in cone cavity was derived and used for evaluation of mass flux and averaged mass transfer coefficients from experimental data. Sherwood numbers were determined and correlated as a function of Rayleigh number. Obtained correlation was compared with existing correlation with satisfactory discrepancy and extended the previous range of validity to Ra_m=(1÷400000).

11:45 **Suchý Jakub**

Aeroakustická analýza profilu NACA 0012 pomocí CFD
Aeroacoustical Investigation of NACA 0012 Airfoil Using CFD

Supervisor: Nožička Jiří, prof. Ing. CSc. (12112)

This paper presents an investigation of a two-dimensional approach to numerical prediction of aerodynamical noise generated by NACA 0012 airfoil. The aim of this paper is to investigate this approach as a simple prediction method for aerodynamical noise generated by two-dimensional bodies. The numerical simulation was performed by the commercial software (Ansys Fluent) using unsteady Reynolds-averaged Navier-Stokes (URANS) equations for a flow solution and Ffowcs-Williams and Hawkings (FW-H) analogy for an acoustic solution. The obtained results were compared to available published experimental results.

12:00 **Kachalouski Yauheni**

Kombinace fotovoltaiky a tepelného čerpadla pro ohřev vody a vytápění v domě
Combined photovoltaic and heat pump system for domestic hot water and space heating

Supervisor: Matuška Tomáš, doc. Ing. Ph.D. (12116)

The system combination of photovoltaic modules and heat pump is a very promising way of increasing renewable energy usage for domestic hot water preparation and space heating. The paper deals with analysis of ground-source heat pump connected to the customer domestic hot water and space heating load through the thermal energy storage. This combined system has been studied by means of numerical simulations. The challenging issue in the system is the controller setup. In this research, several ruler-based controller strategies are employed to maximize photovoltaic electricity usage on-site: by means of overheating the building or/and by means of overheating thermal energy storage. These approaches allow to store energy surplus generated by photovoltaics. Comparison between different system control setups and the refence case shows the absolute electricity savings and moreover, the results reveal advantages of proposed combined system and show the ways to maximize usage of the high volatile photovoltaic electricity. The simulation results for NZEB house with heating energy demand of 14 kWh/m2.a indicate solar fraction raise up to 50 % , furthermore such combined systems are able to reach system seasonal performance factors in the range of 6.0.