University *of Ljubljana*
Faculty *of Mechanical Engineering*

Annual Report

2021

University *of Ljubljana*
Faculty *of Mechanical Engineering*

University of Ljubljana

Faculty of Mechanical Engineering

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FACULTY MANAGEMENT

Dean
Prof. Mihael Sekavčnik, PhD

Vice Dean for Education, 1st Cycle
Prof. Franci Pušavec, PhD

Vice Dean for Education, 2nd and 3rd Cycles
Prof. Jernej Klemenc, PhD

Secretary
Tone Češnovar, PhD

Vice Dean for Research and International Relations
Prof. Janko Slavič, PhD

SUPPORTING SERVICES

Faculty secretariat	Andreja Koban Domitrovič
Student office	Nika Vardjan Naglič
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Department of international cooperation, scientific and research work	Tanja Mavrič Rušt, MSc
Department of Economic Affairs and Communications	Katja Pustovrh
Library	Zorka Kešelj
Technical and maintenance department	Vinko Tomc
IT department	Vida Trček
Publishing department	Pika Škraba, MSc, Roman Putrih

WITH FRESH MOMENTUM TOWARDS EXCELLENCE

The Faculty of Mechanical Engineering has been boosted. The orientations outlined in our development strategy of 2019-2025 have proven to be very necessary and welcome; they have already started to show their positive effects in our business and in consolidating the excellent image of our team in the surrounding area. The new management knows this and is committed to continuing the development activities in all areas of FME with full responsibility and dedication. Last year, the COVID -19 pandemic still had a major impact and restricted our activities to some extent, but we have shown and proved that with a well-organised and responsible approach it is possible to carry out lecturing in the classrooms and laboratories and conduct research smoothly. We are proud that we have implemented the RVT conditions for the entry of a large number of FME students and staff helped by a high-tech device developed with the knowledge, staff, and infrastructure of FME. In doing so, we proved to ourselves and the surrounding community that there are no such challenges - no matter how difficult - that do not lead to new thinking, new ideas, new knowledge, new solutions, new innovations, and, last but not least, new entrepreneurial spirit.

The new academic year required thorough preparation, as the study process began in both undergraduate programmes (Professional higher and University) and the Master's programme according to the revised curricula. Last year, special attention was given to organising the implementation of the Master's programme, where students enrol in one of the six sub-programmes while having a broad choice of courses at and outside of FME. In this context, we carried out the enrolment, the grouping of students into courses and electives in a very short time during the summer holidays with a special computer algorithm approved by the FME Senate, which considered the balance between the choice of subjects on the one hand and the equal representation of students in each subject on the other. As lectures for Master's students partly overlap, all lecture halls have been equipped with modern audio-video recording equipment and the contents of lectures are available to students in online classrooms. In addition, the Studo web application was launched in a very short time, allowing students to create a personalised timetable through a single sign-in point, while providing a whole range of additional functionalities for students. With the introduction of such digital solutions, FME is setting new standards and is a role model for other UL members. To attract more excellent high school students to study mechanical engineering, we have introduced "smart" (targeted) communication via digital social media, the creation of short dedicated video content and the revision of the overall presentation of study programmes and activities on FME. All these changes require continuous staff training, which is why we have continued to hold special educational colloquia. The number of incoming (112) and outgoing (35) Erasmus+ student exchanges has returned to pre-pandemic levels, while there were slightly fewer staff exchanges in 2021 due to the pandemic.

We have also renovated the premises where the new OpenLab FME (OLFS) is being built, despite the very restrictive space in the current building. The mission of the OLFS is to create a focal point for student engagement and innovation in engineering at FME. The vision is for every mechanical engineer to become an excellent team player, mentor, innovator, and socially responsible individual who never stops learning. As part of OLFS, student team projects such as the high profile Formula Student and Edvard Rusjan Team, Design Build Fly, will return to FS where students have successfully achieved high profile results at the international level for many years.

Research activities developed in over thirty laboratories, developing specific cutting-edge knowledge in narrow target areas, have been placed in line with a strategic focus in four research platforms: Factories of the Future, Green and Safe Mobility, Health, and Sustainable Energy. Through its research platforms, FME provides excellence in competences in each of its areas by offering innovative, integrated and evolving solutions to industry and by participating in the coordination of major international research projects.

The volume of research activities is increasing with an upward trend, as evidenced by the following figures:

I. EUR 12 million in R&D revenues,
II. EUR 2.5 million in investments in research equipment and ongoing maintenance,
III. 13 successful applications for Slovenian Research Agency (ARRS)research projects,
IV. successful applications for international research projects,
V. 30 % increase in publications (year-on-year) in high-ranking scientific journals (Q1), including 8 articles published in journals with an IF above 7,
VI. 27 % increase in net citations (year-on-year) according to the WoS database.
VII. 12 awards for outstanding publications given to colleagues under 35.

Several years of intensive efforts and investments to prepare project documentation and administrative procedures related to the new building were brought to a conclusion by the end of 2021 in cooperation with the Rectorate of UL, the Chamber of Commerce and Industry of Slovenia, the Ministry of Science, Higher Education and Sport as well as other government representatives, the Government of the Republic of Slovenia has included the new project FME in the European Cohesion Policy Programme for the period 2021-2027, providing much-

Avtor: Sadar+Vuga

needed funding for implementing the project, which with its state-of-the-art facilities and research equipment is recognised as a key project for the green and digital transformation of the Slovenian economy and society.

And it is the above-mentioned encouraging results of our joint efforts that give us the satisfaction of knowing that we are working well and to benefit society. I am therefore even more convinced that the increasingly demanding challenges that the future holds for us will place us alongside the most advanced economies and societies with the new knowledge, original ideas, solutions, and innovations that we create at the UL Faculty of Mechanical Engineering.

Dean of the Faculty of Mechanical Engineering

Prof. Mihael Sekavčnik, PhD

INTRODUCTION

UNIVERSITY OF LJUBLJANA

University of Ljubljana is the oldest and largest higher education and scientific research institution in Slovenia. University with its rich tradition was founded in 1919. It has approximately 41,000 undergraduate and postgraduate students and employs approximately 6,000 higher education teachers, researchers, assistants and administrative staff in 23 faculties and three arts academies. The central building, all three academies and faculties are located in the centre. Some of the most recent and modern buildings were constructed on the outskirts of Ljubljana, giving the university and its students a ubiquitous presence in the city.

The University of Ljubljana is renowned for its quality social and natural sciences and technical study programmes, structured in accordance with the Bologna Declaration. Our projects keep pace with the latest developments in the areas of arts, sciences and technology at home and abroad.

The University of Ljubljana ranks among the top 3% of universities in the world. It has been ranked among the top 600 universities by the prestigious Academic Ranking of World Universities (ARWU); it is placed 384th in The Center for World University Rankings (CWUR), and listed in the 800-1000 group in the Times Higher Education (THE) ranking.

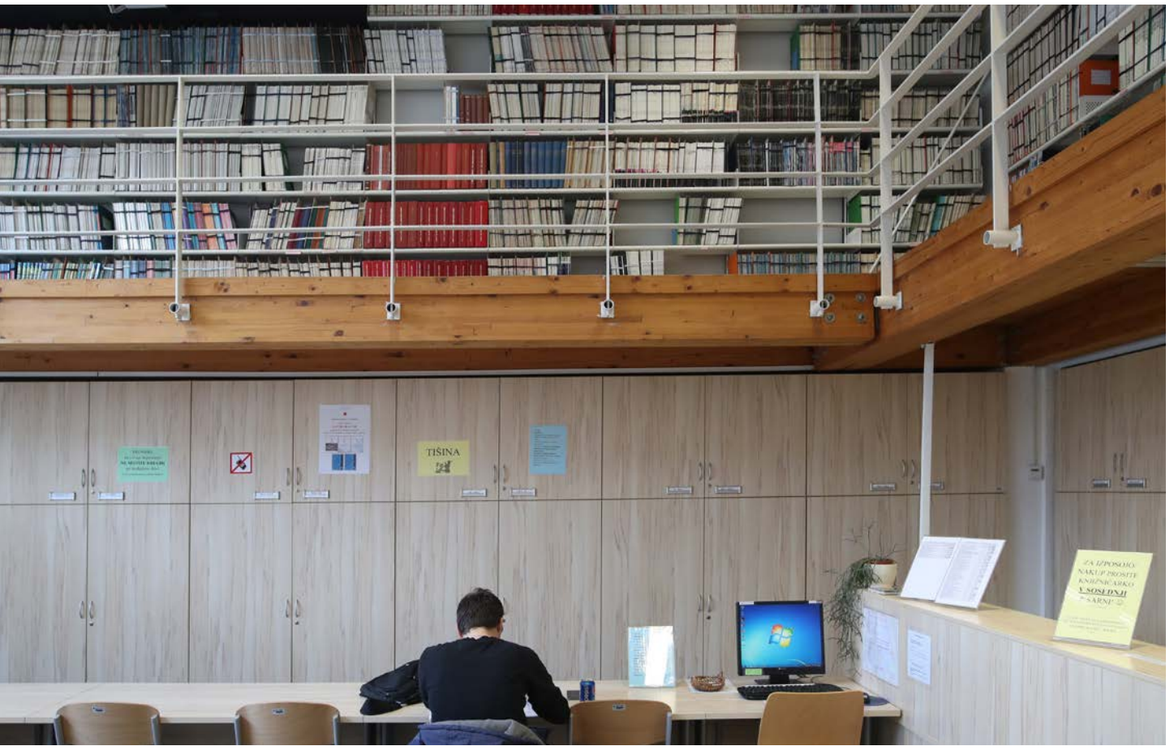
The University of Ljubljana is the central and largest educational institution in Slovenia. It is also the central and largest research institution in Slovenia with 30 percent of all registered researchers (according to the data from the SICRIS database).

The University takes a central pedagogical position by performing public services in the areas of special social importance which ensure the preservation of the national identity.

The University of Ljubljana has close ties with Slovenian companies and foreign enterprises. Our partners include multinational corporations and the most successful Slovenian companies. As we are fully aware of the importance of knowledge and skills in obtaining our own financial sources, we are increasingly developing our market oriented activities every year.

FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF LJUBLJANA

The Faculty of Mechanical Engineering is a member of the University of Ljubljana, and an important educational and research institution with high international standards in the field of mechanical engineering in Slovenia and the wider region of the Central and Southeast Europe. Through the history and with development the faculty overcame the classic understanding of mechanical engineering, since today it offers programmes from numerous specialised engineering fields.



Foundation

Throughout history, technical occupations were well established among the Slovenes, although until the establishment of the University in Ljubljana in 1919, students had to attain their knowledge abroad, mostly in the Austrian universities. After the end of the World War 1, which also meant the end of the Austro-Hungarian rule, the wish to establish our own university, which would include a faculty of technical sciences also came to life. Even before the formal establishment of the University of Ljubljana there were organised lectures for the students of mechanical, electrical and civil engineering. The Faculty of Technical Sciences in Ljubljana was established through the effort by Milan Vidmar, PhD, and it remained in such form until 1957, when the departments of electrical and mechanical engineering were united. In October 1960, under the resolution of the University Board, the Faculty of Mechanical Engineering became an independent member of the University of Ljubljana with study programmes on all three levels. In the beginning it had four chairs – organisational units – where the faculty and assistants performed teaching and scientific work. The faculty was at first housed in the so called old building on Aškerčeva cesta 6; in 1971 it moved into a new building at the same location. Today, the Faculty of Mechanical Engineering of the University of Ljubljana is still located in both buildings.

Today

The Faculty of Mechanical Engineering of the University of Ljubljana is today the largest institution for education and research of mechanical engineering in Slovenia. In-house design and research work, and quality transfer of knowledge to the students and research partners enables a competitive integration into the international environment.

The Faculty of Mechanical Engineering carries out its **educational activities** for all three study cycles in accordance with the Bologna Declaration guidelines. Two first cycle study programmes, the professional and academic programmes, deliver an insight into a wider field of mechanical engineering; the second cycle master's programme is a continuation of the first cycle; the individually tailored third cycle doctoral programme is based on solving problems at the highest scientific level. The educational process in the first and second cycles is carried out in the form of lectures and practicals, where the lectures provide theoretical knowledge, and the laboratories perfect practical skills. The degree, obtained at the Faculty of Mechanical Engineering, is internationally accredited on the European level (ASIIN, ENUA, EUR-ACE), and is equal to other degrees in Europe.

Scientific research work at the Faculty of Mechanical Engineering is carried out in the fields of power and process engineering, design, mechanics and maintenance of machines, production engineering, mechatronics, micromechanic systems and automatisation. The researchers are involved in national basic and applicative projects, and in numerous international projects, actively working with scientific research centres and the industry. Through cooperation with the industry and other institutions the faculty is contributing toward higher economic growth, and is publishing the results of innovation potentials in international scientific journals. Special attention is also given to the education of young and promising researchers, who decide on the career path in research also because of the tenders from ARRS (Slovenian Research Agency).

CHAIRS AND LABORATORIES AT THE FACULTY OF MECHANICAL ENGINEERING

The Faculty of Mechanical Engineering has been broken into units called chairs since the very start of its independent operations. The organisational structure derives from the basic courses, which further spread and evolved into specific areas or subunits called laboratories with the development of research engineering.

In 2021, 33 laboratories and a Unit for Supplementary Division operated within the scope of 16 chairs.

CHAIR OF SYNERGETICS

Laboratory for Synergetics LASIN

1

CHAIR OF MACHINE ELEMENTS AND DEVELOPMENT EVALUATION

Laboratory for Machine Elements LASEM

Laboratory for Structure Evaluation LAVEK

2

CHAIR OF POWER ENGINEERING

Laboratory for Internal Combustion Engines and Electromobility LICeM

Laboratory for Heat and Power LTE

Laboratory for Hydraulic Machines LVTS

Laboratory for Pumps, Compressors and Technical Acoustics LEDSTA

3

CHAIR OF OPTODYNAMICS AND LASER APPLICATIONS

Laboratory for photonics and laser systems FOLAS

Laboratory for laser techniques LASTEH

10

CHAIR OF TRIBOLOGY AND MAINTENANCE SYSTEMS

Laboratory for tribology and interface nanotechnology TINT

Laboratory for Fluid Power and Controls LFT

11

CHAIR OF FLUID DYNAMICS AND THERMODYNAMICS

Laboratory for Fluid Dynamics and Thermodynamics LFDT

12

CHAIR OF CYBERNETICS, MECHATRONIC AND PRODUCTION ENGINEERING

Laboratory for Mechatronics, Production Systems and Automation LAMPA

4

CHAIR OF MANUFACTURING TECHNOLOGIES AND SYSTEMS

Laboratory for Forming LAP

Laboratory for Alternative Technologies LAT

Laboratory for Handling, Assembly and Pneumatics LASIM

5

CHAIR OF MATERIALS, SCIENCE AND TECHNOLOGY

Laboratory for heat treatment and materials testing LATOP

Laboratory for Welding LAVAR

6

CHAIR OF THERMAL AND ENVIRONMENTAL ENGINEERING

Laboratory for Heating, Sanitary, Solar and Air Conditioning Engineering LOSK

Laboratory for Refrigeration and District Energy LAHDE

Laboratory for Sustainable Technologies in Buildings LOTZ

13

CHAIR OF MACHINING TECHNOLOGY MANAGEMENT

Laboratory for Cutting LABOD

Laboratory of Quality Assurance LAZAK

14

CHAIR OF ENGINEERING DESIGN AND TRANSPORTATION SYSTEMS

Laboratory for Engineering Design LECAD

Laboratory for Material Handling and Machine Structures LASOK

15

CHAIR OF HEATING AND PROCESS ENGINEERING

Laboratory for Measurements in Process Engineering LMPS

Laboratory for Heating Technology LTT

7

CHAIR OF MECHANICS

Laboratory for Non-Linear Mechanics LANEM

Laboratory for Numerical Modelling and Simulation LNMS

Laboratory for Dynamics of Machines and Structures LADISK

8

CHAIR OF MECHANICS OF POLYMERS AND COMPOSITES

Laboratory for Experimental Mechanics LEM

9

CHAIR OF MODELLING IN ENGINEERING SCIENCES AND MEDICINE

Laboratory for Modelling Machine Elements and Structures LAMEK

Traffic Accident Analysis and Research Laboratory LAPN

16

AVIATION DIVISON

Laboratory for aeronautics AEROL

17

UNIT FOR SUPPLEMENTARY DIVISION

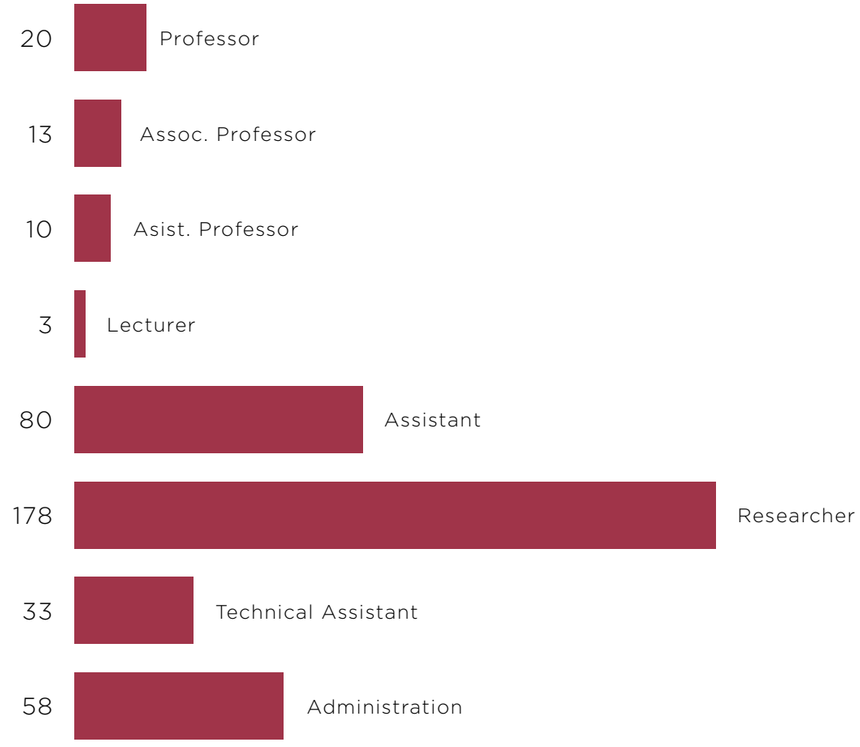
Mathematics Research Team RSMAT

Unit for Supplementary Division EDZ

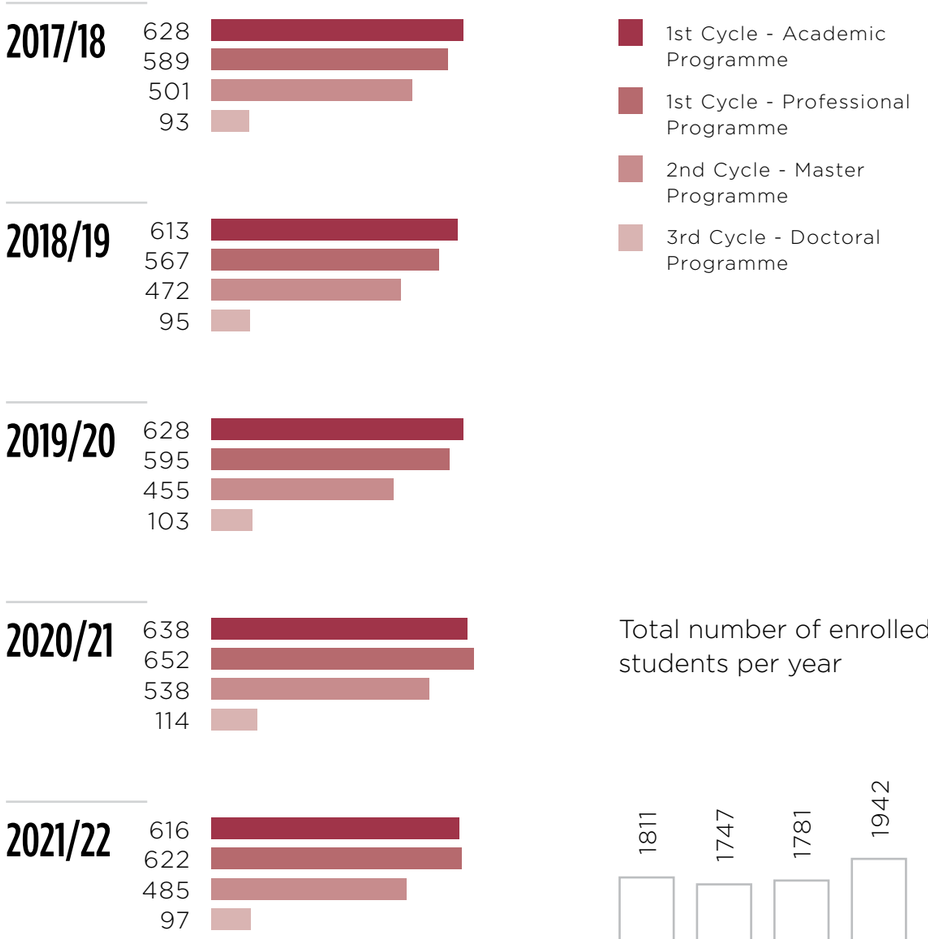
18

THE FACULTY OF MECHANICAL ENGINEERING IN NUMBERS

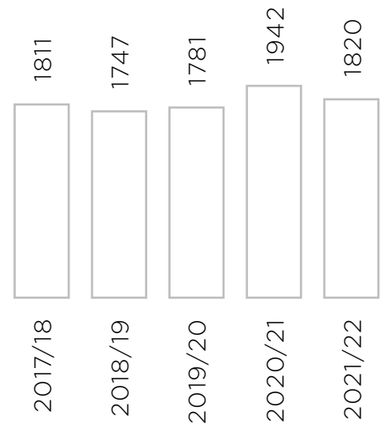
EMPLOYEE STRUCTURE



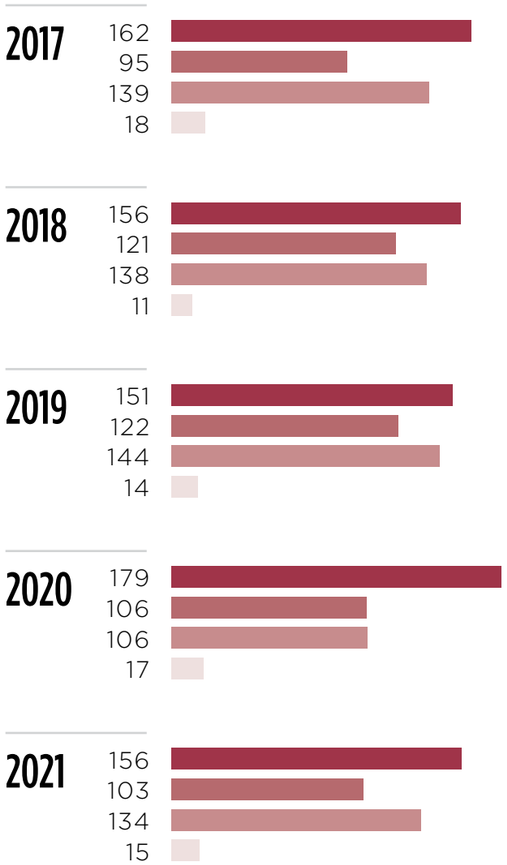
NUMBER OF ENROLLED STUDENTS

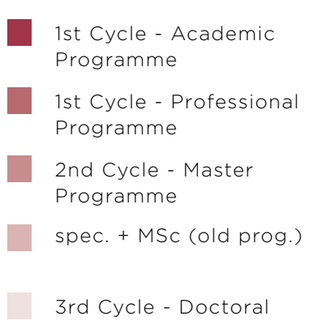


Total number of enrolled students per year

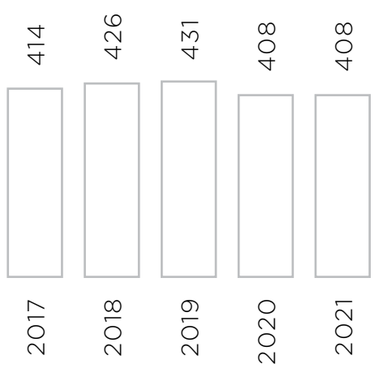


NUMBER OF GRADUATES





Total number of graduates per year

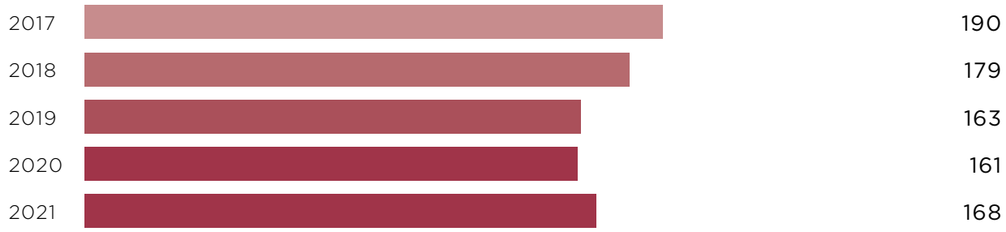


FINANCING STRUCTURE IN %

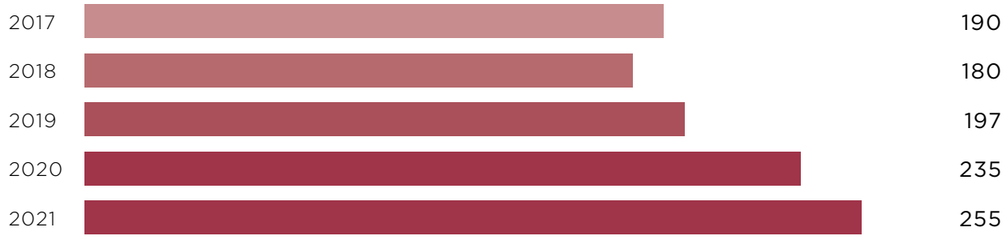
NUMBER OF INTERNATIONAL RESEARCH PROJECTS

Programm	2017	2018	2019	2020	2021
Obzorje Evropa					**1**
Horizon 2020	7	11	11	12	**12**
7. frame programm	Z	Z	Z	Z	**Z**
ERDF - European regional develoment fond	7	9	10	4	**2**
ERA-NET M-era.Net	1	1	1	1	**0**
Life+	1	1	1	1	**1**
Erasmus +	5	6	9	8	**9**
LLP life long learning programm	Z	Z	Z	Z	**Z**
European defence agency (EDA	0	0	1	1	**1**
European space agency (ESA)	2	1	1	0	**0**
Eureka	1	1	1	1	**1**
EIT – European Institute od Innoavation & Technology	0	2	2	2	**3**
COST	8	8	8	7	**7**
Other	7	5	5	7	**9**
ARRS – international projects	**1**	**1**	**1**	**2**	**3**
Total	**40**	**45**	**50**	**44**	**49**

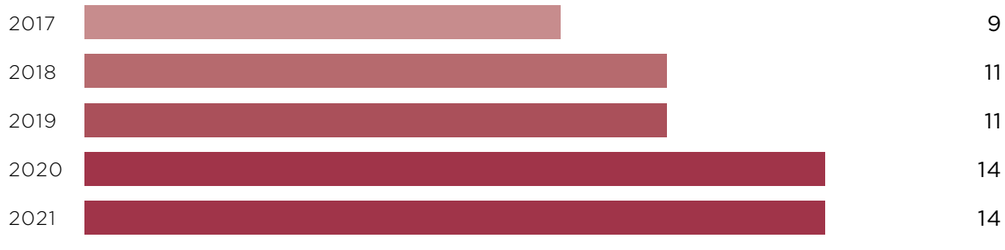
NUMBER OF MARKET-ORIENTED PROJECTS WITH THE INDUSTRY



NUMBER OF ORIGINAL SCIENTIFIC ARTICLES



NUMBER OF PATENTS



PUBLISHING AND JOURNALS

PUBLISHING

The publishing department of the Faculty of Mechanical Engineering is publishing study materials and other non-periodicals. The department is following the rules, set out by the Senate of the faculty, which define the main framework of its activities. The publishing department publishes 25 publications per year with an international standard book number (ISBN) and CIP, the acronym for the cataloguing in publication. The publishing department began using the ISBN system in 1986; since then it published almost 340 works with the ISBN number. These are course books, proceedings of domestic and international conferences, organised by chairs and laboratories of the faculty, printed editions of doctoral works, and scientific monographs. In the recent years the publications are also available in electronic form on CDs and USB sticks; free course books are available at the faculty website and the Repository of the University of Ljubljana.

With the introduction of digital printing technology the process for printing publications is significantly shorter and also much cheaper. Digital printing technology provides quality and relatively low cost printing also for limited editions. Due to this new technology the policy of the publishing department is to sell the entire edition of a textbook in three years; after this it gets reprinted with any possible revisions and updates. The editions for the first year programmes have up to 400 copies; and up to 150 copies for higher year programmes and the second cycle. The publishing department tries to offer the textbooks at an affordable price for students; around €10 for the first year textbooks, and around €15 for higher years. In order for the textbooks to be available at the student friendly prices, the authors usually charge no fees for the first editions. Only after a reprint, when there is no cost of reviews, proofreading, and design, the authors get some compensation.

JOURNALS

Strojniški vestnik – Journal of Mechanical Engineering

The scientific international journal publishes original and (mini)review articles covering the concepts of materials science, mechanics, kinematics, thermodynamics, energy and environment, mechatronics and robotics, fluid mechanics, tribology, cybernetics, industrial engineering and structural analysis. The journal follows new trends and progress proven practice in the mechanical engineering and also in the closely related sciences as are electrical, civil and process engineering, medicine, microbiology, ecology, agriculture, transport systems, aviation, and others, thus creating a unique forum for interdisciplinary or multidisciplinary dialogue. The international conferences selected papers are welcome for publishing as a special issue of SV-JME with invited co-editor(s). The Journal is indexed in the WoS Thomson and Scopus databases where is positioned in the third and second quarter, respectively. The growth of the Journal is evident in the constant increase in the number of citations in WoS.

The SV-JME has been published since 1955; the publishers are the Faculty of Mechanical Engineering of the University of Ljubljana, the Faculty of Mechanical Engineering of the University of Maribor, the Association of Mechanical Engineers of Slovenia, and the Chamber of Commerce and Industry of Slovenia.

The Journal is freely available at https://www.sv-jme.eu/issues/volume-67-2021/

Ventil

The scientific and professional journal Ventil publishes articles, dealing with the development and research work at universities, institutes and companies from the field of fluid technics, automatisation and mechatronics. Its aim is to familiarise with the achievements of Slovene companies, their products, and events, which are connected with the development and production in the relevant fields. It creates new connections between the Slovene industry and the research and development sphere, and among the Slovene and world production, developmental and expert community. It also encourages popularity of fluid technics, automatisation, and mechatronics, especially among the young people, while it also cultivates the scientific terminology in these fields.

The publishers are the University of Ljubljana, the Faculty of Mechanical Engineering with co-founders GZS-ZKI-FT (Chamber of Commerce and Industry of Slovenia, Chemical Industries Association) and SDFT (Slovene Fluid Technics Association). It has 6 issues per volume in single issues at 1,000 copies each. The technical quality conforms to the international standards, valid in Slovenia. It is also included in the COBBIS, INSPEC and university and library databases (RWTH Aachen – IFAS, TU – Wien, University in Hannover and The British Library). Under its present title Ventil the journal has been published since 1995.

The magazine is freely available at http://www.revija-ventil.si.

STUDY PROGRAMMES

The Faculty of Mechanical Engineering of the University of Ljubljana offers study programmes for all three levels since 1960, which testifies to the strong foundations of its study programmes in Slovenia. Through the years the programmes were adapted to various requirements, changed in accordance with legislation and regulations, and were recently thoroughly renewed in accordance with the Bologna Declaration.

Today, the Faculty of Mechanical Engineering offers the following study programmes:

1ST CYCLE

Professional Study Programme in Mechanical Engineering – Project and Applicative Programme lasts 3 years and is practice oriented; in the 2nd year it is separated into 5 basic study directions, and in the 3rd year into sub-directions. The graduates acquire the degree of Bachelor of Applied Science in Mechanical Engineering (graduate's professional degree).

The academic year 2021/2022 started with the renewed Applicative Programme; in the 2nd year it separates in 6 basic study direction: Energy engineering, process engineering, Design of machines and devices, production technologies, Production engineering, Airline transport pilot, Aircraft design and maintenance, Mechatronics.

1st year	2nd year – directions
Common curriculum	**Energy engineering**
	Process engineering
	Design of machines and devices
	Design of industrial systems
	Production technologies
	Production engineering
	Airline transport pilot
	Aircraft design and maintenance
	Mechatronics

Academic Study Programme in Mechanical Engineering – Research and Development Program lasts 3 years and has no directions. Students acquire theoretical knowledge for continuation of the studies in the 2nd Cycle. Graduates acquire the degree of Bachelor of Science in Mechanical Engineering.

2ND CYCLE

Master's Study Programme in Mechanical Engineering – Development Research Program lasts 2 years and is divided into 6 basic directions. Graduates acquire the degree of Master of Engineering.

Basic directions
Engineering design
Mechanics
Energy engineering
Process engineering
Production engineering
Mechatronics and laser technology

TRIBOS – Joint Master's Programme in Tribology of Surfaces and Interfaces lasts 2 years and is carried out by four partner European universities. Graduates acquire the degree of Master of Tribology of Surfaces and Interfaces.

3RD CYCLE

Doctoral Study Programme in Mechanical Engineering lasts 4 years and is divided into three basic fields of study. Graduates acquire the degree of Doctor of Science.

Fields
Machine Design and Mechanics Engineering Science
Power and Process Engineering Science
Production Engineering Sciences, Cybernetics and Mechatronics

Interdisciplinary Doctoral Programme in Environmental Protection (coordinated at the level of the University of Ljubljana) lasts 4 years and combines the scientific fields of 13 faculties. Graduates acquire the degree of Doctor of Science.

Interdisciplinary Doctoral Study Programme Biosciences lasts 4 years and is carried out by four members of the University of Ljubljana. Graduates acquire the degree of Doctor of Science.

RESEARCH

The Faculty of Mechanical Engineering of the University of Ljubljana is carrying out its social agenda in the scientific research and applicative developmental fields in order to provide high level of excellence, and to transfer new research findings into the industrial environment.

Research and development activities at the Faculty of Mechanical Engineering include:

- Power and process engineering,
- Design,
- Engine mechanics and maintenance,
- Production engineering,
- Mechatronics,
- Micromechanical systems,
- Automatisation.

The research activities are carried out within the laboratories. The faculty is closely linked with institutes, domestic and foreign companies, and with other organisations from the field of medicine, electrical engineering, chemistry, informational technology and civil engineering. It is venturing outside the boundaries of classic research engineering, since it is reaching into new research fields, which bring higher added value to the society.

Research work is the basis for modern and quality teaching

Our researchers strongly believe that research work is the basis for progressive and quality teaching, therefore taking part in national basic and applicative projects and international projects is a regular practice at the faculty.

Development of young and promising researchers

The faculty pays special attention to the education and development of young and promising students, who are deciding on the career in research through the programme of the Slovenian Research Agency.

The Infrastructure centre for modern engineering

Within the Network of infrastructure centres of the University of Ljubljana (MRIC UL) the faculty has the Infrastructure centre for modern engineering, which offers quality operations, infrastructural support, know-how and cooperation between research groups within research institutions, the Slovene industry and the wider international arena. The Centre uses high-end equipment, which requires highly qualified and specialised staff for its operation and maintenance. The Centre is divided into four sub-units:

- Centre for macromechanical assessments of materials and structures
- Centre for video-diagnostic analysis in process engineering
- Centre for surface diagnostics and lubricants in machine structures
- Centre for informational technologies and support

Highly trained staff, wide networks of researchers and interdisciplinary approach make the Faculty of Mechanical Engineering the largest scientific research institution in mechanical engineering in Slovenia.

Program groups

Within the Slovene Research Agency there are programme groups, which represent research fields established for a longer time period, and are important for Slovenia. The researchers from the Faculty of Mechanical Engineering are involved in the following 14 programme groups:

1. Modelling in technics and medicine
2. Multiphase systems
3. Energy engineering
4. Development evaluation
5. Heat and mass transfer
6. Tribology
7. Synergetics of complex systems and processes
8. Innovative production systems and processes
9. Engineering design
10. Mechanics in Engineering
11. Sustainable Polymer Materials and Technologies
12. Advanced Manufacturing Technologies for High Quality and Sustainable Production
13. Production systems, laser technologies and materials welding - PLAS
14. Optodynamics

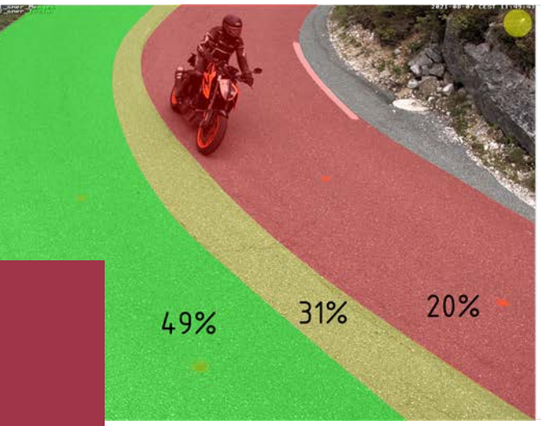
PRESENTATION OF PROGRAMME GROUPS AND ACTIVITIES OF LABORATORIES

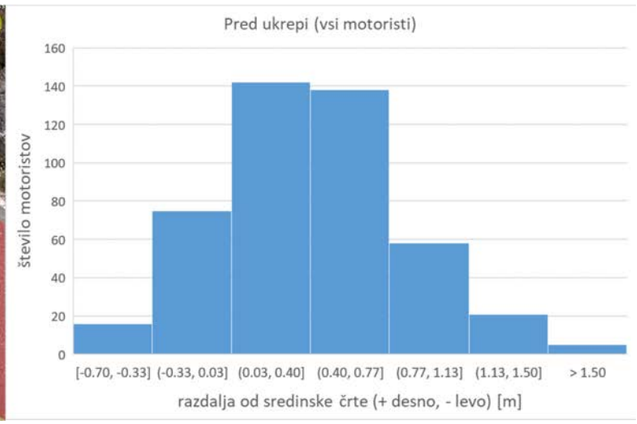
01 MODELLING IN TECHNICS AND MEDICINE

The Modelling in Engineering Sciences and Medicine programme group is based on an interdisciplinary approach and consists of researchers from the Faculty of Mechanical Engineering and the Faculty of Medicine (both University of Ljubljana).

The group's main research activity is modelling of systems related to traffic which involve modelling of mechanical and anatomical structures for investigating systems response to different kinds of excitation. Integrated into commercial software packages and expandable, these developed material and mechanical models are used for predicting the initiation and growth behaviour of damage to metallic and non-metallic materials at diverse monotonic and dynamic loads.

This enables modelling of various types of mechanical and biomechanical systems (human body, vehicles, traffic devices). The group also investigates and updates data and their relationships in traffic databases and develops geoinformation systems designed to determine exposure to traffic accident risk on specific sections of the road network.





Laboratory for Modelling Machine Elements and Structures LAMEK

RESEARCH AREAS

Technical Product Documentation (TPD) • Geometric Product Specifications (GPS) • Geometric dimensioning and tolerancing (GDT) • Tolerance analysis • Expert systems • CAD and TPD systems • Mechanics of structures and machines • Structures, machine elements and materials modelling • Development and design of machines and production systems • Special engineering design know-how • Large size bearings • Rolling rotational connections • Vehicle engineering • Theory of ground vehicles driving • Ground vehicles and traffic safety • Transportation research • Traffic logistics • Biomechanics • Measurement in traffic • Traffic accident analysis

DEPARTMENT HEAD Assoc. Prof. Robert Kunc, PhD

DEPARTMENT MEMBERS Assist. Prof. Zupan Samo, PhD, Assist. Prof. Miha Ambrož, PhD, Assist. Prof. Jovan Trajkovski, PhD, Assist. Prof. Andrej Žerovnik, PhD, Assist. Simon Krašna, PhD, Assist. Ana Trajkovski, PhD, Asist. Matej Kranjec, PhD, Assist. Aleksander Novak, Slobodanka Ivanjić Kostrešević, Jernej Korinšek, Assist. Luka Roblek, Assist. Narendra Singh, Silva Brenčič

avtor fotografije: Željko Stevanić, IFP d.o.o.

ORIGINAL SCIENTIFIC ARTICLES

KRAŠNA, Simon, KELLER, Arne, LINDER, Astrid, SILVANO, Ary P., XU, Jia-Cheng, THOMSON, Robert, KLUG, Corina. Human response to longitudinal perturbations of standing passengers on public transport during regular operation. Frontiers in bioengineering and biotechnology, ISSN 2296-4185, vol. 9, 2021, str. 1-15, ilustr.

XU, Jia-Cheng, SILVANO, Ary P., KELLER, Arne, KRAŠNA, Simon, THOMSON, Robert, KLUG, Corina, LINDER, Astrid. Identifying and characterizing types of balance recovery strategies among females and males to prevent injuries in free-standing public transport passengers. Frontiers in bioengineering and biotechnology, ISSN 2296-4185, vol. 9, 2021, str. 1-18, ilustr.

PROJECTS

EDA – HybriDT – Hybrid Drive Trains. Samo Zupan. 24. 1. 2020 – 23. 1. 2021

Horizon 2020 - VIRTUAL - Open access virtual testing protocols for enhanced road users safety. Simon Krašna. 01.06.2018 – 31.05.2022

Company SMM – Research work. Robert Kunc. Ongoing since 1.1.2016

02 MULTIPHASE SYSTEMS

The program group Multiphase systems (2022-2027) is focused on the following highly interconnected research and development activities, encompassing the whole spectra of technology readiness levels:

1. Computational and experimental investigation of an extended-spectrum of coupled multiphase, multiscale and multiphysics problems with solids, fluids, and gasses. Key accents on multiphase flows, melting and solidification.

2. Investigation of the influence of external fields (rotation, shaking, magnetohydrodynamics, ultrasonics) on multiphase systems.

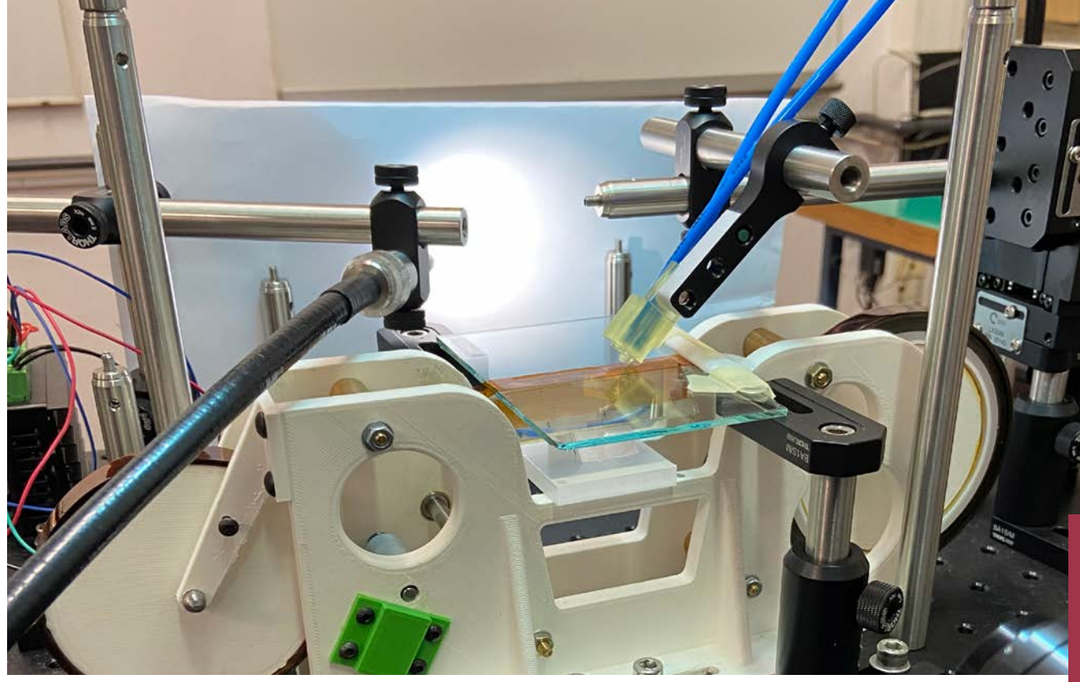
3. Development of a new generation of highly efficient and self-adaptive meshless methods for problems of classical field theories.

4. Horizontal integrated materials modelling for through process simulations; development of artificial intelligence and physical models of manufacturing and materials processing chains; in particular for casting, rolling, extrusion and heat treatment.

5. Vertical integrated materials modelling for multiscale simulations; relations between process parameters - macrostructure - microstructure - properties.

6. Vital connection of the developments with the high-end Slovenian and global industry concerning digitalization, quality, productivity, safety and environmental impact.

7. Design of novel microfluidic sample delivery systems for femtosecond crystallography used in large international research centres with free-electron lasers and synchrotrons.



Laboratory for Fluid Dynamics and Thermodynamics LFDT

RESEARCH AREAS

Two-phase flow • Microfluidics • Solidification • Meshless methods
Multiscale and multiphysics • Modelling of materials and processes
• Intelligent systems

DEPARTMENT HEAD Prof. Božidar Šarler, PhD

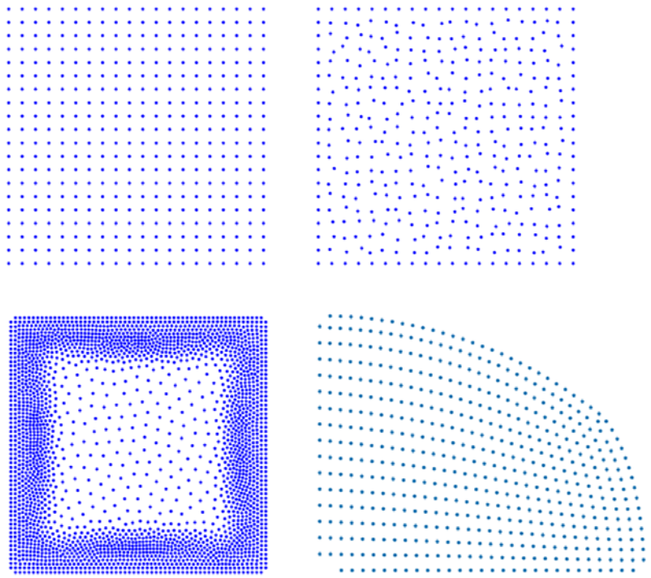
DEPARTMENT MEMBERS Assist. Prof. Anton Bergant, PhD, Assist. Prof. Andrej Bombač, PhD, Assist. Prof. Matjaž Perpar, PhD, Assist. Boštjan Mavrič, PhD, Assist. Jurij Gregorc, PhD, Assist. Zahoor Rizwan, PhD, Assist. Vanja Hatić, PhD, Res. Assoc. Zlatko Rek, PhD, Assist. Umut Hanoglu, PhD, Assist. Katarina Mramor, PhD, Res. Assoc. Miha Kovačič, PhD, Res. Assoc. Robert Vertnik, PhD, Assist. Qingguo Liu, PhD, Belšak Grega, Matic Cotič, Assist. Rana Khush Bakhat, Assist. Gašper Vuga, Assist. Ajda Kunavar, Assist. Tadej Dobravec, PhD, Assist. Izaz Ali, Zdenka Rupič

ORIGINAL SCIENTIFIC ARTICLES

KOVAČIČ, Miha, LEŠER, B., BREZOČNIK, Miran. Modelling and optimization of sulfur addition during 70MnVS4 steelmaking: An industrial case study. Advances in production engineering & management, ISSN 1854-6250, June 2021, vol. 16, no. 2, str. 253-261.

GREGORC, Jurij. Numerical prediction of maldistribution in a series of T-junctions. Chemical Engineering Science, ISSN 0009-2509, Aug. 2021, vol. 239, str. 1-10.

REK, Zlatko, ZAHOOR, Rizwan, ŠARLER, Božidar. Modified method of regularized sources for potential flow. Computers & Mathematics with Applications, ISSN 0898-1221, Apr. 2021, vol. 88, str. 110-119.



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URBANOWICZ, Kamil, BERGANT, Anton, KODURA, Apoloniusz, KUBRAK, Michał, MALESIŃSKA, Agnieszka, BURY, Paweł, STOSIAK, Michal. Modeling transient pipe flow in plastic pipes with modified discrete bubble cavitation model. Energies, ISSN 1996-1073, 2021, vol. 14, iss. 20, str. 1-22.

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HATIĆ, Vanja, MAVRIČ, Boštjan, ŠARLER, Božidar. Meshless simulation of a lid-driven cavity problem with a non-Newtonian fluid. Engineering analysis with boundary elements, ISSN 0955-7997, Oct. 2021, vol. 131, str. 86-99.

URBANOWICZ, Kamil, STOSIAK, Michal, TOWARNICKI, Krzysztof, BERGANT, Anton. Theoretical and experimental investigations of transient flow in oil-hydraulic small-diameter pipe system. Engineering failure analysis, ISSN 1350-6307, Oct. 2021, vol. 128, str. 1-16.

ZAHOOR, Rizwan, KNOŠKA, Juraj, BAJT, Saša, ŠARLER, Božidar. Experimental and numerical investigation of gas-focused liquid micro-jet velocity. International journal of multiphase flow, ISSN 0301-9322, Feb. 2021, vol. 135, str. 1-13.

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GAJŠEK, Brigita, ĐUKIĆ, Goran, KOVAČIČ, Miha, BREZOČNIK, Miran. A multi-objective genetic algorithms approach for modelling of order picking. International journal of simulation modelling, ISSN 1726-4529, Dec. 2021, vol. 20, no. 4, str. 719-729.

GANTAR, Gašper, GÖNCZ, Péter, KOVAČIČ, Miha. Optimization of press-fit processes = Optimizacija postopkov montaže z vtiskovanjem. Materiali in tehnologije, ISSN 1580-2949. [Tiskana izd.], mar.-apr. 2021, letn. 55, št. 2, str. 207-212.

ŠARLER, Božidar, ZAHOOR, Rizwan, BAJT, Saša. Alternative geometric arrangements of the nozzle outlet orifice for liquid micro-jet focusing in gas dynamic virtual nozzles. Materials, ISSN 1996-1944, Mar. 2021, vol. 14, iss. 6, str. 1-18.

BELŠAK, Grega, BAJT, Saša, ŠARLER, Božidar. Numerical study of the micro-jet formation in double flow focusing nozzle geometry using different water-alcohol solutions. Materials, ISSN 1996-1944, Jul. 2021, vol. 14, iss. 13, str. 1-11.

HANOGLU, Umut, ŠARLER, Božidar. Developments towards a multiscale meshless rolling simulation system. Materials, ISSN 1996-1944, 2021, vol. 14, iss. 15, str. 1-26.

KOVAČIČ, Miha, SALIHU, Shpetim, GANTAR, Gašper, ŽUPERL, Uroš. Modeling and optimization of steel machinability with genetic programming: Industrial study. Metals, ISSN 2075-4701, Mar. 2021, vol. 11, iss. 3 (426), str. 1-13.

GREGORC, Jurij, KUNAVAR, Ajda, ŠARLER, Božidar. RANS versus scale resolved approach for modeling turbulent flow in continuous casting of steel. Metals, ISSN 2075-4701, Jul. 2021, vol. 11, iss. 7, str. 1-12.

BABIČ, Matej, PETROVIČ, Dušan, SODNIK, Jošt, SOLDO, Božidar, KOMAC, Marko, CHERNIEVA, Olena, KOVAČIČ, Miha, MIKOŠ, Matjaž, CALÌ, Michele. Modeling and classification of alluvial fans with DEMs and machine learning methods : a case study of Slovenian torrential fans. Remote sensing, ISSN 2072-4292, 2021, letn. 13, št. 9/1711, str. 1-18.

SIDDIQUI, M. Salman, KHALID, Muhammad Hamza, ZAHOOR, Rizwan, BUTT, Fahad Sarfraz, SAEED, Muhammed, BADAR, Abdul Waheed. A numerical investigation to analyze effect of turbulence and ground clearance on the performance of a roof top vertical-axis wind turbine. Renewable energy, ISSN 0960-1481. [Print ed.], Feb. 2021, vol. 164, str. 978-989.

PROJECTS

Slovenian Research Agency - Multiphysics and multiscale numerical modelling for competitive continuous casting. Božidar Šarler. 1.7.2018 – 30.6.2021

Slovenian Research Agency. Advanced meshless modelling and simulation of multiphase systems. Božidar Šarler 1.7.2019 – 30.6.2022

Slovenian Research Agency. Modelling for thermal control of Plasma Facing Components (PFCs) in fusion reactors 1.3.2020 - 28.2.2022

Company DESY - Innovative methods for imaging with the use of x-ray Free Electron Laser and synchrotron sources. Božidar Šarler. 13.4.2018 – 12.4.2022

Slovenian Research Agency. Advanced simulation and optimization of the entire process route for production of topmost steels. Božidar Šarler 1.10.2021 – 30.9.2024

03 ENERGY ENGINEERING

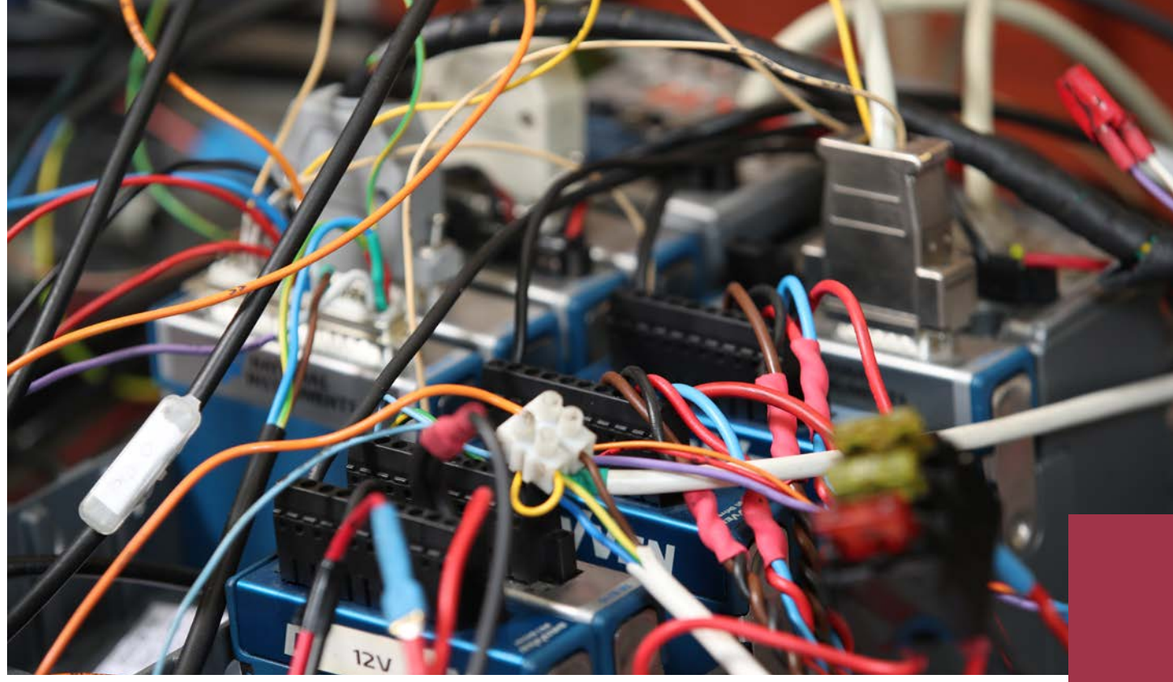
The Energy Engineering research programme is engaged in a wide range of activities:

In the field of internal combustion engines we research advanced designs of engine control and scavenging optimisation. We take part in designing future hybrid, electric and conventional powertrain systems.

In the field of fuel cells and batteries we have been developing next-generation electrochemical models containing nanomaterials.

To achieve high efficiency, durability, economic and environmental sustainability of the use of alternative fuels for, among other things, the research into stationary energy systems, we optimise the performance of systems for cogeneration of heat and electricity.

The research work in the field of turbine machines is concerned with the development of high efficiency and low noise systems. We develop cavitation erosion models. We also study the biological effects of cavitation for medical use and for wastewater treatment.



Laboratory for Internal Combustion Engines and Electromobility LICeM

RESEARCH AREAS

Internal combustion engines • Alternative fuels • Exhaust emission
• Hybrid powertrain systems • Electric vehicles • Fuel cells • Batteries
• Numerical modelling of systems and components

DEPARTMENT HEAD Prof. Tomaž Katrašnik, PhD

DEPARTMENT MEMBERS Assist. Prof. Tine Seljak, PhD, Assist. Ambrož Kregar, PhD, Assist. Samuel Rodman Oprešnik, PhD, Assist. Gregor Tavčar, PhD, Assist. Rok Vihar, PhD, Assist. Anton Žnidarčič, PhD, Chowdhury Haque Amer Amor, PhD, Assist. Klemen Zelič, PhD, Assist. Urban Žvar Baškovič, PhD, Dev. Igor Mele, Assist. Andraž Kravos, Ivo Pačnik, Dev. Davor Rašić, Assist. Žiga Rosec, Tilen Tibaut, Tit Voglar, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

CALIGIURI, Carlo, ŽVAR BAŠKOVIČ, Urban, RENZI, Massimiliano, SELJAK, Tine, RODMAN OPREŠNIK, Samuel, BARATIERI, Marco, KATRAŠNIK, Tomaž. Complementing syngas with natural gas in spark ignition engines for power production : effects on emissions and combustion. Energies, ISSN 1996-1073, Jun. 2021, vol. 14, iss. 12, str. 1-18.

KRAVOS, Andraž, KREGAR, Ambrož, MAYER, Kurt, HACKER, Viktor, KATRAŠNIK, Tomaž. Identifiability analysis of degradation model parameters from transient CO2 release in low-temperature PEM fuel cell under various AST protocols. Energies, ISSN 1996-1073, 2021, vol. 14, iss. 14, str. 1-16.

DU, Zhang Peng, KRAVOS, Andraž, STEINDL, Christoph, KATRAŠNIK, Tomaž, JAKUBEK, Stefan, HAMETNER, Christoph. Physically motivated water modeling in control-oriented polymer electrolyte membrane fuel cell stack models. Energies, ISSN 1996-1073, 2021, vol. 14, iss. 22, str. 1-20.

SREDENŠEK, Klemen, SEME, Sebastijan, ŠTUMBERGER, Bojan, HADŽISELIMOVIĆ, Miralem, CHOWDHURY, Amor, PRAUNSEIS, Zdravko. Experimental validation of a dynamic photovoltaic/thermal collector model in combination with a thermal energy storage tank. Energies, ISSN 1996-1073, 2021, vol. 14, issue 23, str. 1-21.

ŽNIDARČIČ, Anton, KATRAŠNIK, Tomaž, ZSÉLY, I. G., NAGY, T., SELJAK, Tine. Sewage sludge combustion model with reduced chemical kinetics mechanisms. Energy conversion and management, ISSN 0196-8904, May 2021, vol. 236, str. 1-15.

KATRAŠNIK, Tomaž, MELE, Igor, ZELIČ, Klemen. Multi-scale modelling of Lithium-ion batteries : from transport phenomena to the outbreak of thermal runaway. Energy conversion and management, ISSN 0196-8904. [Print ed.], May 2021, vol. 236, str. 1-22.

ŽVAR BAŠKOVIČ, Urban, VIHAR, Rok, RODMAN OPREŠNIK, Samuel, SELJAK, Tine, KATRAŠNIK, Tomaž. RCCI combustion with renewable fuel mix - Tailoring operating parameters to minimize exhaust emissions. Fuel, ISSN 0016-2361, Nov. 2021, str. 1-13.

AGWU, Ogbonnaya, VALERA-MEDINA, Augustin, KATRAŠNIK, Tomaž, SELJAK, Tine. Flame characteristics of glycerol/methanol blends in a swirl-stabilised gas turbine burner. Fuel, ISSN 0016-2361, Apr. 2021, vol. 290, str. 1-12.

KRAVOS, Andraž, RITZBERGER, Daniel, HAMETNER, Christoph, JAKUBEK, Stefan, KATRAŠNIK, Tomaž. Methodology for efficient parametrisation of electrochemical PEMFC model for virtual observers : model based optimal design of experiments supported by parameter sensitivity analysis. International journal of hydrogen energy, ISSN 0360-3199, Apr. 2021, vol. 46, iss. 26, str. 13832-13844.

KREGAR, Ambrož, GATALO, Matija, MASELJ, Nik, HODNIK, Nejc, KATRAŠNIK, Tomaž. Temperature dependent model of carbon supported platinum fuel cell catalyst degradation. Journal of power sources, ISSN 0378-7753, Dec. 2021, vol. 514, str. 1-11.

ZELIČ, Klemen, KATRAŠNIK, Tomaž, GABERŠČEK, Miran. Derivation of transmission line model from the concentrated solution theory (CST) for porous electrodes. Journal of the Electrochemical Society, ISSN 1945-7111, 2021, vol. 168, no. 7, str. [1-12].

PROJECTS

COMET K2 Funding Program - K2 Digital Mobility - Context-Embedded Vehicle Technologies. Tomaž Katrašnik. 01.01.2018 – 31.12.2021

ERDF (Smart Specialization) MOZTART - More efficient electric motors with the development of an EXPERT system and new technologies. Tomaž Katrašnik. 1.10.2018 – 30.9.2021

Slovenian Research Agency. Zero-footprint combustion for green power generation. Tine Seljak. 1. 7. 2019 – 30. 6. 2021

Slovenian Research Agency. Advanced multi-scale modelling of NMC cathode materials for enhanced next-generation energy storage systems. Tomaž Katrašnik. 1.9.2020 - 31.8.2023

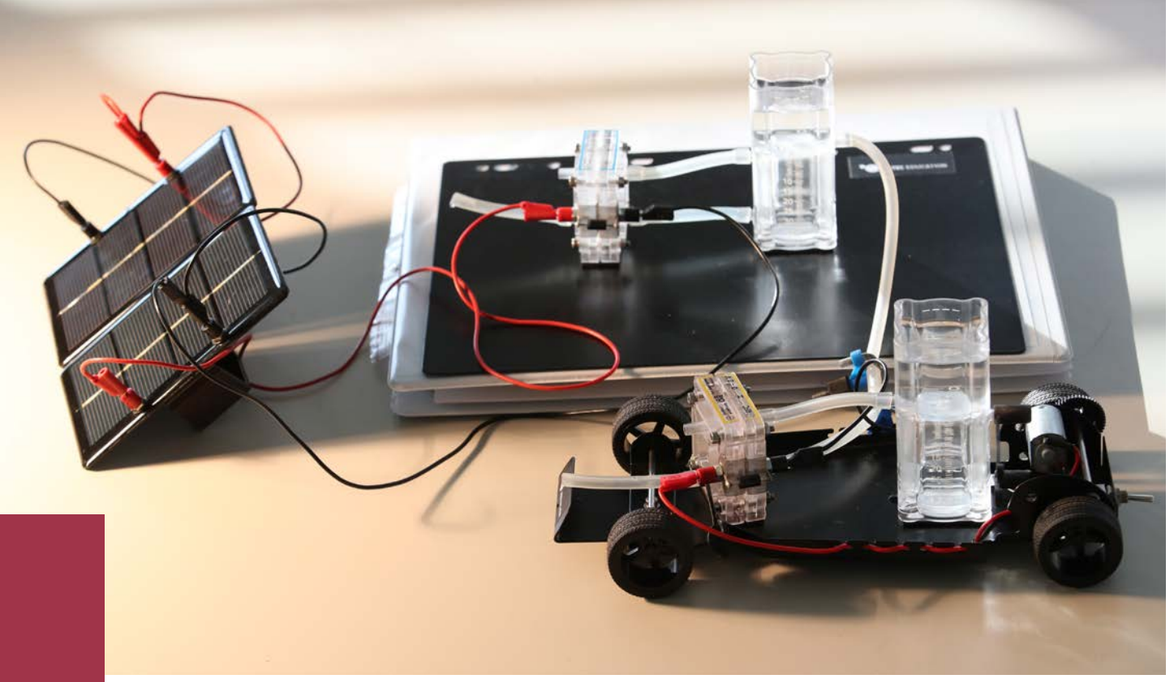
AVL List GmbH - Liion Battery. Tomaž Katrašnik. 1.1.2021 - 31.12.2021

Horizon 2020 – MORELife. Material, Operating strategy and REliability optimisation for LIFEtime improvements in heavy duty trucks. Tomaž Katrašnik. 01.09.2021 - 31.08.2024

Slovenian Research Agency. Preparation of expert documents, design of a database and development of a vehicle simulation model for calculation of the energy and environmental footprint with an aim to optimize implementation of the public transport service.Tomaž Katrašnik. 01.09.2021 - 31.8.2024

AWARDS AND ACHIEVEMENTS

Assist. Anton Žnidarčič, PhD, and Assist. Ambrož Kregar, PhD, received an award of the Faculty of Mechanical Engineering for high quality publications.



Laboratory for Heat and Power LTE

RESEARCH AREAS

Energy systems • Heat generators • Combustion • Hydrogen technologies • Smart Grids • Life Cycle Assessment • Environmental impacts of energy conversion

DEPARTMENT HEAD Prof. Mihael Sekavčnik, PhD

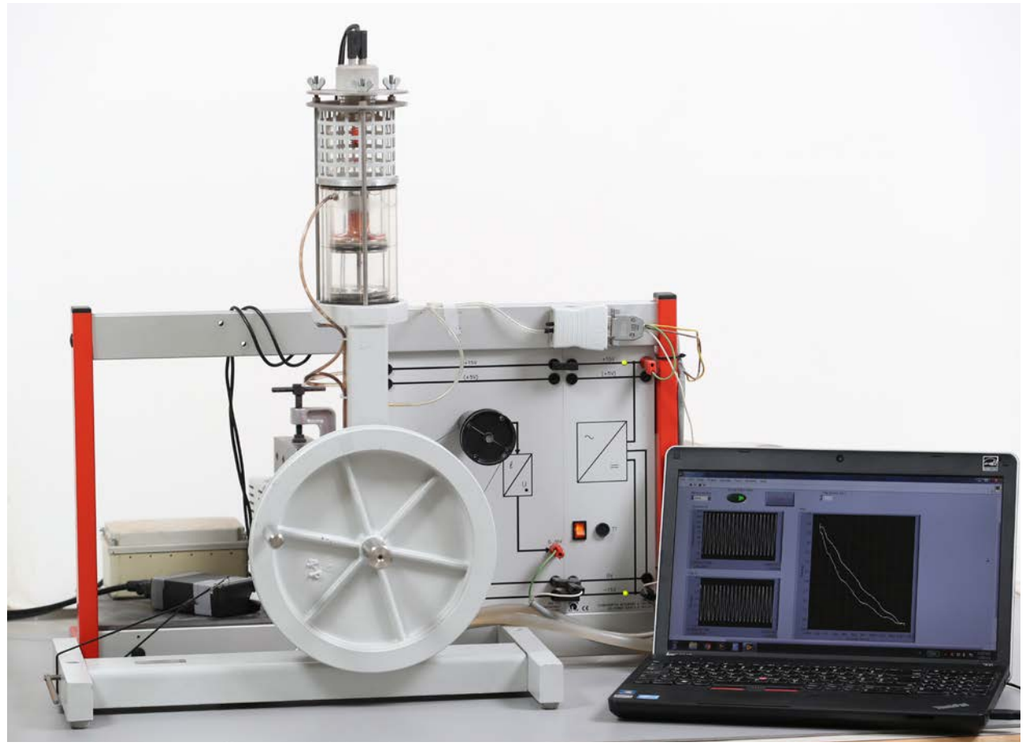
DEPARTMENT MEMBERS Assoc. Prof. Andrej Senegačnik, PhD, Assist. Prof. Boštjan Drobnič, PhD, Assist. Prof. Mitja Mori, PhD, Res. Assoc. Igor Kuštrin, PhD, Assist. Andrej Lotrič, PhD, Assist. Nejc Mlakar, Assist. Rok Stropnik, PhD, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

ARAYA, Samuel Simon, THOMAS, Sobi, LOTRIČ, Andrej, SAHLIN, Simon Lennart, LISO, Vincenzo, ANDREASEN, Søren J. Effects of impurities on pre-doped and post-doped membranes for high temperature PEM fuel cell stacks. Energies, ISSN 1996-1073, Jun. 2021, vol. 14, iss. 11, str. 1-18.

LOTRIČ, Andrej, SEKAVČNIK, Mihael, KUŠTRIN, Igor, MORI, Mitja. Life-cycle assessment of hydrogen technologies with the focus on EU critical raw materials and end-of-life strategies. International journal of hydrogen energy, ISSN 0360-3199, Mar. 2021, vol. 46, iss. 16, str. 10143-10160.

MORI, Mitja, GUTIÉRREZ, Manuel, CASERO, Pedro. Micro-grid design and life-cycle assessment of a mountain hut's stand-alone energy system with hydrogen used for seasonal storage. International journal of hydrogen energy, ISSN 0360-3199, Aug. 2021, vol. 46, iss. 57, str. 29706-29723.



MORI, Mitja, STROPNIK, Rok, SEKAVČNIK, Mihael, LOTRIČ, Andrej. Criticality and life-cycle assessment of materials used in fuel-cell and hydrogen technologies. Sustainability, ISSN 2071-1050, Mar. 2021, vol. 13, iss. 6, str. 1-29.

PROJECTS

Horizon 2020. Establishing Eco-design Guidelines for Hydrogen Systems and Technologies. Mitja Mori. 01.01.2021 - 31.12.2023

Šoštanj Thermal Power Plant d. o. o. Izvedba strokovne podpore za preverjanje učinkov dolgoročne vzdrževalne pogodbe LTSA za blok 6. Igor Kuštrin. 1.3.2021 - 28.2.2022

Slovenian Research Agency. PROMETHEIA - Processes for metal-to-char encapsulation. Mihael Sekavčnik. 01.12.2021 - 30.11.2025

Horizon 2020. BEST4Hy. SustainaBIE SoluTions FOR recycling of end of life Hydrogen technologies. Mitja Mori. 01.01.2021 - 31.12.2023

AWARDS AND ACHIEVEMENTS

Project Best4Hy was the second successfully registered LTE laboratory project in Horizon 2020. The project leader is doc. Dr. Mitja Mori.

The project Best4Hy received the Best Success Story Award 2021 at the EU Hydrogen Week.

Laboratory for Hydraulic Machines LVTS

RESEARCH AREAS

Fluid mechanics • Turbine machines • Computer aided visualisation

DEPARTMENT HEAD Prof. Marko Hočevar, PhD

DEPARTMENT MEMBERS Prof. Matevž Dular, PhD, Assist. Prof. Benjamin Bizjan, PhD, Assist. Prof. Martin Petkovšek, PhD, Assist. Prof. Lovrenc Novak, PhD, Res. Assoc. Mojca Zupanc, PhD, Assist. Jurij Gostiša, Assist. Jure Zevnik, Ind. Dev. MSc Tone Godeša, Assist. Gregor Kozmus, Sr. Dev. Aleš Malneršič, Dev. Matej Sečnik, Assist. Peter Pipp, Assist. Žiga Pandur, Assist. Primož Drešar, PhD, Asist. Jernej Ortar, Biljana Stojković, Darja Jeločnik

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PIPP, Peter, HOČEVAR, Marko, DULAR, Matevž. Numerical insight into the Kelvin-Helmholtz instability appearance in cavitating flow. Applied sciences, ISSN 2076-3417, Mar. 2021, vol. 11, iss. 6, str. 1-12.

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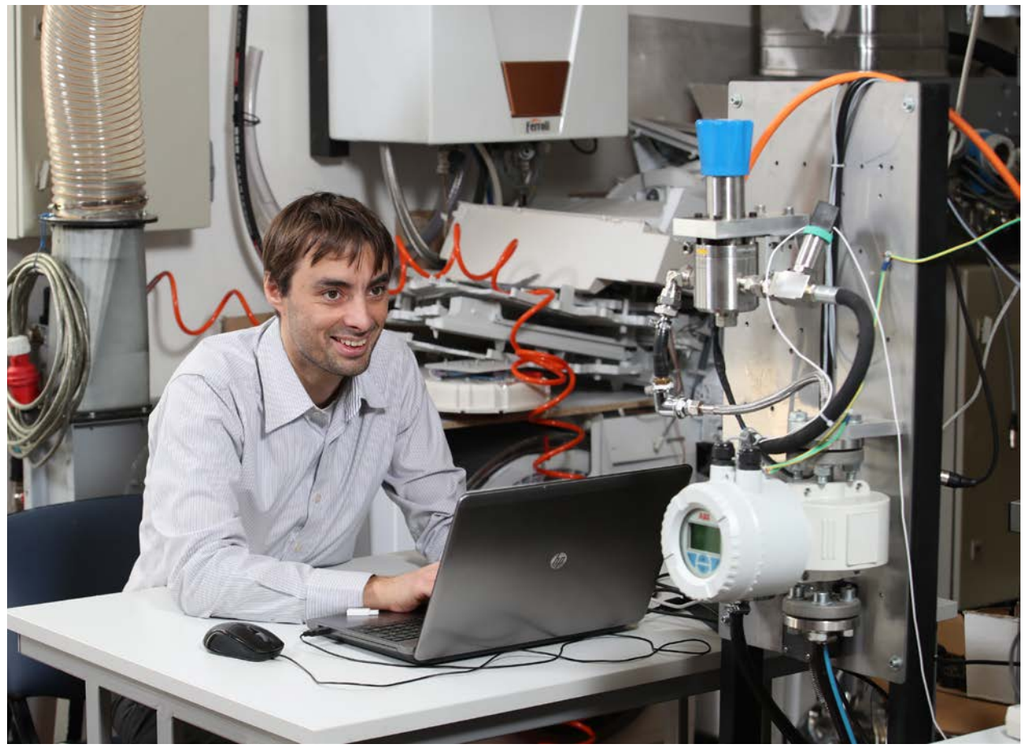
DRAB, Mitja, PANDUR, Žiga, PENIČ, Samo, IGLIČ, Aleš, KRALJ-IGLIČ, Veronika, STOPAR, David. A Monte Carlo study of giant vesicle morphologies in nonequilibrium environments. Biophysical journal, ISSN 0006-3495, 2021, vol. 120, iss. 20, str. 4418-4428.

BIZJAN, Benjamin, ŠIROK, Brane, BLAGOJEVIČ, Marko. Experimental investigation of liquid disintegration by twin spinning wheel atomizer. Chemical engineering research & design, ISSN 0263-8762, Jan. 2021, vol. 165, str. 230-241.



DOGŠA, Iztok, ŠPACAPAN, Mihael, DRAGOŠ, Anna, DANEVČIČ, Tjaša, PANDUR, Žiga, MANDIĆ-MULEC, Ines. Peptide signaling without feedback in signal production operates as a true quorum sensing communication system in Bacillus subtilis. Communications biology, ISSN 2399-3642, 2021, vol. 4, str. 1-12.

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NOVAK, Lovrenc, ŠIROK, Brane, HOČEVAR, Marko, GATARIĆ, Pero. Influence of load mass and drum speed on fabric motion and performance of a heat pump tumble dryer. Drying technology, ISSN 0737-3937, 2021, vol. 39, iss. 7, str. 950-964.

WANG, Yong, JIANG, Linglin, LIU, Houlin, YAN, Jun, HOČEVAR, Marko, XIANG, Minglang. Cooling performance and power consumption analysis of automobile engine cooling system. Energy sources. Part A, Recovery, utilization, and environmental effects., ISSN 1556-7036, Aug. 2021, str. 1-17.

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OMAN, Simon, NAGODE, Marko, KLEMENC, Jernej, MAJDIČ, Franc, HOČEVAR, Marko, GOSAR, Aleš, ŠKRLEC, Andrej, OLAH, Laslo. Submersible pump assembly and method for use of same : United States patent US 10,883,488 B1, 2021-01-05. Alexandria: United States Patent and Trademark Office, 2021.

OMAN, Simon, NAGODE, Marko, KLEMENC, Jernej, MAJDIČ, Franc, HOČEVAR, Marko, GOSAR, Aleš, ŠKRLEC, Andrej, OLAH, Laslo. Submersible pump assembly and method for use of same : United States patent US 10,995,745 B1, 2021-05-04. Alexandria: United States Patent and Trademark Office, 2021.

DOCTORAL DISSERTATION

GATARIĆ, Pero. Influence of clothes kinematics in the clothes dryer drum or drying performance: dissertation: Mentor prof. dr. Marko Hočevar.

PROJECTS

Horizon 2020 - ERC- CABUM - An investigation of the mechanisms at the interaction between cavitation bubbles and contaminants. Matevž Dular. 01.07.2018 – 30.06.2023

Slovenian Research Agency. Development of new, environment-friendly approaches for plant and human virus inactivation in waters. Matevž Dular. 1.7.2018 – 30.6.2021

Slovenian Research Agency. Cavitation - a solution for microplastics degradation? Martin Petkovšek. 1.7.2019 – 30.6.2022

Slovenian Research Agency. Method for decontamination of sewage sludge and sludge products for their sustainable use as phosphorous fertilizers. Matevž Dular. 1.9.2020 - 31.8.2023

Denso. Feasibility study (Phase 1). 10.6.2020 - 30.6.2021

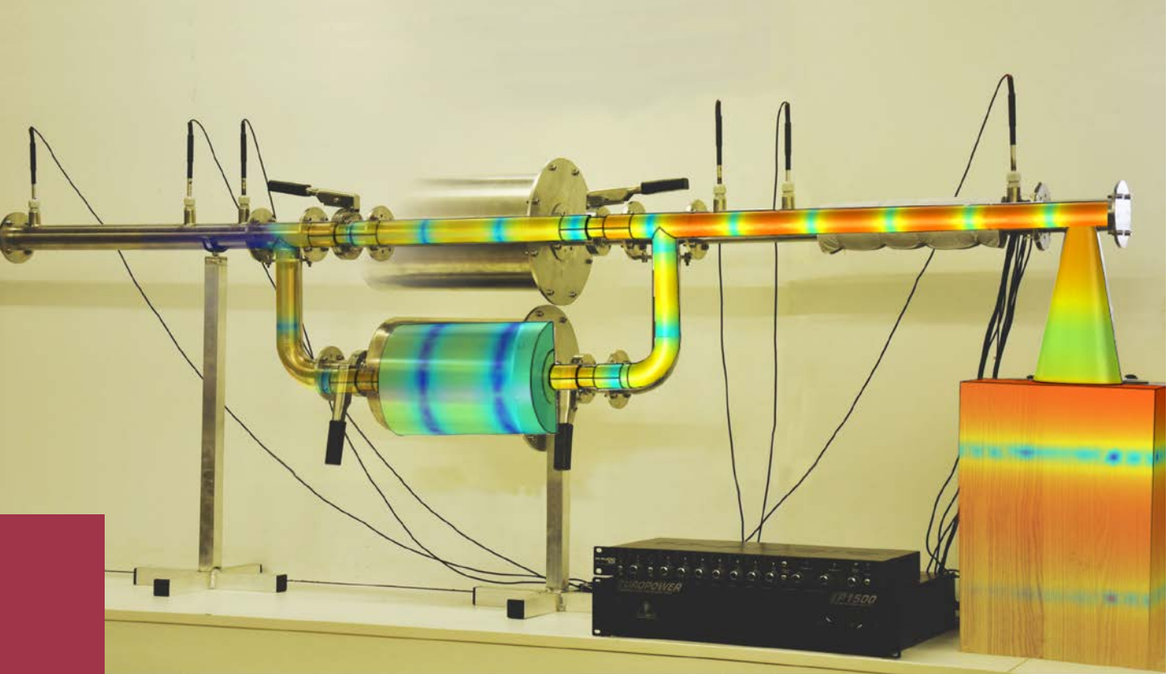
Slovenian Research Agency. Controlling extreme cavitation conditions by laser tailoring of surface functionalities (eCATS). Martin Petkovšek. 01.10.2021 - 30.09.2024

Slovenian Research Agency. Controlled generation of microbubbles and exploration of their physics for exploitation in chemistry, biology and medicine. Matevž Dular. 01.10.2021 - 30.09.2024

Slovenian Research Agency. Low emission household tumble drying with evaluation of damage to textile materials. Marko Hočevar- 01.10.2021 - 30.09.2024

AWARDS AND ACHIEVEMENTS

Assist. Prof. Martin Petkovšek, PhD, Assist. Jurij Gostiša and Assist. Jure Zevnik received an award of the Faculty of Mechanical Engineering for high quality publication.



Laboratory for Pumps, Compressors and Technical Acoustics LEDSTA

RESEARCH AREAS

Noise measurement and analysis • Environmental noise • Noise reduction • Identification and parametrisation of sound source • Prediction and modelling of noise propagation • Use of noise as a source of information • Psychoacoustics • Pumps • Ventilators • Compressors • Cavitation

DEPARTMENT HEAD Assoc. Prof. Jurij Prezelj, PhD

DEPARTMENT MEMBERS Assist. Luka Čurović, Assist. Jure Murovec, PhD, Tadej Novaković, Železnik Anže, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

ČUROVIĆ, Luka, MUROVEC, Jure, NOVAKOVIĆ, Tadej, PRISLAN, Rok, PREZELJ, Jurij. Stockwell transform for estimating decay time at low frequencies. Journal of sound and vibration, ISSN 0022-460X, Feb. 2021, vol. 493, str. 1-15.

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DOCTORAL DISSERTATION

MUROVEC, Jure. Autonomous systems for classification of noise sources based on spatial filtering. Mentor: izr. prof. dr. Jurij Prezelj.

PROJECTS

Gorenje d.o.o. - Aerodinamična analiza hladilnega kanala za sušilni stroj ASKO TD75.C260. Jurij Prezelj. 01.4.2020 - 31.03.2021

ENERGY ENGINEERING

04 DEVELOPMENT EVALUATION

In the Development evaluation programme group, we are improving upon the rebmix algorithm for finite mixture parameter estimation and the Dirlik method for fatigue life prediction in the frequency-domain.

We will model the stress-strain states of rubber and rubber composites and their fatigue life. We will improve the energy based method for the durability prediction of thermomechanically loaded components. We will research the lithium-ion batteries. We will improve the models of durability showing a significant break-point in the durability curve. We will research the modelling of the fatigue life of casted parts with inhomogeneities and of parts with a hybrid metal-nonmetal load-carrying structure.

Prediction of the behaviour of structures that are loaded with mechanical loads causing high strain rates in the material will be improved. For wood products, the influence of the probability distribution of occurrence and location of inhomogeneities on the material properties of wood will be determined. The damage initiation and damage propagation periods during fatigue of wood and wood-based composites and hybrids will be investigated.

Laboratory for Machine Elements LASEM

RESEARCH AREAS

Machine element • Operational strength • Development evaluations

DEPARTMENT HEAD Prof. Marko Nagode, PhD

DEPARTMENT MEMBERS Assist. Prof. Simon Oman, PhD, Assist. Ivan Okorn, PhD, Assist. Tadej Kocjan, Assist. Branislav Panić, PhD, Boris Šrklec, Silva Brenčič

ORIGINAL SCIENTIFIC ARTICLES

NAGODE, Marko, KLEMENC, Jernej, OMAN, Simon, ŠERUGA, Domen. A closed-form solution for temperature-dependent elastoplastic problems using the Prandtl operator approach. Communications in Nonlinear Science and Numerical Simulation, ISSN 1007-5704, Aug. 2021, vol. 99, str. 1-24.

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DOCTORAL DISSERTATIONS

PANIĆ, Branislav. Improvements of Gaussian mixture models for classification of operational strength problems: dissertation. Mentor prof. dr. Marko Nagode.

PATENTS

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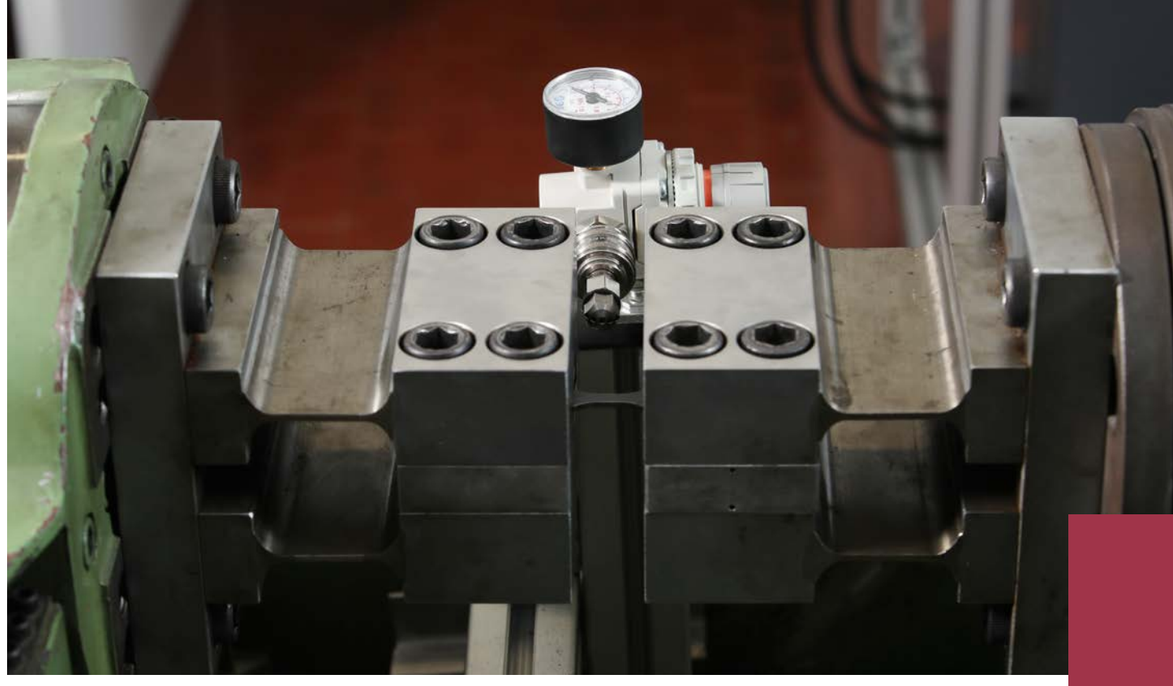
PROJECTS

Company Texas institute of Science. Variable Displacement Modular Axial Piston Pump – design of pump module. Marko Nagode. 18.12.2019 - 31.12.2021

Texas institute of Science. Variable displacement Modular Axial Piston Pump Including Separator. Marko Nagode. 17.06.2019 - 31.12.2021

Slovenian Research Agency - Analysis of failures that were detected at technical inspection procedures by using conventional statistical methods and data mining methods. Jernej Klemenc. 1.11.2019 – 31.10.2022



Laboratory for Structure Evaluation LAVEK

RESEARCH AREAS

Development • Evaluation • Reliability • Maintainability • Supportability • Availability • Dependability • Durability • Prediction

DEPARTMENT HEAD Prof. Jernej Klemenc, PhD

DEPARTMENT MEMBERS Assoc. Prof. Domen Šeruga, PhD, Assist. Andrej Škrlec, PhD, Assist. Dejan Tomažinčič, PhD, Assist. Peter Zobec, Tomaž Bešter, PhD, asist. Aleš Gosar, PhD., Assist. Jure Kajbič, Assist. Aljaž Litrop, Silva Brenčič

ORIGINAL SCIENTIFIC ARTICLES

ŠERUGA, Domen, GOSAR, Aleš, SWEENEY, Caoimhe A., JAGUEMONT, Joris, MIERLO, Joeri Van, NAGODE, Marko. Continuous modelling of cyclic ageing for lithium-ion batteries. Energy, ISSN 0360-5442, Jan. 2021, vol. 215, part B, str. 1-14.

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ŠERUGA, Domen, KAVČIČ, Matija, KLEMENC, Jernej, NAGODE, Marko. Heat treatment consideration in structural simulations of machine elements : analysis of a starter clutch barrel. Technologies, ISSN 2227-7080, 2021, vol. 9, iss. 4, str. 1-10.

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DOCTORAL DISSERTATION

TOMAŽINČIČ, Dejan. Influence of inhomogeneity clusters to fatigue life of dye-casted products: dissertation. Mentor prof. dr. Jernej Klemenc.

PROJECTS

Texas institute of Science. Variable displacement Modular Axial Piston Pump Including Separator. Margo Nagode. 17.06.2019 - 31.12.2021

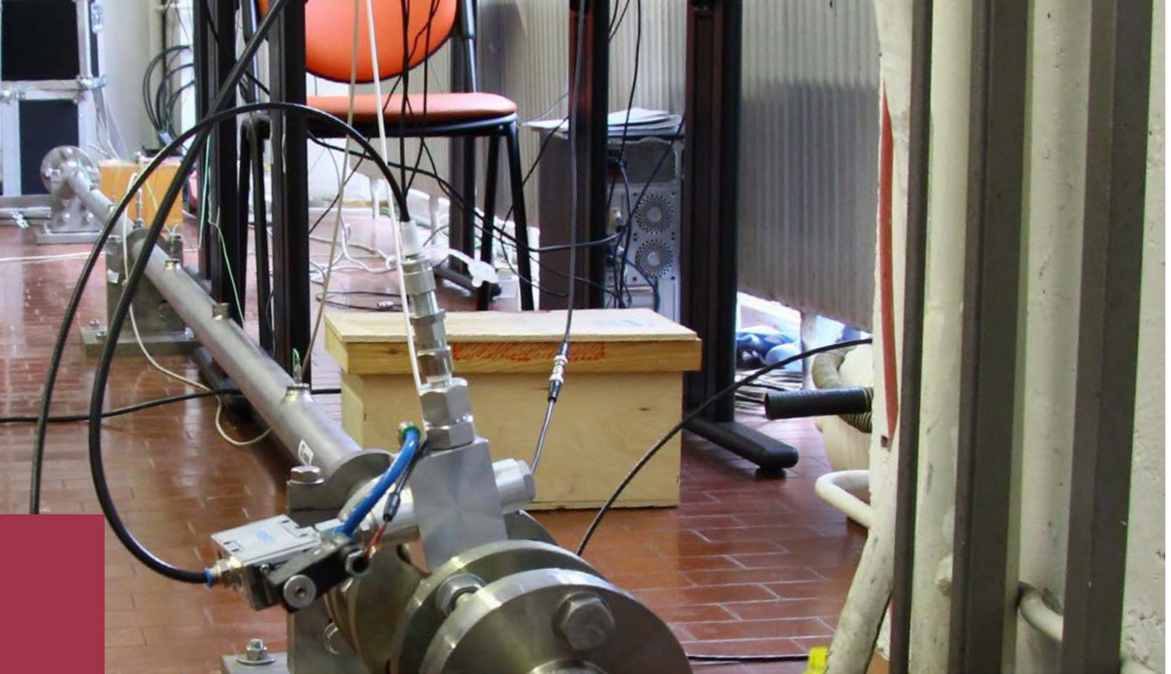
Slovenian Research Agency - Analysis of failures that were detected at technical inspection procedures by using conventional statistical methods and data mining methods. Jernej Klemenc. 1.11.2019 – 31.10.2022

05 HEAT AND MASS TRANSFER

We conduct research and development of systems for the supply and use of energy for heating, cooling, air-conditioning and process engineering with emphasis on renewable energy sources and efficient use of energy.

We are engaged in advanced mechanisms of heat transfer and heat transport, a part of which includes boiling research in microstructures. We are involved in exergoeconomic optimisation of the entire energy supply chain. We research and develop alternative magnetocaloric and electrocaloric cooling technologies for real applications in the domain of conventional refrigerators with inclusion of thermal diodes and switches.

We conduct research of thermal response of cities with natural building elements and integration into buildings' envelope. We study the impact of cooling loads of buildings on electricity consumption and thermal comfort in buildings with inclusion of thermal storage. Research results are verified with measurements conducted in laboratories and on real systems for which innovative measuring methods and meters are being developed.



Laboratory for Measurements in Process Engineering LMPS

RESEARCH AREAS

Metrology • Measurements of temperature, pressure and fluid flow rate
• Development of measuring equipment and measurement methods
• Calibration

DEPARTMENT HEAD Assoc. Prof. Jože Kutin, PhD

DEPARTMENT MEMBERS Assist. Prof. Gregor Bobovnik, PhD, Assist. Prof. Andrej Svete, PhD, Marjan Pohl, Peter Sambol, Dev. Francisco Javier Hernandez Castro, Assist. Primož Žibret, Zdenka Rupič, Katja Tajč

ORIGINAL SCIENTIFIC ARTICLES

BOBOVNIK, Gregor, ŽIBRET, Primož, KUTIN, Jože. Characterization of a piston prover gas flow standard in variable ambient temperature conditions. Measurement : journal of the International Measurement Confederation, ISSN 0263-2241, Jun. 2021, vol. 177, str. 1-9.

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BOBOVNIK, Gregor, MUŠIČ, Tim, KUTIN, Jože. Liquid level detection in standard capacity measures with machine vision. Sensors, ISSN 1424-8220, Apr. 2021, vol. 21, iss. 8, str. 1-13.

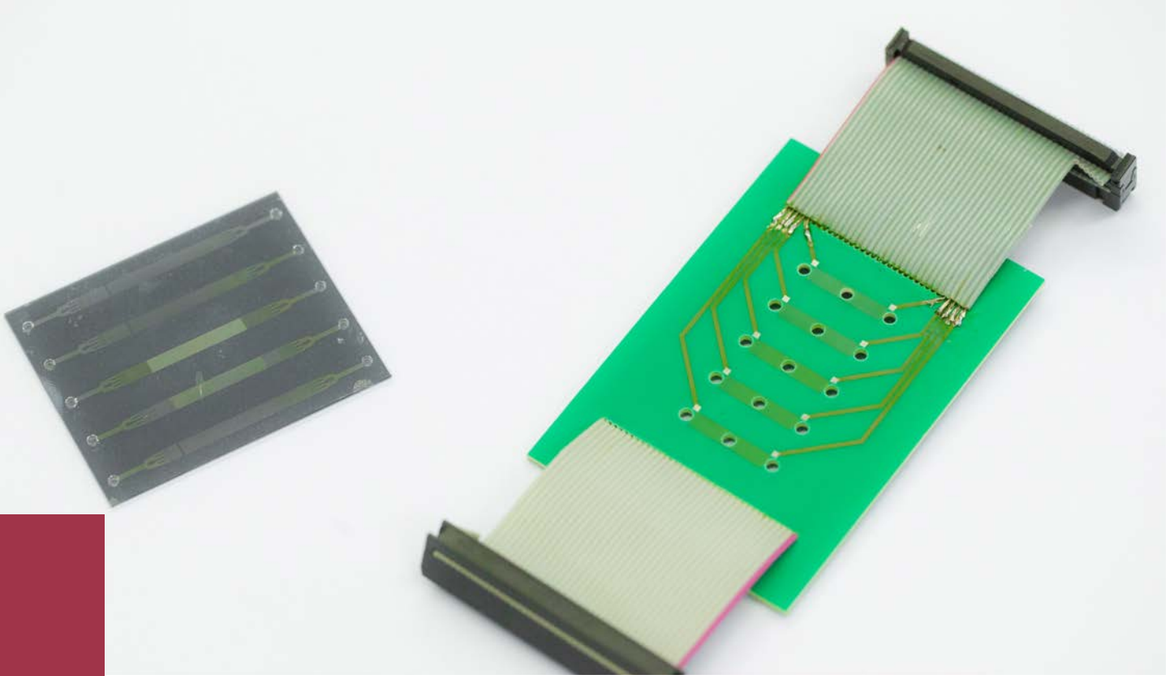
SVETE, Andrej, PLANKO, Urh, KUTIN, Jože. Določanje statičnih občutljivosti hitro odzivnih merilnih sistemov za tlak. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279, avg. 2021, letn. 27, št. 4, str. 254-260.

PROJECTS

Slovenian Research Agency. Advanced shock tube system for high-frequency primary dynamic pressure calibration. Andrej Svete. 01.10.2021 - 30.09.2024

EURAMET - The European Association of National Metrology Institutes. Metrology infrastructure for high-pressure gas and liquified hydrogen flows. MetHyInfra. Jože Kutin. 01.06.2021 - 31.5.2024

HEAT AND MASS TRANSFER



Laboratory for Heating Technology LTT

RESEARCH AREAS

Heat and mass transfer • Thermal engineering • Applied thermodynamics • Process engineering • Biotechnology • Environmental protection technologies

DEPARTMENT HEAD Prof. Iztok Golobič, PhD

DEPARTMENT MEMBERS Assist. Prof. Matevž Zupančič, PhD, Assist. Ivan Sedmak, PhD, Assist. Matic Može, PhD, Assist. Jure Berce, Assist. Mattia Bucci, Assist. Armin Hadžić, Zdenka Rupič

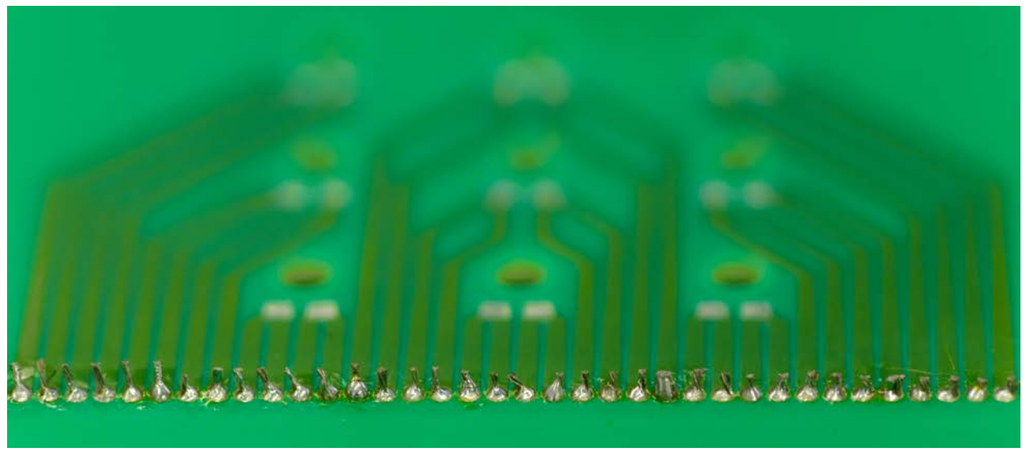
ORIGINAL SCIENTIFIC ARTICLES

ZUPANČIČ, Matevž, ZAKŠEK, Peter, GOLOBIČ, Iztok. Experimental investigation of single-bubble growth during the saturated pool boiling of water and self-rewetting aqueous n-butanol mixtures. Case studies in thermal engineering, ISSN 2214-157X, 2021, vol. 28, str. 1-21.

TAKEYAMA, Mao, ZUPANČIČ, Matevž, KUNUGI, Tomoaki. Influence of hydrodynamic interactions among multiple bubbles on convective heat transfer in nucleate boiling. Experimental thermal and fluid science, ISSN 0894-1777, 1 Oct. 2021, vol. 128, str. 1-11.

ŽALEC, Domen, HANAK, Dawid P., MOŽE, Matic, GOLOBIČ, Iztok. Process development and performance assessment of flexible calcium looping biomass gasification for production of renewable gas with adjustable composition. International journal of energy research, ISSN 0363-907X, Dec. 2021, str. [1-19].

MOŽE, Matic, VAJC, Viktor, ZUPANČIČ, Matevž, GOLOBIČ, Iztok. Hydrophilic and hydrophobic nanostructured copper surfaces for efficient pool boiling heat transfer with water, water/butanol mixtures and Novec 649. Nanomaterials, ISSN 2079-4991, 26 Nov. 2021, vol. 11, iss. 12, str. 1-26.



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MOŽE, Matic, VAJC, Viktor, ZUPANČIČ, Matevž, ŠULC, Radek, GOLOBIČ, Iztok. Pool boiling performance of water and self-rewetting fluids on hybrid functionalized aluminum surfaces. Processes, ISSN 2227-9717, Jun. 2021, vol. 9, no. 6, str. 1-27.

DOCTORAL DISSERTATION

MOŽE, Matic. Hybrid structured surfaces for enhanced nucleate boiling heat transfer. Mentor prof. dr. Iztok Golobič.

PROJECTS

Company Danfoss Trata. Development of smart heating station components for the DOM 24H project. Iztok Golobič. 4.12.2020-4.2.2022

Company Plinovodi. Preparation of a study on the impact of renewable gases, including hydrogen, on the materials and elements of the transmission piping system. Iztok Golobič. 11.8.2020 - 31.12.2021

Slovenian Research Agency. Enhanced boiling heat transfer utilising hierarchical functionalized surfaces (eHEATs). Matevž Zupančič. 1.9.2020 - 31.8.2023

Melamin d.d. Razvoj pilotnega reaktorja za temično razgradnjo težko razgradljivih organskih snovi v void. Iztok Golobič.

Laboratory for Refrigeration and District Energy
LAHDE

RESEARCH AREAS

Heat and Mass Transfer • Refrigeration • Caloric energy conversion • Heat pumps • Thermal control devices • District energy

DEPARTMENT HEAD Prof. Andrej Kitanovski, PhD

DEPARTMENT MEMBERS Assist. Jure Mencinger, PhD, Assist. Prof. Jaka Tušek, PhD, Assist. Dall`Olio Stefano, PhD, Assist. Urban Tomc, PhD, Assist. Boris Vidrih, PhD, Assist. Parham Kabirifar, PhD, Assist. Žiga Ahčin, Assist. Katja Klinar, Assist. Luka Lorbek, PhD, Sr. Dev. Nada Petelin, Assist. Luka Porenta, Miha Bobič, PhD, Simon Bogić, Assist. Jan Cerar, Simon Nosan, Assist. Katja Vozel, Anja Kuhelj, Assist. Pero Gatarić, PhD, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

AHČIN, Žiga, LIANG, Jierong, ENGELBRECHT, Kurt, TUŠEK, Jaka. Thermo-hydraulic evaluation of oscillating-flow shell-and-tube-like regenerators for (elasto)caloric cooling. Applied thermal engineering, ISSN 1359-4311, May 2021, vol. 190, str. 1-15.

MAIORINO, Angelo, DEL DUCA, Manuel Gesù, TOMC, Urban, TUŠEK, Jaka, KITANOVSKI, Andrej, APREA, Ciro. A numerical modelling of a multi-layer LaFeCoSi active magnetic regenerator by using artificial neural networks. Applied thermal engineering, ISSN 1359-4311, Oct. 2021, vol. 197, str. 1-13.

PORENTA, Luka, LAVRENČIČ, Marko, DUJC, Jaka, BROJAN, Miha, TUŠEK, Jaka, BRANK, Boštjan. Modeling large deformations of thin-walled SMA structures by shell finite elements. Communications in Nonlinear Science and Numerical Simulation, ISSN 1007-5704, okt. 2021, vol. 101, no. 105897, str. 1-29.

GATARIĆ, Pero, ŠIROK, Brane, HOČEVAR, Marko, NOVAK, Lovrenc. Influence of load mass, drum speed and load composition on evenness of drying in a heat pump tumble dryer. Drying technology, ISSN 0737-3937, 2021, str. 1-13.

POREDOŠ, Primož, PETELIN, Nada, ŽEL, Tilen, VIDRIH, Boris, GATARIĆ, Pero, KITANOVSKI, Andrej. Performance of the condensation process for water vapour in the presence of a non-condensable gas on vertical plates and horizontal tubes. Energies, ISSN 1996-1073, Apr. 2021, vol. 14, iss. 8, str. 1-28.

POREDOŠ, Primož, VIDRIH, Boris, POREDOŠ, Alojz. Performance and exergy analyses of a solar assisted heat pump with seasonal heat storage and grey water heat recovery unit. Entropy, ISSN 1099-4300, Jan. 2021, vol. 23, iss. 1, f. 1-17.

MASCHE, M., IANNICIELLO, Lucia, TUŠEK, Jaka, ENGELBRECHT, Kurt. Impact of hysteresis on caloric cooling performance. International journal of refrigeration, ISSN 0140-7007. [Print ed.], Jan. 2021, vol. 121, str. 302-312.

GATARIĆ, Pero, LORBEK, Luka. Evaluating R450A as a drop-in replacement for R134a in household heat pump tumble dryers. International journal of refrigeration, ISSN 0140-7007. [Print ed.], Aug. 2021, vol. 128, str. 22-33.

LORBEK, Luka, KATRAŠNIK, Tomaž, KITANOVSKI, Andrej. Impact of neglecting the variations in the relative surface roughnesses of capillary tubes on the accuracy of a capillary tube model. International journal of refrigeration, ISSN 0140-7007, Sep. 2021, vol. 129, str. 194-203.

SWOBODA, Timm, KLINAR, Katja, ABBASI, Shahzaib, BREM, Gerrit, KITANOVSKI, Andrej, MUÑOZ ROJO, Miguel. Thermal rectification in multilayer phase change material structures for energy storage applications. iScience, ISSN 2589-0042, 2021, vol. 24, iss. 8, str. 1-14.

ŠADL, Matej, TOMC, Urban, URŠIČ NEMEVŠEK, Hana. Investigating the feasibility of preparing metal-ceramic multi-layered composites using only the aerosol-deposition technique. Materials, ISSN 1996-1944, Aug. 2021, vol. 14, iss. 16, str. 4548-1-4548-10.

NAVICKAITE, Kristina, IANNICIELLO, Lucia, TUŠEK, Jaka, ENGELBRECHT, Kurt, BAHL, Christian Robert Haffenden, PENZEL, Michael, NESTLER, Klaus, BÖTTGER-HILLER, Falko, ZEIDLER, Henning. Plasma electrolytic polishing of nitinol : investigation of functional properties. Materials, ISSN 1996-1944, Oct. 2021, vol. 14, iss. 21, str. 1-13.

PATENTS

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DOCTORAL DISSERTATION

LORBEK, Luka. Matematični model za simulacijo in optimizacijo procesov v parno-kompresijskih hladilnih sistemih : doktorsko delo. Mentor prof. dr. Andrej Kitanovski.

PROJECTS

Gorenje d.d. - Development of thermal processes in household appliances. Andrej Kitanovski. 23.2.2020-21.2.2022

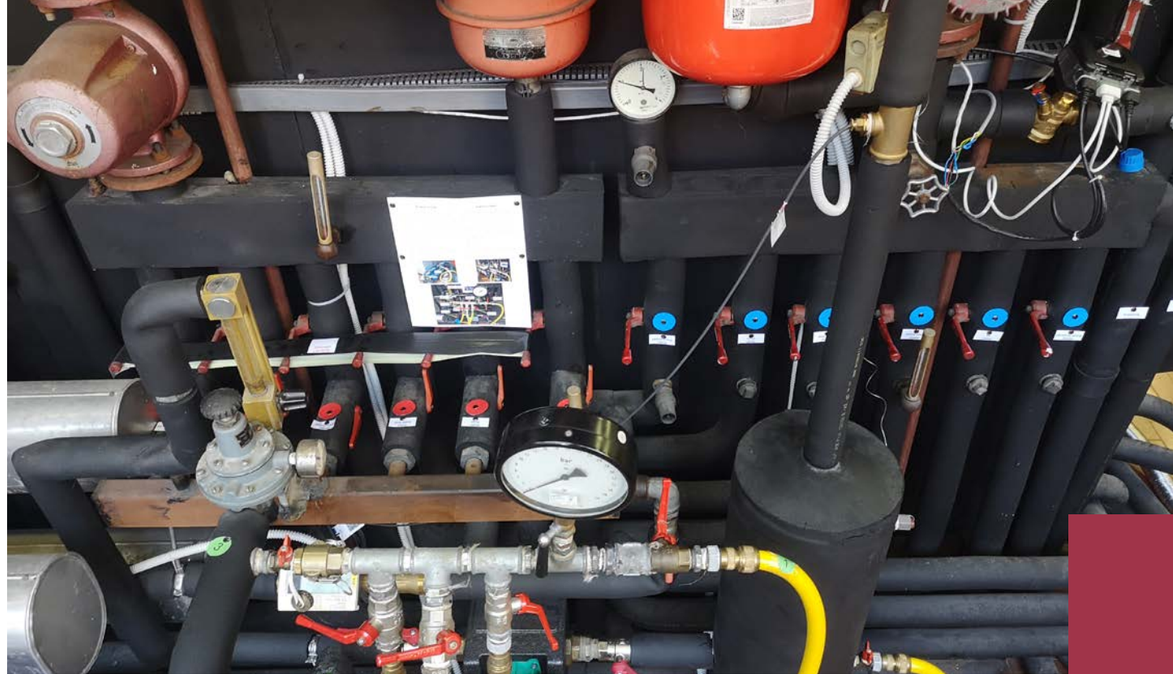
Slovenian Research Agency. MagBoost: Magnetocaloric booster micro-heat pump for district heating system. Andrej Kitanovski. 1.9.2020 - 31.8.2023

Slovenian Research Agency. TCCbuilder: An open-source simulation tool for thermal control circuits. Andrej Kitanovski. 1. 10. 2021 – 31. 8. 2023

AWARDS AND ACHIEVEMENTS

Assist. Katja Klinar received an award of the Faculty of Mechanical Engineering for high quality publications.

Assist. Luka Lorbek, PhD, PhD, Assist. Luka Porenta, Klemen Hvala and prof. Andrej Kitanovski, PhD, were awarded Rector's Award fot he best innovation 2021, 2nd place prize for the innovation called EASE – an advanced system for cooling electronic devices.



Laboratory for Heating, Sanitary, Solar and Air Conditioning Engineering LOSK

RESEARCH AREAS

Heat and mass transfer in buildings and building installations • Indoor environment • Ventilation • Air conditioning • Efficient use of energy • Environment protection (air) • Sanitary engineering • Alternative systems • Modelling

DEPARTMENT HEAD Assoc. Prof. Uroš Stritih, PhD

DEPARTMENT MEMBERS Assoc. Prof. Matjaž Prek, PhD, Assist. Eneja Osterman, PhD, Assist. Rok Koželj, Assist. Žiga Lampret, Assist. Eva Zavrl, Assist. Urška Mlakar, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

KOŽELJ, Rok, MLAKAR, Urška, ZAVRL, Eva, STRITIH, Uroš, STROPNIK, Rok. An experimental and numerical analysis of an improved thermal storagetank with encapsulated PCM for use in retrofitted buildings for heating. Energy and buildings, ISSN 0378-7788. Oct. 2021, vol. 248, str. 1-13.

PROJECTS

Horizon 2020 – HEART - Holistic Energy and Architectural Retrofit Toolkit. Uroš Stritih. 01.10.2017 – 30.09.2021

Laboratory for Sustainable Technologies in Buildings LOTZ

RESEARCH AREAS

Engineering sciences • Energy engineering • Renewable sources and technologies

DEPARTMENT HEAD Prof. Sašo Medved, PhD

DEPARTMENT MEMBERS Assoc. Prof. Ciril Arkar, PhD, Simon Muhič, PhD, Assist. MSc Suzana Domjan, Assist. Tej Žižak, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

BOŠNJAKOVIĆ, Mladen, ČIKIĆ, Ante, Simon Muhič, PhD, HOLIK, Mario. Heat transfer correlations for star-shaped fins. Applied sciences, ISSN 2076-3417, 2021, iss. 13, vol. 11, str. 1-17.

MEDVED, Sašo, DOMJAN, Suzana, ARKAR, Ciril. Contribution of energy storage to the transition from net zero to zero energy buildings. Energy and buildings, ISSN 0378-7788, Apr. 2021, vol. 236, str. 1-13.

PROJECTS

Slovenian Research Agency. Development of technical guidelines for quadruple glazing. Sašo Medved. 1.10.2021 - 30.9.2024

Eureka. SWDGR Storm-water detention green roofs with online modeling application. Ciril Arkar. 1.9.2020 - 31.8.2023

Ministry of the Environment and Spatial Planning. Draft rules on energy performance of buildings, TSG 004-1 and explanatory document. Sašo Medved. 9.7.2019 - 31.1.2022

06 TRIBOLOGY

The Tribology programme group is interdisciplinary and includes 15-20 member from different disciplines: mechanical engineering, physics, chemistry, materials and nanotechnologies.

The group is developing an energy-efficient, sustainable and at the same time more environment-friendly “green” operation of mechanical systems. Linking understanding of tribological and surface processes from nano- to macroscale with the aim of solving industrial problems is the group’s basic goal. The central closely-related areas of work are: contact engineering and surface mechanics, wear-resistant mechanical systems, protective surface coatings, lubrication and surface films, nanotribology, wetting, tribochemestry and adhesion processes, and power-control hydraulic design.

The group is also actively engaged in topography and real contact area models, advanced polymer, electrical and mechatronic contacts tribology, tribology in production processes, polymer gears and automotive applications, and water hydraulics.

Laboratory for tribology and interface nanotechnology TINT

RESEARCH AREAS

Wear • Lubrication • Friction • Surface engineering • Nanotribology • Interface nanotechnology • Maintenance

DEPARTMENT HEAD Prof. Mitjan Kalin, PhD

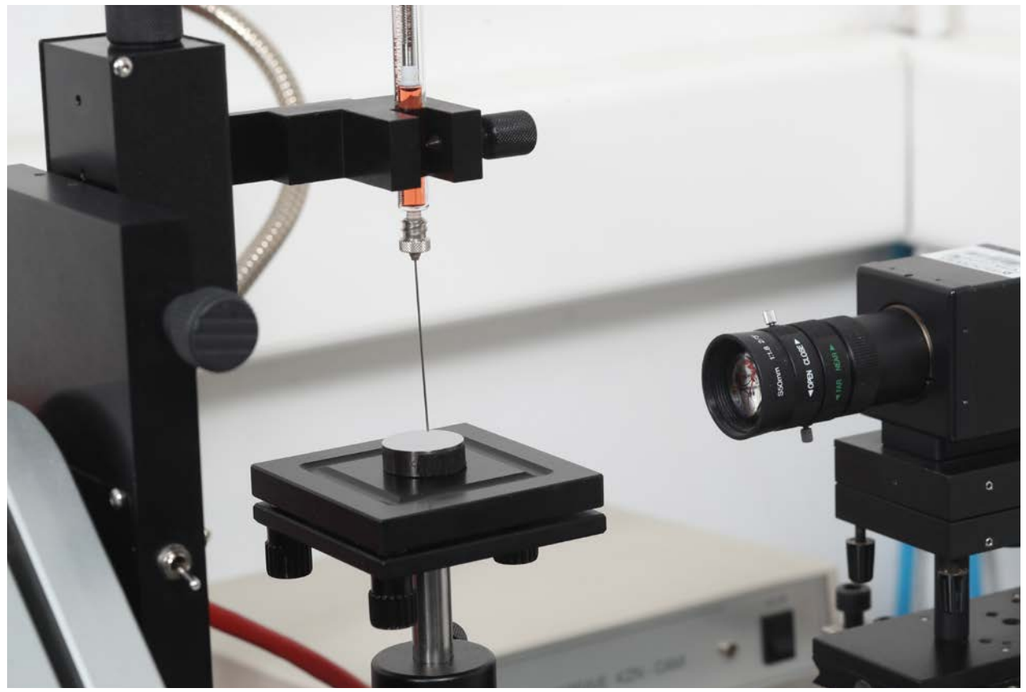
DEPARTMENT MEMBERS Assist. Prof. Marko Polajnar, PhD, Assist. Prof. Janez Kogovšek, PhD, Assist. Arshad Muhammad Shahid, PhD, Assist. Blaž Žugelj, PhD, Assist. Lucija Čoga, PhD, Assist. Jure Jerina, PhD, Assist. Marko Soderžnik, PhD, Assist. Urban Klanjšček, Assist. Sebastjan Matkovič, Assist. Hamouda Karim, Assist. Siddiqui Muhammad Shoaib Naseem, Franc Kopač, Assist. Petra Jan, Prashant Gangwani, Pedro Martins Ferreira, Irfan Nadeem, Sr. Res. Assoc. Tomaž Požar, PhD, Jožica Sterle

ORIGINAL SCIENTIFIC ARTICLES

MATHEW, Jacob Shiby, MARCINAUSKAS, Liutauras, KALIN, Mitjan, KEŽELIS, Romualdas, KAVALIAUSKAS, Žydrunas, GECEVIČIUS, Giedrius, ČAPAS, Vytautas. Improvement of the tribological properties of alumina coatings by zirconia addition. Coatings, ISSN 2079-6412, 2021, vol. 11, str. 1-14.

KALIN, Mitjan, KUS, Maja. New strategy for reducing the EHL friction in steel contacts using additive-formed oleophobic boundary films. Friction, ISSN 2223-7690, 2021, vol. 9, iss. 6, str. 1346-1360.

LOVŠIN, Matija, BRANDL, Dominik, GLAVAN, Gašper, BELYAEVA, Inna A., CMOK, Luka, ČOGA, Lucija, KALIN, Mitjan, SHAMONIN, Mikhail, DREVENŠEK OLENIK, Irena. Reconfigurable surface micropatterns based on the magnetic field-induced shape memory effect in magnetoactive elastomers. Polymers, ISSN 2073-4360, Dec. 2021, vol. 13, art. no. 4422, 13 str.



POLAJNAR, Marko, THIÉBAUT, Benoît, JARNIAS, Frederic, KALIN, Mitjan. Elasto-hydrodynamic friction changes on steel surfaces arising from the modified surface energy of the steel due to additive boundary films. Tribology international, ISSN 0301-679X, Dec. 2021, vol. 164, str. 1-10.

POŽAR, Tomaž, AGREŽ, Vid, PETKOVŠEK, Rok. Laser-induced cavitation bubbles and shock waves in water near a concave surface. Ultrasonics Sonochemistry, ISSN 1350-4177, May 2021, vol. 73, str. 1-11.

KUNAVAR, Matej, NOVAK, Nejc, MAJDIČ, Franc. Analiza realnih in testnih delcev v hidravličnih filtrih : 1. del. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279, feb. 2021, letn. 27, št. 1, str. 24-32.

KUNAVAR, Matej, NOVAK, Nejc, MAJDIČ, Franc. Primerjava standardnih testnih delcev z realnimi iz hidravličnih filtrov. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279, apr. 2021, letn. 27, št. 2, str. 104-108.

MAJDIČ, Franc. Matematični model za hidravlične akumulatorje. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279, avg. 2021, letn. 27, št. 4, str. 246-253.

CIZL, Primož, MAJDIČ, Franc. Vodno-hidravlični trajnostni preizkus oljno-hidravličnega proporcionalnega potnega ventila. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279, okt. 2021, letn. 27, št. 5, str. 314-322.

KALIN, Mitjan, MATKOVIČ, Sebastjan. Effects of slide-to-roll ratio and temperature on the tribological behaviour in polymer-steel contacts and a comparison with the performance of real-scale gears. Wear, ISSN 0043-1648, July 2021, vol. 477, str. 1-13.

MATKOVIČ, Sebastjan, POGAČNIK, Aljaž, KALIN, Mitjan. Wear-coefficient analyses for polymer-gear life-time predictions : a critical appraisal of methodologies. Wear, ISSN 0043-1648, 15. Sep. 2021, vol. 480/481, str. 1-12.

PATENTS

NOVAK, Lovrenc, PETKOVŠEK, Martin, OMAN, Simon, NAGODE, Marko, KLEMENC, Jernej, MAJDIČ, Franc, HOČEVAR, Marko, GOSAR, Aleš, OLAH, Laslo. Downhole three phase separator and method for use of same : United States Patent US 11,143,009 B1, 2021-10-12. Alexandria (VA): United States Patent and Trademark Office, 2021.

OMAN, Simon, NAGODE, Marko, KLEMENC, Jernej, MAJDIČ, Franc, HOČEVAR, Marko, GOSAR, Aleš, ŠKRLEC, Andrej, OLAH, Laslo. Submersible pump assembly and method for use of same : United States patent US 10,883,488 B1, 2021-01-05. Alexandria: United States Patent and Trademark Office, 2021.

OMAN, Simon, NAGODE, Marko, KLEMENC, Jernej, MAJDIČ, Franc, HOČEVAR, Marko, GOSAR, Aleš, ŠKRLEC, Andrej, OLAH, Laslo. Submersible pump assembly and method for use of same : United States patent US 10,995,745 B1, 2021-05-04. Alexandria: United States Patent and Trademark Office, 2021

PROJECTS

Erasmus + (Erasmus Mundus) - TRIBOS+ - Joint European Master on Tribology of Surfaces and Interfaces. Mitjan Kalin. 01.09.2018 – 31.08.2024

Horizon 2020 – GreenTRIBOS. Mitjan Kalin. 01.01.2020 - 31.12.2023

Slovenian Research Agency. Nano-engineered Green lubrication technology for sustainable high-performance stamping. Mitjan Kalin. 1.7.2018 – 30.6.2021

Slovenian Research Agency. Novel design of EHL contacts by employing solid-liquid interface phenomena. Marko Polajnar. 1.7.2019 – 30.6.2021

Slovenian Research Agency. Tribological surface design with advanced metal additive manufacturing – TriboADAM. Mitjan Kalin. 1.9.2020 - 31.8.2023

AWARDS AND ACHIEVEMENTS

Prof. Mitjan Kalin, PhD, became a member of the Engineering Academy of Slovenia.

Laboratory for Fluid Power and Controls LFT

RESEARCH AREAS

Fluid power • Oil and water hydraulics • Numerical simulations • Hydraulic components and systems • Control • Component and system development • Durability tests • Diagnostics in hydraulics

DEPARTMENT HEAD Assist. Prof. Franc Majdič, PhD

DEPARTMENT MEMBERS Rok Jelovčan, Dev. Nejc Novak, Jožica Sterle, Assist. Ana Trajkovski, PhD

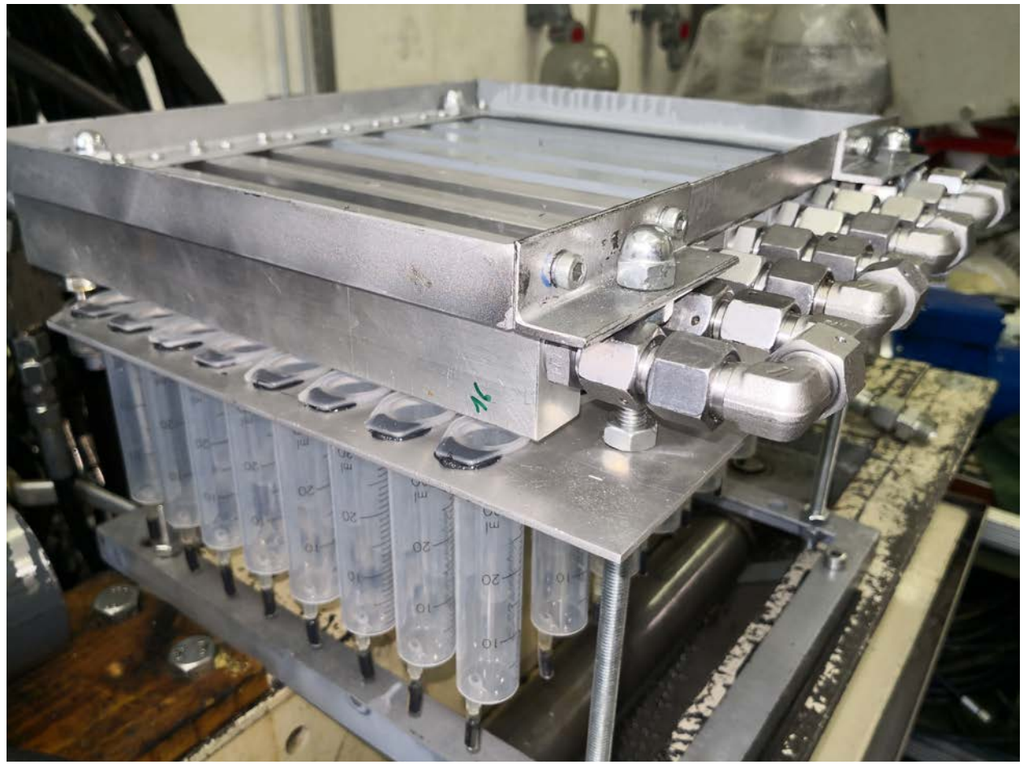
ORIGINAL SCIENTIFIC ARTICLES

MAJDIČ, Franc. Matematični model za hidravlične akumulatorje. Ventil : revija za fluidno tehniko in avtomatizacijo, 2021, vol. 27, no. 4, p. 246-253.

CIZL, Primož, MAJDIČ, Franc. Vodno-hidravlični trajnostni preizkus oljno-hidravličnega proporcionalnega potnega ventila. Ventil : revija za fluidno tehniko in avtomatizacijo, 2021, vol. 27, no. 5, p. 314-322.

PATENTS

NOVAK, Lovrenc, PETKOVŠEK, Martin, OMAN, Simon, NAGODE, Marko, KLEMENC, Jernej, MAJDIČ, Franc, HOČEVAR, Marko, GOSAR, Aleš, OLAH, Laslo. Downhole three phase separator and method for use of same : United States Patent US 11,143,009 B1, 2021-10-12. Alexandria (VA): United States Patent and Trademark Office, 2021.



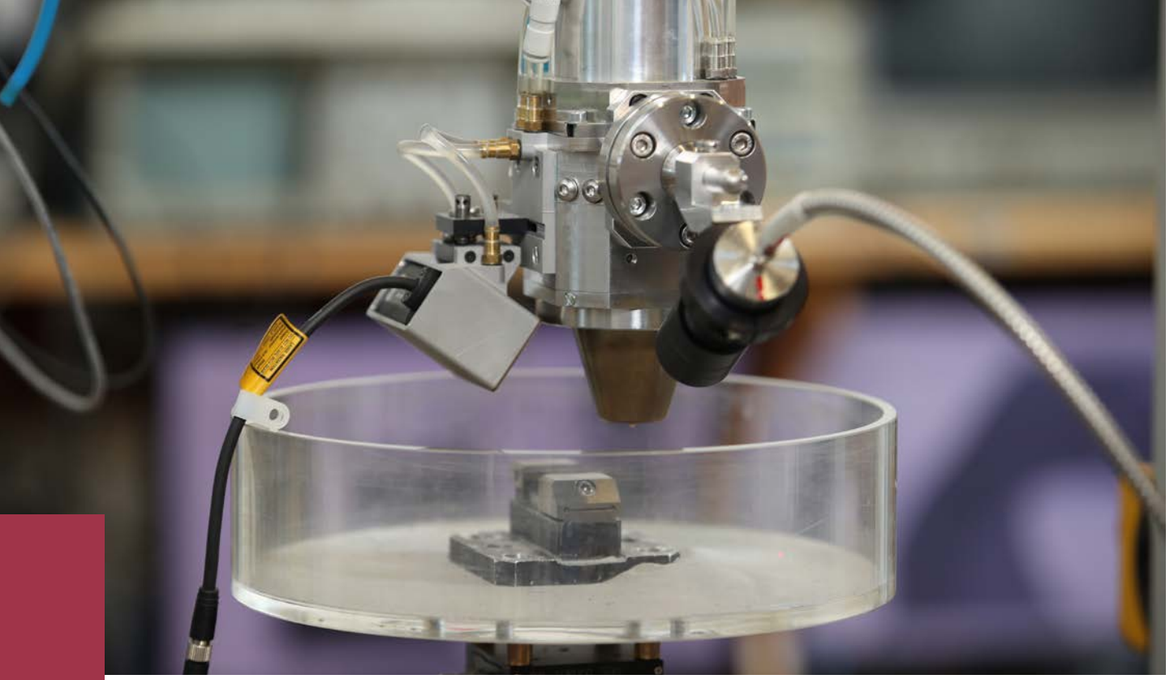
OMAN, Simon, NAGODE, Marko, KLEMENC, Jernej, MAJDIČ, Franc, HOČEVAR, Marko, GOSAR, Aleš, ŠKRLEC, Andrej, OLAH, Laslo. Submersible pump assembly and method for use of same : United States patent US 10,883,488 B1, 2021-01-05. Alexandria: United States Patent and Trademark Office, 2021.

OMAN, Simon, NAGODE, Marko, KLEMENC, Jernej, MAJDIČ, Franc, HOČEVAR, Marko, GOSAR, Aleš, ŠKRLEC, Andrej, OLAH, Laslo. Submersible pump assembly and method for use of same : United States patent US 10,995,745 B1, 2021-05-04. Alexandria: United States Patent and Trademark Office, 2021

07 SYNERGETICS OF COMPLEX SYSTEMS AND PROCESSES

Development of new as well as optimisation of existing technologies, systems and processes with complex and time-varying properties requires an understanding of the mutual nonlinear interactions which can often lead to instabilities and even chaos, and are reflected in the corresponding temporal spatial structures.

The main aim of the research programme is to contribute to world science with regards to description and understanding of complex technological systems and processes. Methods of research are based on synergetic approach to complex systems which includes use of advanced methods of probability and statistics, information theory, chaotic dynamics, soft computing, data mining, adaptive empirical modelling, machine learning, methods of optimisation and predictive control. Within the context of the programme, research is conducted in the field of additive technologies using direct laser deposition of materials, in the field of adaptive information systems for automated monitoring, optimisation and control of complex technological systems and processes, and in the field of non-destructive diagnostics of loaded materials and products.



Laboratory for Synergetics LASIN

RESEARCH AREAS

Synergetics • Technology driven physics • Additive manufacturing
• Direct laser deposition • Empirical modelling and industrial diagnostics
• Optimisation and predictive control

DEPARTMENT HEAD Prof. Edvard Govekar, PhD

DEPARTMENT MEMBERS Assist. Prof. Primož Potočnik, PhD, Assist. Andrej Jeromen, PhD, Assist. Jaka Peternel, Assist. Ana Vidergar, Assist. Jaka Simončič, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

POTOČNIK, Primož, OLMOS LOPEZ-ROSO, Borja, VODOPIVEC, Lučka, SUSIČ, Egon, GOVEKAR, Edvard. Condition classification of heating systems valves based on acoustic features and machine learning. Applied acoustics, ISSN 0003-682X, Mar. 2021, vol. 174, str. 1-9.

POTOČNIK, Primož, ŠKERL, Primož, GOVEKAR, Edvard. Machine-learning-based multi-step heat demand forecasting in a district heating system. Energy and buildings, ISSN 0378-7788, Feb. 2021, vol. 233, str. 1-14.

KOTAR, Matjaž, FUJISHIMA, Makoto, LEVY, Gideon N., GOVEKAR, Edvard. Advances in the understanding of the annular laser beam wire cladding process. Journal of materials processing technology, ISSN 0924-0136, Aug. 2021, vol. 294, str. 1-12.

VENKATESH, Ragunanth, BROJAN, Miha, EMRI, Igor, VOLOSHIN, Arkady S., GOVEKAR, Edvard. Influence of particle size distribution width on GFA index of uniaxially compressed granular materials. Powder technology. [Print ed.]. Jan. 2021, vol. 377, str. 666-675, ilustr. ISSN 0032-5910. https://www.sciencedirect.com/science/article/pii/S0032591020308846?via%3Dihub, DOI: HYPERLINK "https://dx.doi.org/10.1016/j.powtec.2020.09.020"10.1016/j.powtec.2020.09.020. [COBISS.SI-ID HYPERLINK "https://plus.si.cobiss.net/opac7/bib/30054147?lang=sl"30054147]

DOCTORAL DISSERTATIONS

VENKATESH, Ragunanth. Evaluation of particle size distribution influence on flowability of granular materials using a digital image correlation method: doctoral thesis. Mentor prof. dr. Edvard Govekar.

KOTAR, Matjaž. Process of direct annular laser beam metal wire deposition: doctoral thesis. Mentor: prof. dr. Edvard Govekar.

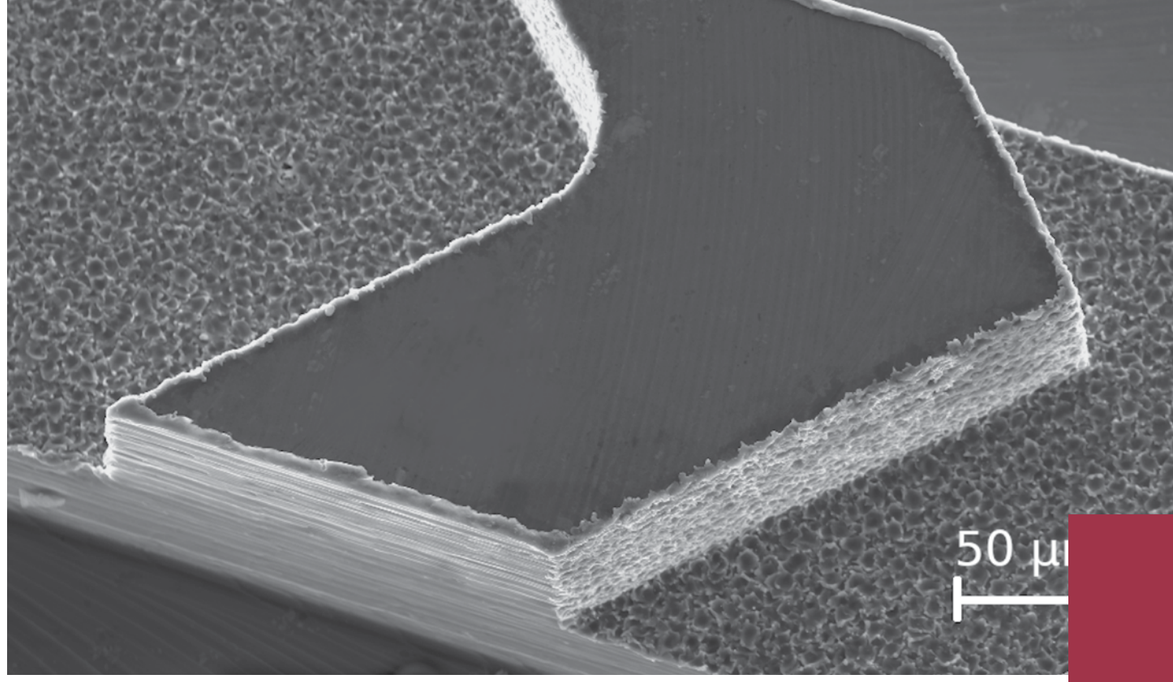
SYNERGETICS OF COMPLEX SYSTEMS AND PROCESSES

08 INNOVATIVE PRODUCTION SYSTEMS AND PROCESSES

The programme group Innovative manufacturing systems is continuing the research work from previous years with its main focus on the Smart factories concept.

The aim is to increase the efficiency and flexibility of manufacturing systems and processes (MSP), based on the principles of the Digital Factory, LEAN, AGILE and TQM and aligned with the Industry 4.0 guidelines. In constructing self-adjusting mechanisms of MSP with defined roles we are focusing on the development of an intelligent algorithm that would automatically suggest optimization steps and solutions. We will apply the above mentioned technologies, related to the Smart Factories concepts, also in the fields of smart forming tools, IceJet cutting, high-dynamic hydraulic positioning axes, intelligent MSP in the domain of assembly and packaging of the consumer products, etc.

In this way we are keeping pace with the evolution and the prospect of manufacturing systems and processes, which extends from the current state of the so-called LEAN manufacturing, through the paradigm of Manufuture to smart factories and further on to the concept of Remote factory.



Laboratory for Alternative Technologies LAT

RESEARCH AREAS

Unconventional machining processes • Additive technologies • Forming and machining of plastic materials and composites • Metrology • Microtechnologies

DEPARTMENT HEAD Assoc. Prof. Joško Valentinčič, PhD

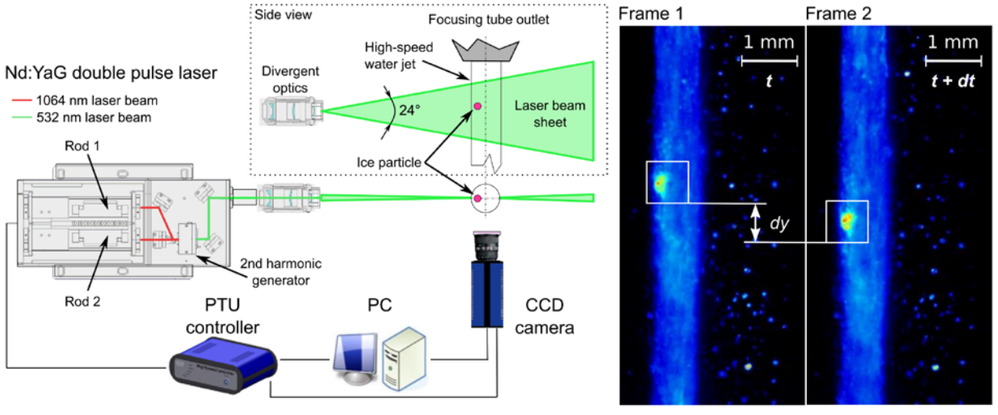
DEPARTMENT MEMBERS Assist. Prof. Andrej Lebar, PhD, Assist. Prof. Henri Orbanić, PhD, Assist. Izidor Sabotin, PhD, Assist. Marko Jerman, PhD, Assist. Suzana Vinetič, Pavel Drešar, Tanja Plestenjak

ORIGINAL SCIENTIFIC ARTICLES

VALENTINČIČ, Joško, BISSACCO, Giuliano, TRISTO, Gianluca. Uncertainty of the electrode wear on-machine measurements in micro EDM milling. Journal of manufacturing processes, ISSN 1526-6125, Apr. 2021, vol. 64, str. 153-160.

JERMAN, Marko, ZELEŇÁK, Michal, LEBAR, Andrej, FOLDYNA, Vladimir, FOLDYNA, Josef, VALENTINČIČ, Joško. Observation of cryogenically cooled ice particles inside the high-speed water jet. Journal of materials processing technology, ISSN 0924-0136, Mar. 2021, vol. 289, str. 1-9.

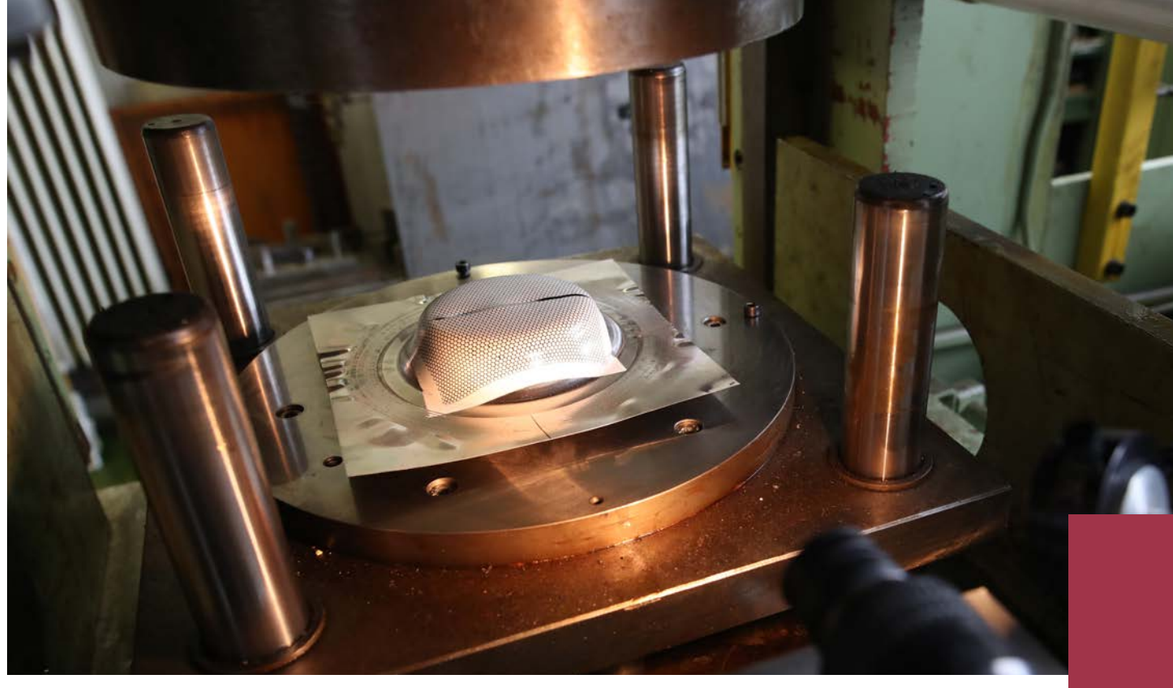
SABOTIN, Izidor, VALENTINČIČ, Joško, PLETERSKI, Matej, JERMAN, Marko, LEBAR, Andrej, DREŠAR, Pavel. An apparatus and a method for loosening a tube section from a tube plate : UK Patent GB 2576062 B, 2021-01-13. South Wales: Intellectual Property Office, 2021.



ORBANIĆ, Henri, UPLAZNIK, Marko, POGAČAR, Toni, PAČNIK, Roman. Autostop function in a kitchen device = Autostoppfunktion in einer Küchenvorrichtung = Fonction d'arrêt automatique d'un dispositif de cuisine : European patent specification EP 3 142 531 B1, 2021-03-10. Munich: European Patent Office, 2021.

PROJECTS

Chair Of Micro Process Engineering and Technology – COMPETE. Joško Valentinčič. 1. 9. 2019 – 31. 12. 2024



Forming Laboratory LAP

RESEARCH AREAS

Theory of plasticity • Forming properties of materials • Forming processes • Biomimetics in forming • Tribology in forming, CARP, CAE, MKE

DEPARTMENT HEAD Assoc. Prof. Tomaž Pepelnjak, PhD

DEPARTMENT MEMBERS Assist. Luka Sevšek, Matjaž Rot, Assist. Ema Stefanovska, Tanja Plestenjak

ORIGINAL SCIENTIFIC ARTICLE

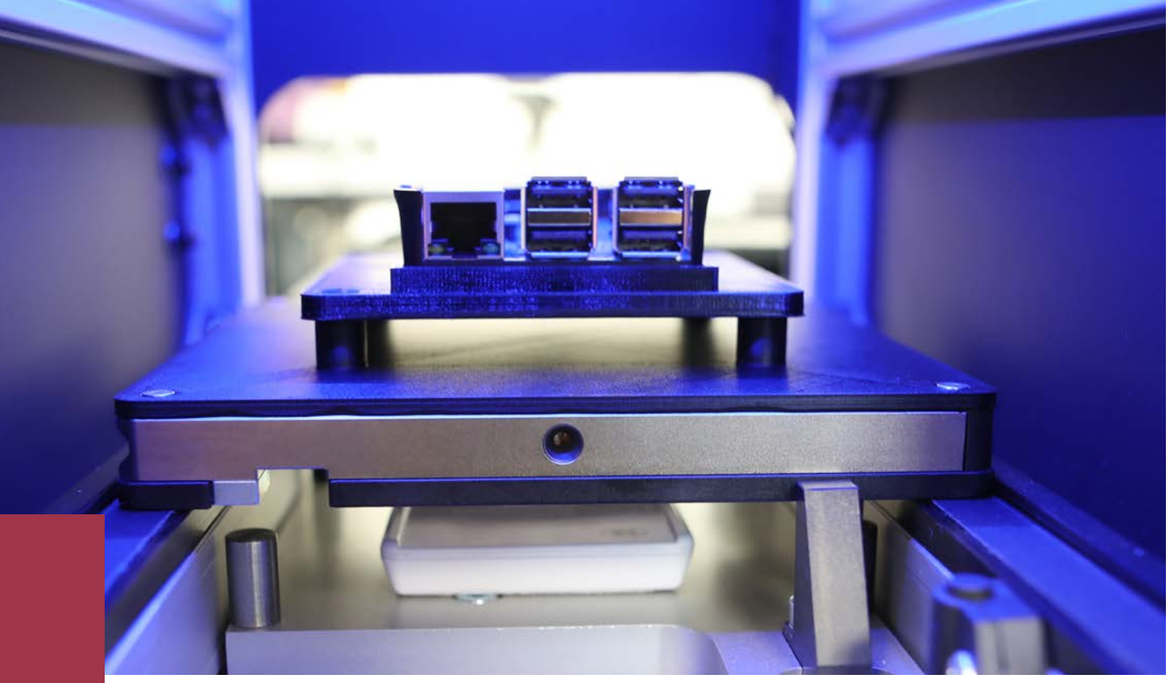
MILUTINOVIĆ, Mladomir, LENDJEL, Robert, BALOŠ, Sebastian, LABUS ZLATANOVIĆ, Danka, SEVŠEK, Luka, PEPELNJAK, Tomaž. Characterisation of geometrical and physical properties of a stainless steel denture framework manufactured by single-point incremental forming. Journal of Materials Research and Technology, ISSN 2238-7854, Jan.-Feb. 2021, vol. 10, str. 605-623.

DOCTORAL DISSERTATION

BORIĆ, Andrej. Analysis of technological parameters and deformation of polymer nanocomposites sheets during single point incremental forming process: dissertation. Mentor: izr. drof. dr. Tomaž Pepelnjak.

PROJECTS

Slovenian Research Agency. Adaptable hardening of austenitic steel surfaces by cryogenic forming processes. Tomaž Pepelnjak. 1.9.2020 - 31.8.2023



Laboratory for Handling, Assembly and Pneumatics LASIM

RESEARCH AREAS

Handling and assembly • Industry 4.0, smart factories • Discrete simulation • Production logistics • Production resources • Fluid power • Hydraulic and pneumatic control systems and components • Piezo engineering

DEPARTMENT HEAD Prof. Niko Herakovič, PhD

DEPARTMENT MEMBERS Assist. Prof. Marko Šimic, PhD, Assist. Mihael Debevec, PhD, Assist. Miha Pipan, PhD, Assist. Hugo Zupan, PhD, Assist. Jernej Protner, Assist. Matevž Resman, Edo Adrović, Assist. Denis Jankovič, Assist. Maja Turk, Rok Živec, Andrej Kos, Tanja Plestenjak

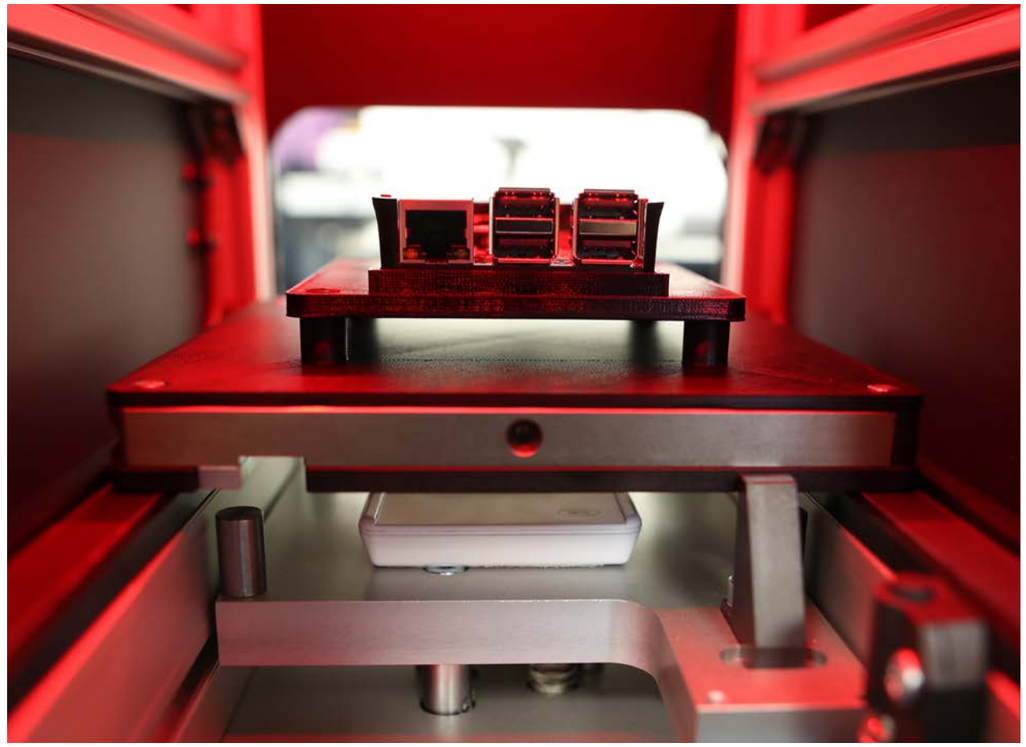
ORIGINAL SCIENTIFIC ARTICLES

RESMAN, Matevž, PROTNER, Jernej, ŠIMIC, Marko, HERAKOVIČ, Niko. A five-step approach to planning data-driven digital twins for discrete manufacturing systems. Applied sciences, ISSN 2076-3417, Apr. 2021, vol. 11, iss. 8, str. 1-25.

ŠIMIC, Marko, HERAKOVIČ, Niko. Characterization of energy consumption of new piezo actuator system used for hydraulic on/off valves. Journal of cleaner production, ISSN 0959-6526, Feb. 2021, vol. 284, str. 1-11.

DOCTORAL DISSERTATION

TURK, Maja. Self-configuration of the workplace with the worker participation: dissertation. Mentor prof. dr. Niko Herakovič.



PROJECTS

Company Comnet Global. Implementation of the research and development project of digital models (digital twins) of logistics of the Postal Logistics Centre PLC Ljubljana. Niko Herakovič. 17.9.2020 - 17.6.2021

IMT Armature d.o.o. Distribuiran koncept pametne tovarne za peskalno calico. Niko Herakovič. 19. 3. 2021 – 31. 12. 2021

Digiteh d.o.o. Raziskave in razvoj modelov (digitalnih dvojčkov) za izvedbo analize proizvodnje, interne logistike, vmesnih skladišč in optimalnega tlorisa proizvodnih prostorov. Niko Herakovič. 20. 5. 2021 – 31. 12. 2021

09 ENGINEERING DESIGN

The Engineering design programme group develops basic and applied knowledge needed for the development of new products: design models and methods of innovation, in-depth application of CFX methods, PDM/PLM methods for comprehensive management of information flows in companies, physical/mathematical modelling of polymer gears, and hybrid numerical methods with code development in the field of fusion (ITER) and wider (plasma simulation).

The research was carried out in four basic directions, providing knowledge in the field of design necessary for the innovative development of new products and their implementation. The group has established supercomputing structures in the Slovenian academic environment and is integrated into projects of the supercomputer association PRACE.

Together with domestic and foreign companies (Germany, Japan, China) the group participates in projects in the fields of fusion research (ITER, MSU-USA), auxiliary heart pump (TU Eindhoven and UT Houston) and development of polymer gears and gear trains. The group also implements the model of laboratories, linked to companies.

Laboratory for Engineering Design LECAD

RESEARCH AREAS

Engineering design • Computer-aided design • Technical information system • Kansei engineering • Polymer gears research • High-Performance Computing • Big data analysis • Computer-intensive methods and applications • Mathematical optimisation • Plasma sheath transition research • Fusion process simulation • Integrated modelling of fusion

DEPARTMENT HEAD Assist. Prof. Nikola Vukašinović, PhD

DEPARTMENT MEMBERS Assist. Prof. Janez Benedičič, PhD, Assist. Prof. Leon Kos, PhD, Assist. Vanja Čok, PhD, Assist. Ivan Demšar, PhD, Assist. Janez Rihtaršič, PhD, Assist. Prof. Aleksander Grm, PhD, Assist. Borut Černe, PhD, Assist. Pavel Tomšič, PhD, Assist. Prof. Damijan Zorko, PhD, Assist. Timotej Hrga, Mateja Maffi, Luka Sedej, Matjaž Šubelj, Assist. Ivona Vasileska, Assist. Uroš Urbas, Assist. Matic Brank, Assist. Daria Vlah, Alenka Maffi, Gregor Simič, Assoc. Prof. Janez Povh, PhD, Leon Bogdanovič, Tadej Kanduč, PhD, Petra Kim Krasnić, Silva Brenčič

ORIGINAL SCIENTIFIC ARTICLES

VLAH, Daria, ČOK, Vanja, URBAS, Uroš. VR as a 3D modelling tool in engineering design applications. Applied sciences, ISSN 2076-3417, Aug. 2021, vol. 11, iss. 16, f. 1-19.

KASTRIN, Andrej, POVH, Janez, ZADNIK STIRN, Lidija, ŽEROVNIK, Janez. Methodologies and applications for resilient global development from the aspect of SDI-SOR special issues of CJOR. Central European Journal of Operations Research, ISSN 1435-246X, 2021.

POVH, Janez, ŽEROVNIK, Janez. On sufficient properties of sufficient matrices. Central European journal of operations research, ISSN 1613-9178, 2021, vol. 29, str. 809-822.

KODŽOMAN, Duje, HLADNIK, Aleš, PAVKO-ČUDEN, Alenka, ČOK, Vanja. Exploring color attractiveness and its relevance to fashion. Color research and application, ISSN 0361-2317, 28 June 2021, vol. , no. , 12 str.

ZORKO, Damijan, TAVČAR, Jože, ŠTURM, Roman, BERGANT, Zoran. Investigation of the durability and performance of autoclave-cured, woven carbon fiber-reinforced polymer composite gears in mesh with a steel pinion. Composite structures, ISSN 0263-8223, Oct. 2021, vol. 273, str. 1-15.

HRGA, Timotej, POVH, Janez. MADAM : a parallel exact solver for max-cut based on semidefinite programming and ADMM. Computational optimization and applications, ISSN 0926-6003, 2021, vol. 80, str. 347-375.

BABIČ, Matej, HLUCHÝ, Ladislav, ŠTER, Branko, POVH, Janez. Modeling public transport network system by using statistics, network theory and ant colony optimization. Computing and informatics, ISSN 1335-9150, 2021, vol. 40, no. 5, str. 1160-1173.

BENEDIK, Blaž, RIHTARŠIČ, Janez, POVH, Janez, TAVČAR, Jože. Failure modes and life prediction model for high-speed bearings in a through-flow universal motor. Engineering failure analysis, ISSN 1350-6307, Oct. 2021, vol. 128, str. 1-17.

VASILESKA, Ivona, BONNIN, Xavier, KOS, Leon. Kinetic-fluid coupling simulations of ITER Type I ELM. Fusion engineering and design, ISSN 0920-3796, Jul. 2021, vol. 168, str. 1-5.

ZORKO, Damijan. Investigation on the high-cycle tooth bending fatigue and thermo-mechanical behavior of polymer gears with a progressive curved path of contact. International journal of fatigue, ISSN 0142-1123, Oct. 2021, vol. 151, str. 1-15.

TAVČAR, Jože, ČERNE, Borut, DUHOVNIK, Jože, ZORKO, Damijan. A multicriteria function for polymer gear design optimization. Journal of computational design and engineering, ISSN 2288-4300, 2021, str. 1-19.

ZORKO, Damijan, DUHOVNIK, Jože, TAVČAR, Jože. Tooth bending strength of gears with a progressive curved path of contact. Journal of computational design and engineering, ISSN 2288-4300, Aug. 2021, vol. 8, iss. 4, str. 1037-1058.

ČOK, Vanja, VLAH, Daria, POVH, Janez. Methodology for mapping form design elements with user preferences using Kansei engineering and VDI. Journal of engineering design, ISSN 0954-4828, Dec. 2021, str. [1-27].

HRIBAR, Rok, HRGA, Timotej, PAPA, Gregor, PETELIN, Gašper, POVH, Janez, PRŽULJ, Nataša, VUKAŠINOVIĆ, Vida. Four algorithms to solve symmetric multi-type non-negative matrix tri-factorization problem. Journal of global optimization, ISSN 0925-5001, Aug. 2021, str. [1-30].

GRM, Aleksander. Ships added mass effect on a flexible mooring dolphin in berthing manoeuvre. Journal of marine science and engineering, ISSN 2077-1312, 2021, vol. 9, iss. 2, str. 1-21.

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URBAS, Uroš, ZORKO, Damijan, ČERNE, Borut, TAVČAR, Jože, VUKAŠINOVIĆ, Nikola. A method for enhanced polymer spur gear inspection based on 3D optical metrology. Measurement : journal of the International Measurement Confederation, ISSN 0263-2241. [Print ed.], Feb. 2021, vol. 169, str. 1-14.

URBAS, Uroš, VLAH, Daria, VUKAŠINOVIĆ, Nikola. Machine learning method for predicting the influence of scanning parameters on random measurement error. Measurement science & technology, ISSN 0957-0233, 2021, vol. 32, no. 6, str. 1-9.

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GRM, Gašper, GRM, Aleksander. Testing the functionality and applicability of smart devices for a handheld celestial navigation system = Testiranje funkcionalnosti i primjenjivosti pametnih uređaja za ručni sustav astronomske navigacije. Naše more : pomorski znanstveni časopis, ISSN 0469-6255, 2021, vol. 68, no. 3, str. 157-166.

HOELZL, Matthias, HUIJSMANS, Guido, PAMELA, Stanislas, BÉCOULET, Marina, NARDON, Eric, ARTOLA, Francisco Javier, NKONGA, Boniface, ATANASIU, Calin, BANDARU, Vinodh, BHOLE, Ashish, KOS, Leon, PENKO, Dejan (konzultant), et al. The JOREK non-linear extended MHD code and applications to large-scale instabilities and their control in magnetically confined fusion plasmas. Nuclear fusion, ISSN 0029-5515, 2021, vol. 61, no. 6, str. 1-71.

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COBURN, Jonathan, LEHNEN, M., PITTS, Richard, THOREN, E., IBANO, K., KOS, Leon, BRANK, Matic, SIMIČ, Gregor, RATYNSKAIA, S., KHAYRUTDINOV, R., LUKASH, V., STEIN-LUBRANO, B., ARTOLA, Francisco Javier, MATVEEVA, E. Reassessing energy deposition for the ITER 5 MA vertical displacement event with an improved DINA model. Nuclear materials and energy, ISSN 2352-1791, Sep. 2021, vol. 28, str. 1-9.

TSKHAKAYA, D. D., VASILESKA, Ivona, KOS, Leon. Time-dependent behavior of a Debye sheath : lengthening and establishment of the stationary state. Physics of plasmas, ISSN 1070-664X, Feb. 2021, vol. 28, str. 1-7.

HOLOD, I., HOELZL, Matthias, VERMA, P. S., HUIJSMANS, G. T. A., NIES, R., KOS, Leon, et al. Enhanced preconditioner for JOREK MHD solver. Plasma physics and controlled fusion, ISSN 0741-3335, 2021, vol. 63, no. 11, str. 1-9.

NARDON, Eric, HU, Di, ARTOLA, Francisco Javier, BONFIGLIO, D., HOELZL, Matthias, BOBOC, A., CARVALHO, P., GERASIMOV, S., HUIJSMANS, Guido, MITTERAUER, V., SCHWARZ, Norbert, SUN, H., KOS, Leon, et al. Thermal quench and current profile relaxation dynamics in massive-material-injection-triggered tokamak disruptions. Plasma physics and controlled fusion, ISSN 0741-3335, 2021, vol. 63, no. 11, str. 1-14.

ZORKO, Damijan, DEMŠAR, Ivan, TAVČAR, Jože. An investigation on the potential of bio-based polymers for use in polymer gear transmissions. Polymer testing, ISSN 0142-9418, Jan. 2021, vol. 93, str. 1-13.

ZORKO, Damijan, TAVČAR, Jože, BIZJAK, Milan, ŠTURM, Roman, BERGANT, Zoran. High cycle fatigue behaviour of autoclave-cured woven carbon fibre-reinforced polymer composite gears. Polymer testing, ISSN 0142-9418, Oct. 2021, vol. 102, str. 1-15.

URBAS, Uroš, ARIANSYAH, Dedy, ERKOYUNCU, John Ahmet, VUKAŠINOVIĆ, Nikola. Augmented reality aided inspection of gears. Tehnički vjesnik : znanstveno-stručni časopis tehničkih fakulteta Sveučilišta u Osijeku, ISSN 1330-3651, Jun. 2021, vol. 28, no. 3, str. 1032-1037.

TAVČAR, Jože, ČERNE, Borut, DUHOVNIK, Jože, ZORKO, Damijan. Večkriterijski pristop pri konstruiranju polimernih zobnikov. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279, feb. 2021, letn. 27, št. 1, str. 34-45.

TAVČAR, Jože, ČERNE, Borut, DUHOVNIK, Jože, ZORKO, Damijan. Večkriterijski model za optimiranje polimernih zobnikov. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279, apr. 2021, letn. 27, št. 2, str. 110-119.

ZORKO, Damijan, ČERNE, Borut, TAVČAR, Jože, DEMŠAR, Ivan. Agilni razvoj kompleksnih mehatronskih sistemov. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279, apr. 2021, letn. 27, št. 2, str. 120-126.

PATENTS

DEMŠAR, Ivan, BENEDIČIČ, Janez. Lahko predalčno kolo za povečanje oprijema in stabilnosti terenskih vozil : patent : SI25967 A, 2021-08-31. Ljubljana: Urad Republike Slovenije za intelektualno lastnino, 2021.

BERNIK, Rajko, DEMŠAR, Ivan. Verižna motorna žaga : patent SI 25888 A, 2021-03-31. Ljubljana: Urad RS za intelektualno lastnino, 2021.

DOCTORAL DISSERTATION

VASILESKA, Ivona. Modelling of divertor target plate heat fluxes during intense plasma transients in tokamaks : doctoral thesis. Mentor Leon Kos.

PROJECTS

ERDF (Smart Specialization) – MAPgears - Advanced materials, methodologies and technologies for the development of lightweight power transmission components for drives technology. Jože Tavčar. 01.09.2018 – 31.12.2021

Erasmus + ELPID - E-learning Platform for Innovative Product Development. Nikola Vukašinovič. 01.09.2018 – 31.08.2021

Erasmus + SCTrain - Supercomputing knowledge partnership. Pavel Tomšič. 01.12.2020 – 30.11.2023

Horizon 2020 - PRACE-6IP - PRACE 6th Implementation Phase Project. Janez Povh. 01.05.2019 – 31.12.2021

ITER - IPA Nomination Gregor Simič. Roman Žavbi. 01.03.2020 - 28.02.2021

ITER - Integrated Modelling Analysis Suite (IMAS). Roman Žavbi. 01.01.2020 - 15.11.2022

Ministry of Agriculture, Forestry and Food. Improvement of the process of animal feeding in dairy and meat production, considering climate change and nature conservation (EIP-AVTO). Janez Benedičič. 01.12.2020 – 30.11.2023

National Competence Centres in the framework of EuroHPC (EUROCC)- Pavel Tomšič. 01.09.2020 - 31.08.2022

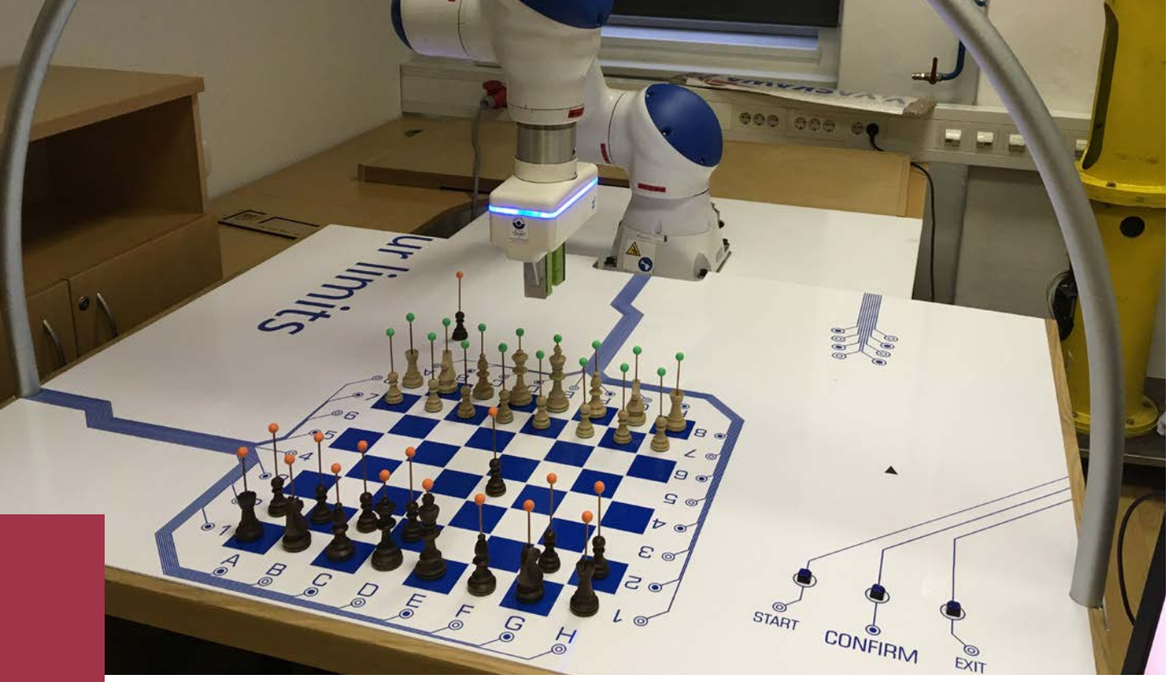
Slovenian Research Agency. Fast evaluation of tooth bending fatigue strength of polymer gears. Damijan Zorko. 1. 10. 2021 – 30. 9. 2023

Slovenian Research Agency. Renewable bio-based composite gears – development and performance evaluation using enhanced experimental analyses and numerical simulations. Borut Černe. 1. 10. 2021 – 30. 9. 2023

AWARDS AND ACHIEVEMENTS

Assist. Prof. Damijan Zorko, PhD, received an award of the Faculty of Mechanical Engineering for high quality publications.

Assist. Prof. Damijan Zorko, PhD, Borut Černe, PhD, Zoran Bergant, PhD, were the recipients of 2021 Innovation Fund at the University for Ljubljana with the project “Development of lightweight and advanced components of powertrains”.



Laboratory for Material Handling and Machine Structures LASOK

RESEARCH AREAS

Load-bearing structures • Welded structures • Pressure vessels and pipelines • Lifting and transport devices • Development • Optimisation • Evaluation

DEPARTMENT HEAD Assoc. Prof. Boris Jerman, PhD

DEPARTMENT MEMBERS Assist. Jurij Hladnik, PhD, MSc Franc Resman, Assist. Luka Bizjak, Silva Brenčič

ORIGINAL SCIENTIFIC ARTICLE

JERMAN, Boris, EKREN, Banu Y., KÜÇÜKYAŞAR, Melis, LERHER, Tone. Simulation-based performance analysis for a novel AVS/RS technology with movable lifts. Applied sciences, ISSN 2076-3417, Mar. 2021, vol. 11, iss. 5, str. 1-14.

PROJECTS

Slovenian Research Agency. Warehousing 4.0 – Integration model of robotics and warehouse order-picking systems. Boris Jerman. 1.9.2020 - 31.8.2023

10 MECHANICS IN ENGINEERING

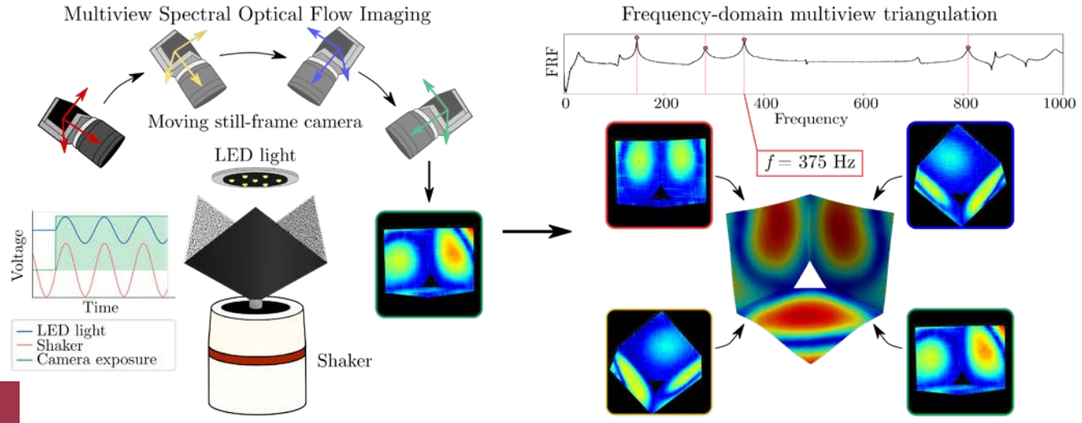
The Mechanics in engineering programme group consists of four laboratories: The Laboratory for Dynamics of Machines and Structures (LADISK), the Laboratory for Numerical Modelling and Simulation (LNMS), the Laboratory for Non-Linear Mechanics (LANEM) and the Laboratory for aeronautics (AEROL).

LADISK: Within the context of flexible multibody system dynamics, the research is focused on advanced methods of valid nonlinear dynamics modelling of rigid-flexible multibody systems with unilateral contacts or large displacements/deformations. In the field of structural dynamics, the group is focused on management of vibration fatigue and product noise. Here, the main emphasis is on research into valid models. Research activities are also geared toward smart structures with sensing function and the development of advanced optical methods for identifying dynamic parameters of structures.

LNMS: Long-term research activities are related to the constitutive modelling of the metallic materials response and the development of numerical methods in this field, whereby the numerical aspect of an effective integration of developed algorithms into the FEM programs is crucial. The more complex constitutive models also require the development of algorithms for inverse identification of model parameters.

LANEM: The theory of elasticity and thermoelasticity, geometric and material nonlinearities, stability, fluid mechanics, inelastic deformation, materials with shape memory, characterization of mechanical properties of materials, biomechanics.

AEROL: Development of unmanned aerial vehicles and systems, research into the possibility of controlling unmanned aerial vehicles using cameras and ground landmarks in areas without the GPS signal, aircraft calculation, calculation and measurement of resistance, lift and torque of aerodynamic bodies, measurement of aerodynamic properties and airflow around bodies in the wind tunnel, construction and testing components related to firearms, modelling and mold making for the manufacture of composite parts of unmanned aerial vehicles.



Laboratory for Dynamics of Machines and Structures LADISK

RESEARCH AREAS

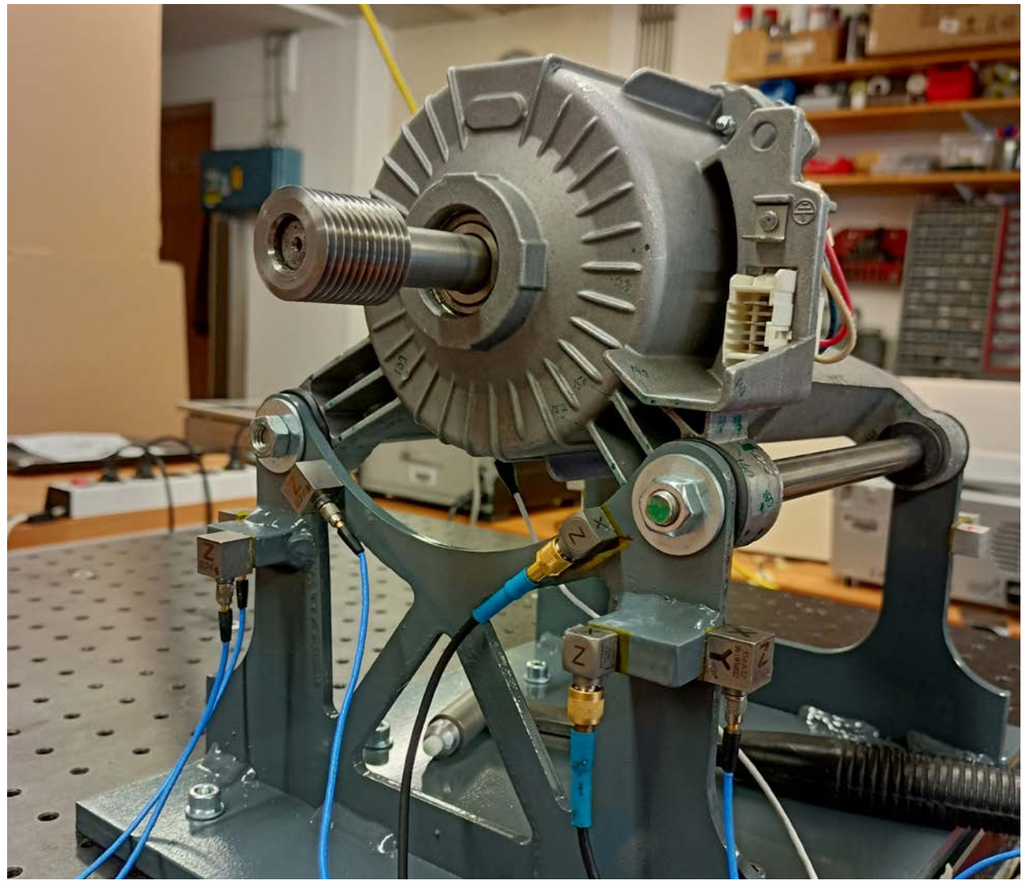
Mechanics • Dynamics • Dynamics of machines and structures • Structural dynamics • Vibration fatigue • Mechanical vibrations • Nonlinear vibrations • Dynamics of rigid and flexible multibody systems • Structure-borne noise • Signal processing (CWT, HOS) • Rotor dynamics • Automatic fault detection in mechanical systems • Dynamics of moving continua • Digital image correlation methods

DEPARTMENT HEAD Prof. Miha Boltežar, PhD

DEPARTMENT MEMBERS Prof. Janko Slavič, PhD, Assoc. Prof. Gregor Čepon, PhD, Assist. Prof. Martin Česnik, PhD, Assist. Blaž Starc, PhD, Vitoslav Bratuš, PhD, Assist. Aleš Mihelič, PhD, Assist. Tibor Barši Palmić, Assist. Miha Kodrič, Assist. Miha Pogačar, Assist. Domen Gorjup, Assist. Klemen Zaletelj, Assist. Martin Furlan, PhD, Assist. Matic Arh, Luka Kenk, Assist. Domen Ocepek, Assist. Aleš Zorman, Assist. Tilen Košir, Gašper Krivic, Assist. Ivan Tomac, PhD, Assist. Tim Vrtač, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

KOŠIR, Tilen, SLAVIČ, Janko. Single-process fused filament fabrication 3D-printed high-sensitivity dynamic piezoelectric sensor. Additive manufacturing, ISSN 2214-8604, Nov. 2021, str. 1-9.



PALMIERI, Massimiliano, SLAVIČ, Janko, CIANETTI, Filippo. Single-process 3D-printed structures with vibration durability self-awareness. Additive manufacturing, ISSN 2214-8604, Nov. 2021, vol. 47, str. 1-8.

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BREGAR, Tomaž, EL MAHMOUDI, Ahmed, ČEPON, Gregor, RIXEN, Daniel J., BOLTEŽAR, Miha. Performance of the expanded virtual point transformation on a complex test structure. Experimental techniques, ISSN 0732-8818, Feb. 2021, vol. 45, iss. 1, str. 83-93.

ZORMAN, Aleš, SLAVIČ, Janko, BOLTEŽAR, Miha. Short-time fatigue-life estimation for non-stationary processes considering structural dynamics. International journal of fatigue, ISSN 0142-1123, Jun. 2021, vol. 147, str. 1-14.

POGAČAR, Miha, BREGAR, Tomaž, ČEPON, Gregor, BOLTEŽAR, Miha. Near-to-node modal identification using multiple related response models. Measurement : journal of the International Measurement Confederation, ISSN 0263-2241, Feb. 2021, vol. 171, str. 1-12.

BREGAR, Tomaž, ZALETELJ, Klemen, ČEPON, Gregor, SLAVIČ, Janko, BOLTEŽAR, Miha. Full-field FRF estimation from noisy high-speed-camera data using a dynamic substructuring approach. Mechanical systems and signal processing, ISSN 0888-3270, Mar. 2021, vol. 150, str. 1-12.

GORJUP, Domen, SLAVIČ, Janko, BABNIK, Aleš, BOLTEŽAR, Miha. Still-camera multiview spectral optical flow imaging for 3D operating-deflection-shape identification. Mechanical systems and signal processing, ISSN 0888-3270, May 2021, vol. 152, str. 1-14.

ARH, Matic, SLAVIČ, Janko, BOLTEŽAR, Miha. Design principles for a single-process 3d-printed accelerometer - theory and experiment. Mechanical systems and signal processing, ISSN 0888-3270, May 2021, vol. 152, str. 1-15.

KODRIČ, Miha, ČEPON, Gregor, BOLTEŽAR, Miha. Experimental framework for identifying inconsistent measurements in frequency-based substructuring. Mechanical systems and signal processing, ISSN 0888-3270, Jun. 2021, vol. 154, str. 1-19.

ZALETELJ, Klemen, AGREŽ, Vid, SLAVIČ, Janko, PETKOVŠEK, Rok, BOLTEŽAR, Miha. Laser-light speckle formation for deflection-shape identification using digital image correlation. Mechanical systems and signal processing, ISSN 0888-3270, Dec. 2021, vol. 161, str. 1-15.

PATENTS

KOREN, Uroš, ČEPON, Gregor, STARC, Blaž, MIHELIČ, Aleš, POGOREVC, Robi, BOLTEŽAR, Miha, KATANEC, Jože. Jermenica bobna pralnega stroja iz materiala iz umetne snovi : patent SI 25993 A, 2021-10-29. Ljubljana: Urad Republike Slovenije za intelektualno lastnino, 2021.

ČEPON, Gregor, KATANEC, Jože, ŠTIMULAK, Mitja, BOLTEŽAR, Miha, STARC, Blaž, BREGAR, Tomaž, MIHELIČ, Aleš. Postopek zaznavanja lastnih frekvenc pri pralnem stroju z bobnom : SI 25920 A, 2021-05-31. Ljubljana: Urad RS za intelektualno lastnino, 2021.

SCIENTIFIC MONOGRAPHY

SLAVIČ, Janko, MRŠNIK, Matjaž, ČESNIK, Martin, JAVH, Jaka, BOLTEŽAR, Miha. Vibration fatigue by spectral methods : from structural dynamics to fatigue damage - theory and experiments. Amsterdam; Oxford; Cambridge (MA): Elsevier, cop. 2021.

DOCTORAL DISSERTATIONS

BREGAR, Tomaž. Equivalent mixing of experimental models in dynamic substructuring: dissertation. Mentor prof. dr. Miha Boltežar.

ARH, Matic. The Characterisation of the Dynamic Piezoresistivity of Structures Manufactured by Fused Deposit Modelling: dissertation. Mentor prof. dr. Janko Slavič.

PROJECTS

Company Gorenje - Research development cooperation and lease of capacities for numerical analyses and performance of measurements and tests. Miha Boltežar. 27.6.2019-26.6.2021

ERDF (Smart Specialization) MOZTART - More efficient electric motors with the development of an EXPERT system and new technologies. Miha Boltežar. 1.10.2018 - 30.9.2021

Slovenian Research Agency. Hybrid Dynamic Substructuring in the Industry of Home Appliances. Miha Boltežar. 1.7.2019 – 30.6.2022

Slovenian Research Agency. High-speed-camera based high-spatial-density sensing of 3D vibrations with applications in digital-twins and remote sensing. Janko Slavič. 1.7.2019 – 30.6.2022

Slovenian Research Agency. Vision based reduced order modeling approach for operational parameter identification of nonlinear finite element models. Miha Boltežar. 1.1.2020 - 31.12.2023

Obzorje 2020. NOn-contact STRucturAl DAMage for fUture Safety and lightweight. Janko Slavič. 1. 10. 2021 – 30. 9. 2023

Slovenian Research Agency. Single-Process Fused Filament Fabrication 3D-Printed Piezoelectric Sensor. Janko Slavič. 1. 10. 2021 – 30. 9. 2024

Company Gorenje - Research development cooperation and lease of capacities for numerical analyses and performance of measurements and tests. Gregor Čepon. 27. 6. 2021 – 26. 6. 2023

AWARDS AND ACHIEVEMENTS

FME was successful in Horizon 2020 call: MSCA IF. Prof. Janko Slavič, PhD, is the project supervisor.

Assist. Matic Arh, PhD, Assist. Tilen Košir, Assist. Klemen Zaletelj, Assist. Miha Pogačar and Assist. Miha Kodrič received an award of the Faculty of Mechanical Engineering for high quality publications.

Prof. Janko Slavič, PhD, received special recognition from Slovenian Research Agency – Excellent in Science – for his contribution to article Virtanen, P., Gommers, R., Oliphant, T.E. et al. SciPy 1.0: fundamental algorithms for scientific computing in Python, published in prestigious journal Nature Methods.

Laboratory for Non-Linear Mechanics LANEM

RESEARCH AREAS

Nonlinear mechanics • Stability • Mechanics of materials • Materials with shape memory

DEPARTMENT HEAD Assist. Prof. Miha Brojan, PhD

DEPARTMENT MEMBERS Assist. Matjaž Čebron, PhD, Assist. Matej Bogataj, Assist. Jan Zavodnik, Jonas Trojer, Assist. Tomaž Brzin, Assist. Enej Istenič, Assist. Damjan Lolić, PhD, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

SARKAR, S., ČEBRON, Matjaž, BROJAN, Miha, KOŠMRLJ, Andrej. Elastic multipole method for describing deformation of infinite two-dimensional solids with circular inclusions. Physical review. E., ISSN 2470-0053, 2021, vol. 103, iss. 5, str. 1-25.

SARKAR, S., ČEBRON, Matjaž, BROJAN, Miha, KOŠMRLJ, Andrej. Method of image charges for describing deformation of bounded two-dimensional solids with circular inclusions. Physical review. E., ISSN 2470-0053, 2021, vol. 103, iss. 5, str. 1-34.

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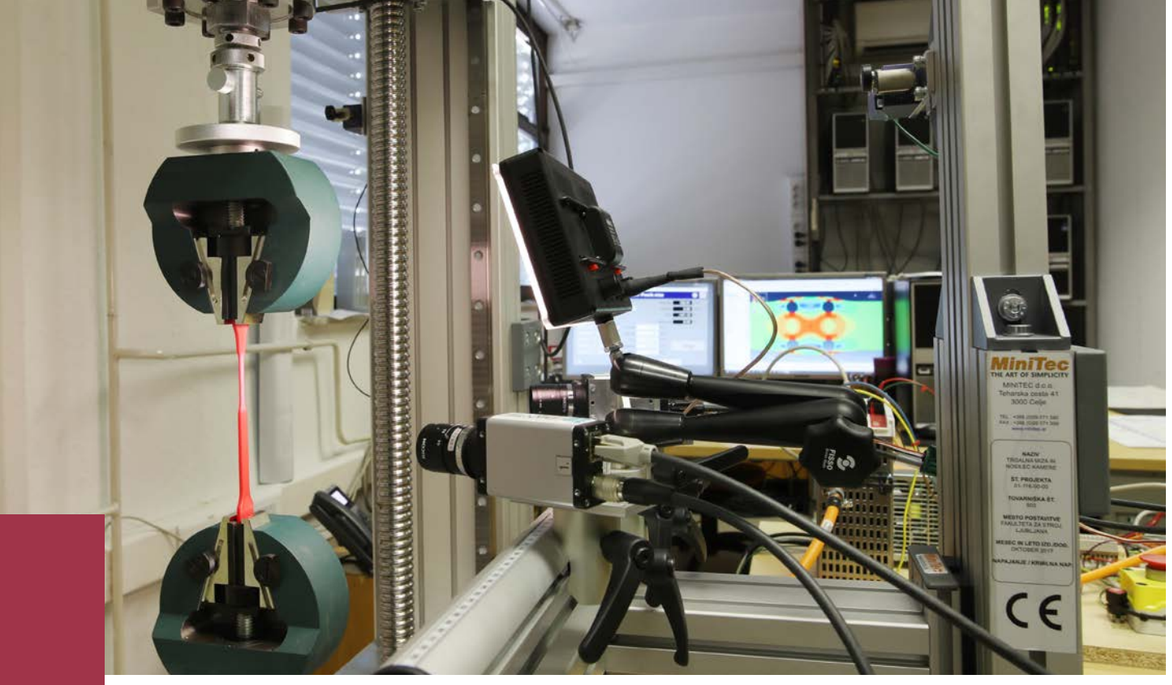
PROJECTS

Slovenian Research Agency. Crystallography of wrinkled elastic surfaces. Miha Brojan. 1.7.2018 – 30.6.2021

Slovenian Research Agency. Development of quasi-periodic deformation patterns in viscoelastic structures. Miha Brojan. 1.9.2020 - 31.8.2023



Laboratory for Numerical Modelling and Simulation LNMS

RESEARCH AREAS

Mechanics • Numerical methods • Computer simulations of technological processes • Modelling of thermomechanical processes • Optimisation of products and processes • Nuclear engineering • Constitutive modelling • Electromagnetism • Finite element method and boundary element method

DEPARTMENT HEAD Assist. Prof. Miroslav Halilovič, PhD

DEPARTMENT MEMBERS Assoc. Prof. Nikolaj Mole, PhD, Assist. Prof. Pino Koc, PhD, Assist. Kristjan Krebelj, PhD, Assist. Primož Rus, PhD, Assist. Prof. Bojan Starman, PhD, Assist. Janez Urevc, PhD, MSc Andrej Kotar, Assist. Štefan Obid, Assist. Tomaž Kastelic, Assist. Andraž Maček, PhD, Assist. Matija Nabergoj, Assist. Dejan Kovšca, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

UREVC, Janez, STARMAN, Bojan, MAČEK, Andraž, HALILOVIČ, Miroslav. A novel class of collocation methods based on the weighted integral form of ODEs. Computational & Applied Mathematics, ISSN 1807-0302, Jun. 2021, vol. 40, iss. 4, str. 1-28.

MAČEK, Andraž, UREVC, Janez, ŽAGAR, Tomaž, HALILOVIČ, Miroslav. Crimp joint with low sensitivity to process parameters: numerical and experimental study. International journal of material forming, ISSN 1960-6206, July 2021, vol. 14, str. 1233-1241.

UREVC, Janez, HALILOVIČ, Miroslav. Enhancing accuracy of Runge-Kutta-type collocation methods for solving ODEs. Mathematics, ISSN 2227-7390, Jan. 2021, vol. 9, iss. 2, f. 1-25.

STARMAN, Bojan, CAFUTA, Gašper, MOLE, Nikolaj. A method for simultaneous optimization of blank shape and forming tool geometry in sheet metal forming simulations. Metals, ISSN 2075-4701, Apr. 2021, vol. 11, iss. 4, str. 1-20.

KREBELJ, Kristjan, KREBELJ, Anton, HALILOVIČ, Miroslav, MOLE, Nikolaj. Modeling injection molding of high-density polyethylene with crystallization in open-source software. Polymers, ISSN 2073-4360, Jan. 2021, vol. 13, iss. 1, f. 1-15.

MAČEK, Andraž, UREVC, Janez, HALILOVIČ, Miroslav. Flat specimen shape recognition based on full-field optical measurements and registration using mapping error minimization method. Strojniški vestnik, ISSN 0039-2480, May 2021, vol. 67, no. 5, str. 203-213.

DOCTORAL DISSERTATION

MAČEK, Andraž. Inverse identification of constitutive model parameters based on inhomogeneous strain field: doctoral thesis. Mentor doc. dr. Miroslav Halilovič.

PROJECTS

EIT KIC RawMaterials - SPL-CYCLE - Closing the loop of the Spent Pot-line (SPL) in Al smelting process. Miroslav Halilovič 01.02.2018 – 31.03.2021

ERDF (Smart Specialization) MOZTART - More efficient electric motors with the development of an EXPERT system and new technologies. Nikolaj Mole. 1.10.2018 – 30.9.2021

Kovinoplastika LOŽ d.o.o. Računalniška simulacija izdelave enojnega pomivalnega korita z odcejalnikom dimenzij 790x500mm. Nikolaj Mole. 7. 5. 2018 – 16. 9. 2021

Slovenian Research Agency. Razvoj tehničnih smernic za štirislojne zasteklitve. Miroslav Halilovič. 1. 10. 2021 – 30. 9. 2024

Laboratory for aeronautics AEROL

RESEARCH AREAS

Construction mechanics • Special development know-how • Special constructions know-how

DEPARTMENT HEAD Prof. Franci Pušavec, PhD

DEPARTMENT MEMBERS Assist. Igor Petrović, PhD, Teja Pirnat

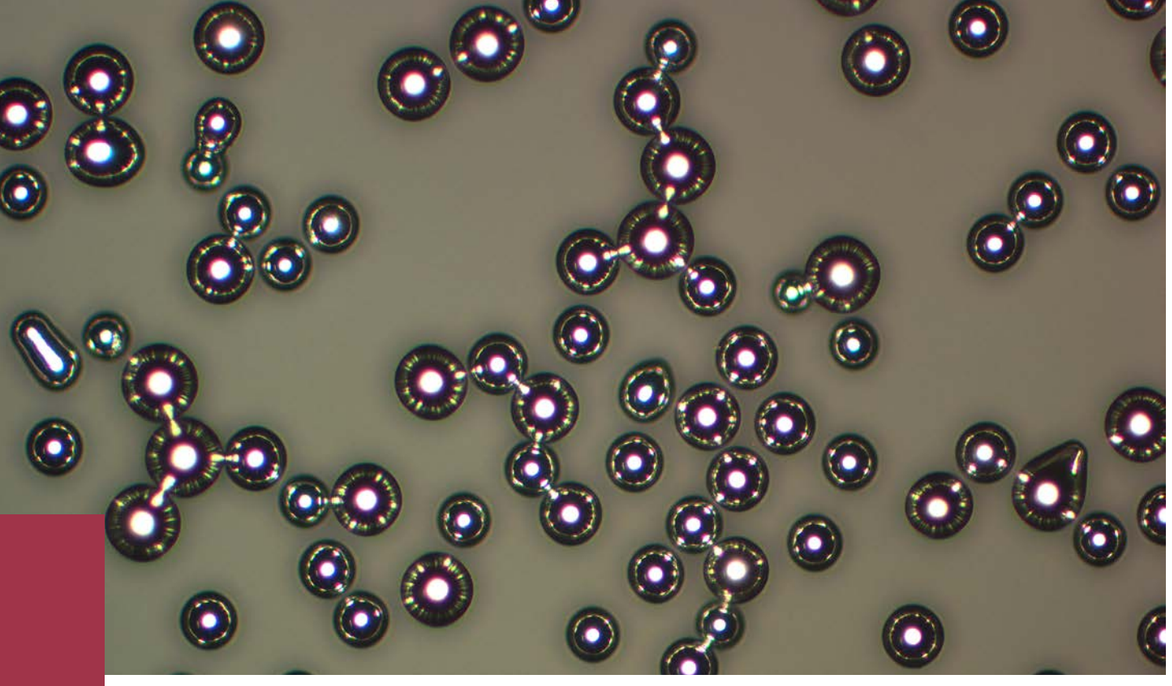
11 SUSTAINABLE POLYMER MATERIALS AND TECHNOLOGIES

The Sustainable polymer materials and technologies programme group covers basic research on non-linear time-dependent behaviour of polymers and their composites which are regarded as dissipative systems. The programme is divided into three complementary research spheres:

SPHERE 1: Study of the structure-property relationship in polymeric materials (without changing their chemical composition) and the means of controlling their inherent topological structure. This allows us to control their physical properties and, consequently, to fit properties of polymeric materials to a particular application.

SPHERE 2: Development of experimental methods for analyzing dissipative time-dependent behaviour of materials that will allow characterisation and prediction of the durability of products made of polymeric materials.

SPHERE 3: Development of theoretical models and numerical tools which, together with new experimental methods, can be used to predict the mechanical behaviour of polymers and their nano-, micro-, and macrocomposites over a longer period of time.



Laboratory for Experimental Mechanics LEM

RESEARCH AREAS

Polymers • Composites • Nanomaterials • Time-dependent behaviour of materials • Experimental mechanics • Modelling of mechanical properties of materials • Technology of polymer processing • Material structure formation

DEPARTMENT HEAD Assist. Prof. Lidija Slemenik Perše, PhD

DEPARTMENT MEMBERS Assist. Alexandra Aulova, PhD, Assist. Marko Bek, PhD, Assist. Mohor Mihelčič, PhD, Assist. Alen Oseli, PhD, Król Elżbieta, Assist. Urška Gradišar Centa, PhD, Assist. Andrii Vakulka, PhD, Jasna Gornik

ORIGINAL SCIENTIFIC ARTICLES

BEK, Marko, AULOVA, Alexandra, OSELI, Alen, EMRI, Igor. New generation impact and vibration insulation based on high pressure force-network technology = Nova generacija udarne in vibracijske izolacije na osnovi visokotlačne omrežne tehnologije. Anali PAZU, ISSN 2232-416X, 2021, letn. 11, št. 1/2, str. 38-51.

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SHANKAR VADIVEL, Hari, BEK, Marko, ŠEBENIK, Urška, SLEMENIK PERŠE, Lidija, KÁDÁR, Roland, EMAMI, Nazanin, KALIN, Mitjan. Do the particle size, molecular weight, and processing of UHMWPE affect its thermomechanical and tribological performance?. Journal of Materials Research and Technology, ISSN 2238-7854, May-Jun. 2021, vol. 12, str. 1728-1737.

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AULOVA, Alexandra, OSELI, Alen, BEK, Marko. Neural networks for predicting the temperature-dependent viscoelastic response of PEEK under constant stress rate loading. Polymer testing, ISSN 0142-9418. [Print ed.], Aug. 2021, vol. 100, str. 1-9.

PUŠNIK ČREŠNAR, Klementina, BEK, Marko, LUXBACHER, Thomas, BRUNČKO, Mihael, FRAS ZEMLJIČ, Lidija. Insight into the surface properties of wood fiber-polymer composites. Polymers, ISSN 2073-4360, May 2021, vol. 13, iss. 10, str. 1-24.

POGAČNIK KRAJNC, Anja, PIRKER, Luka, GRADIŠAR CENTA, Urška, GRADIŠEK, Anton, MEKJAVIĆ, Igor B., GODNIČ, Matej, ČEBAŠEK, Metod, BREGANT, Tina, REMŠKAR, Maja. Size- and time-dependent particle removal efficiency of face masks and improvised respiratory protection equipment used during the COVID-19 pandemic. Sensors, ISSN 1424-8220, 2021, no. 5, vol. 21, str. 1567-1-1567-16.

NIKLAUS, Lukas, SCHOTT, Marco, POSSET, Uwe, MIHELČIČ, Mohor, JERMAN, Ivan, GIFFIN, Guinevere A. Charge balancing and optical contrast optimization in Fe–MEPE/Ni1–xO electrochromic devices containing a Li reference electrode. Solar energy materials and solar cells, ISSN 0927-0248. 1. Aug. 2021, vol. 227, 111080, str. 1-8, ilustr.

GRADIŠAR CENTA, Urška, STERNIŠA, Meta, VIŠIĆ, Bojana, FEDERL, Žiga, SMOLE MOŽINA, Sonja, REMŠKAR, Maja. Novel nanostructured and antimicrobial PVDF-HFP/PVP/MoO[sub]3 composite. Surface innovations, ISSN 2050-6252, Oct. 2021, vol 9, iss. 5, str. 256-266.

DOCTORAL DISSERTATION

OSELI, Alen. Carbon nanotube network formation in polyethylene and its effect on physical properties of nanocomposites: doctoral thesis. Mentor doc. dr. Lidija Slemenik Perše.

PROJECTS

Slovenian Research Agency. Rheological behavior and mechanical properties for processing of highly filled powder – polymer systems. Lidija Slemenik Perše. 1.11.2018 – 31.10.2021

Slovenian Research Agency. Neural networks for determination of polymer creep response at different temperatures. Alexandra Aulova. 1.7.2019 – 30.6.2021

Slovenian Research Agency. Sustainable polymer materials and technologies. Lidija Slemenik Perše. 1. 1. 2020 - 31. 12. 2025

Slovenian Research Agency. Sustainable use of polymers in home appliances - Prediction of long-term viscoelastic behavior. Lidija Slemenik Perše. 1. 10. 2021 - 30. 9. 2024

SUSTAINABLE POLYMER MATERIALS AND TECHNOLOGIES

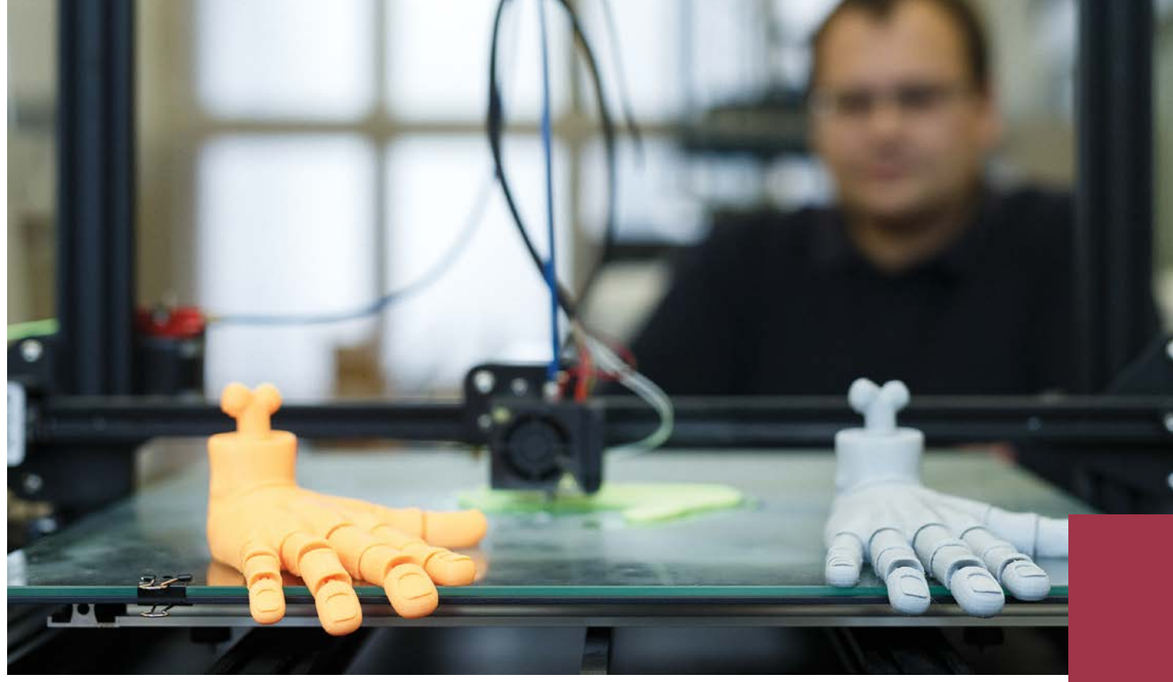
12 ADVANCED MANUFACTURING TECHNOLOGIES FOR HIGH QUALITY AND SUSTAINABLE PRODUCTION

Slovenian industry has a significant impact on the development of economy, employment, innovations and export. A large part of the economy depends on the competitiveness of the manufacturing industry. Thus, the concept of rapid production, innovative machining technologies, manufacturing technology management and the idea of sustainable development are becoming key research areas for increasing the competitiveness of the Slovenian processing industry.

Long-term research content focuses on the development, transfer and research support of high-performance machining technologies (cutting, 3D printing, etc.), including the implementation of sustainable development considerations in manufacturing technologies in response to environmental, social and economic challenges. The focus is not limited to innovations in technology, but also on providing integrated development solutions.

The research domains of the programme group are complementary, and to a certain extent interdisciplinary, comprised of:

- advanced machining processes;
- technology and resource efficiency;
- quality engineering for manufacturing;
- human-centered manufacturing.



Laboratory for Cutting LABOD

RESEARCH AREAS

Technology and product planning • Sustainable development of machining processes • Research of machining processes • Development of new machining processes (cryogenic machining, the novel dry machining) • Characterisation of material machinability • High-speed hard milling for the tool industry • Machine tools • Machining process sensors • Reverse engineering • 3D prototype printing • Characterisation of machining surface quality • Product precision and accuracy

DEPARTMENT HEAD Prof. Franci Pušavec, PhD

DEPARTMENT MEMBERS Assoc. Prof. Peter Krajnik, PhD, Res. Assoc. Radovan Dražumerič, PhD, Assist. Awais Ikram, PhD, Assist. Jani Kenda, PhD, Assist. Jaka Dugar, Assist. Matjaž Kern, Vinko Rotar, Assist. Luka Sterle, Assist. Deepa Kareepadath Santhos, Marija Jeretina

ORIGINAL SCIENTIFIC ARTICLES

DUGAR, Jaka, IKRAM, Awais, PUŠAVEC, Franci. Comparative characterization of different cutting strategies for the sintered ZnO electroceramics. Applied sciences, ISSN 2076-3417, Oct. 2021, vol. 11, iss. 20, str. 1-15.

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KADIVAR, Mohammadali, AZARHOUSHANG, Bahman, KLEMENT, Uta, KRAJNIK, Peter. The role of specific energy in micro-grinding of titanium alloy. Precision engineering : journal of the International Societies for Precision Engineering and Nanotechnology, ISSN 0141-6359. [Print ed.], Nov. 2021, vol. 72, str. 172-183.

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PATENTS

KENDA, Jani, PUŠAVEC, Franci, KOPAČ, Janez. Arrangements and methods for abrasive flow machining = Anordnungen und Verfahren zur Schleifmittelstormesbearbeitung = Agencements et procédés d'usinage par écoulement abrasif : European patent specification EP 2996840 B1, 2021-10-06. Munich: European Patent Office, 2021.

PROJECTS

ERASMUS + REACH - Reinforcing Access to Cross Border Employment at Palestinian Higher Education Institutions –PHEIs. Franci Pušavec. 15.11.2019 - 14.11.2022

Slovenian Research Agency. Development and implementation of innovative machining technology for machining ZnO based ceramics with defined cutting geometry, in serial production, to increase the quality of varistors as final products. Franci Pušavec. 1.7.2019 – 30.6.2022

EIT Manufacturing. Transitioning to a waste-free production – international cryogenic+MQL machining activity. Franci Pušavec. 1. 3. 2021 – 31. 12. 2022

AWARDS AND ACHIEVEMENTS

Assist. Dr. Damir Grguraš and Luka Sterle have won the first place in the BoostUP!

competition with the innovation "ArcLub One"! in the category “CREATE”.

ADVANCED MANUFACTURING TECHNOLOGIES FOR
HIGH QUALITY AND SUSTAINABLE PRODUCTION

Laboratory for Quality Assurance LAZAK

RESEARCH AREAS

Quality planning and control • Quality assurance of processes, products and services • Technology and innovation management • 3D digitisation and reverse engineering • Machine tools precision and accuracy measurement

DEPARTMENT HEAD Assoc. Prof. Davorin Kramar, PhD

DEPARTMENT MEMBERS Assist. Damir Grguraš, PhD, Assist. Luka Kastelic, Marija Jeretina

ORIGINAL SCIENTIFIC ARTICLES

RODIĆ, Dragan, SEKULIĆ, Milenko, GOSTIMIROVIĆ, Marin, PUCOVSKY, Vladimir, KRAMAR, Davorin. Fuzzy logic and sub-clustering approaches to predict main cutting force in high-pressure jet assisted turning. Journal of intelligent manufacturing, ISSN 0956-5515, Jan. 2021, vol. 32, iss. 1, str. 21-36.

GRGURAŠ, Damir, STERLE, Luka, MALNERŠIČ, Aleš, KASTELIC, Luka, COURBON, Cedric, PUŠAVEC, Franci. Media flow analysis of single-channel pre-mixed liquid CO2 and MQL in sustainable machining. Strojniški vestnik, ISSN 0039-2480, Jan.-Feb. 2021, vol. 67, no. 1/2, str. 3-10, ilustr.

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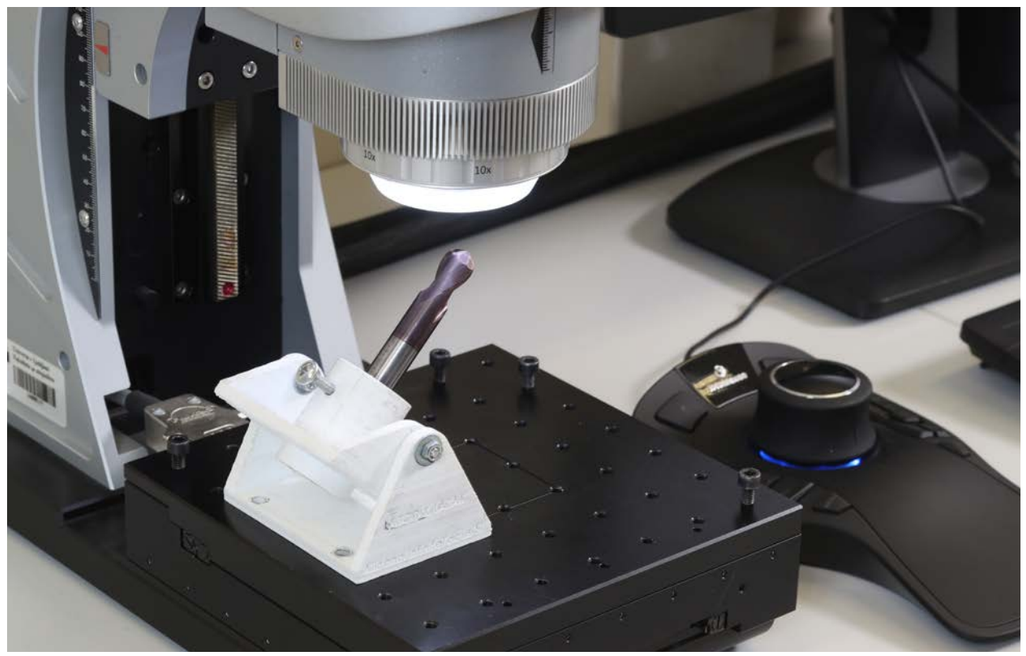

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KRAMAR, Davorin, CICA, Djordje. Modeling and optimization of finish diamond turning of spherical surfaces based on response surface methodology and cuckoo search algorithm. Advances in production engineering & management, ISSN 1854-6250, Sep. 2021, vol. 16, no. 3, str. 326-334.

AWARDS AND ACHIEVEMENTS

Assist. Dr. Damir Grguraš and Luka Sterle have won the first place in the BoostUP! competition with the innovation "ArcLub One"! in the category “CREATE”.

ADVANCED MANUFACTURING TECHNOLOGIES FOR
HIGH QUALITY AND SUSTAINABLE PRODUCTION

13 PRODUCTION SYSTEMS, LASER TECHNOLOGIES AND MATERIALS WELDING - PLAS

The research programme Production systems, laser technologies and materials welding integrates four research fields which are of key importance for the development of modern manufacturing.

The Production systems field focuses on:

- concepts of distributed manufacturing systems, including their structuring and control;
- concurrent product development concepts;
- principles of product-service systems, on-line monitoring and remote control;
- development of mechatronics and cyber-physical systems applications.

The research in the Laser systems field is aimed at:

- Fiber and hybrid laser sources, and pulsed laser sources;
- laser measuring systems for simultaneous 3D shape and color measurement of bodies in real time;
- adaptive control of laser systems based on identification, monitoring and adaptive process control;
- opto-mechatronic systems based on optical elements with free surfaces, electrically focus-tunable lenses and microlens arrays.

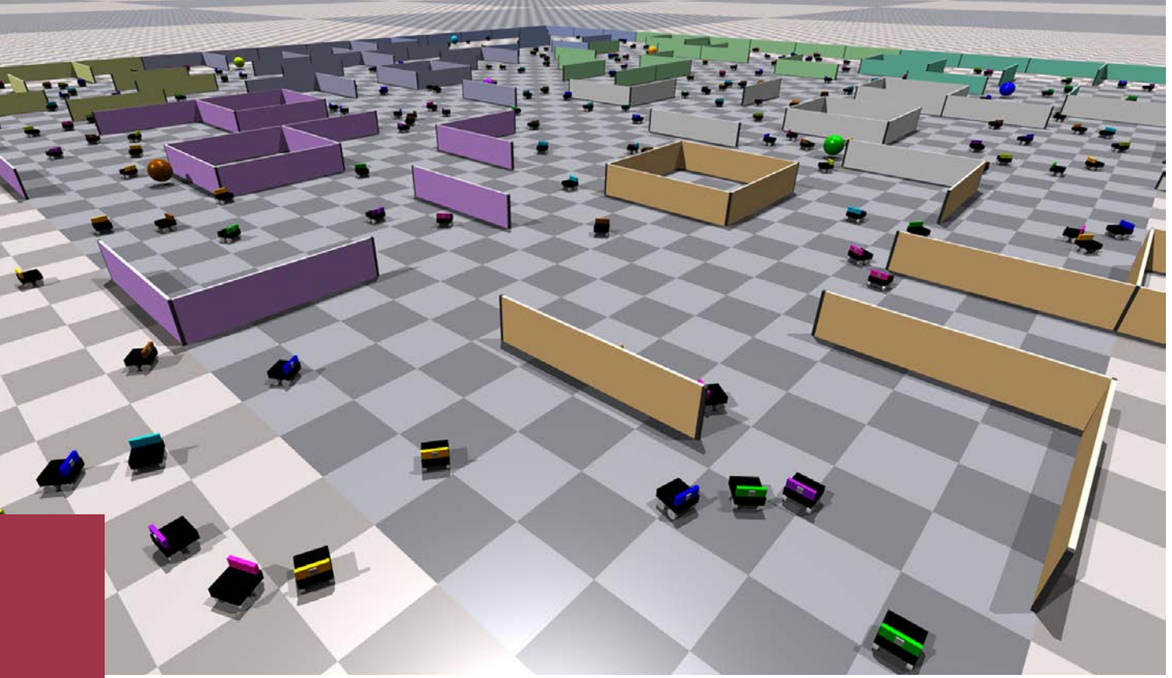
Research in the field of Laser machining processes, surface modification and non-destructive testing is geared towards:

- development of new laser machining processes for surface finishing and improvement of mechanical properties;
- optimisation of various laser processes in terms of surface integrity;
- development of a method for non-destructive testing based on monitoring of die-casting process of reinforced polymeric materials using acoustic emission signals;
- testing of glued joints by means of ultrasound.

The Joining of materials section performs the following research:

- analysis of the chemical composition of joining accelerators;
- optimisation of welding parameters and mutual weldability of dissimilar materials;
- repair-welding of tools for extending the in-service tool life, filler materials;
- development of design welding, friction stir welding and other joining technologies;
- applying different materials with high-energy arc procedures.

These topics are highly relevant for advances of manufacturing science as well as for the economic and social development of Slovenia. The research is conducted in a close cooperation with the industry.



Laboratory for Mechatronics, Production (LAMPA) systems and Automation LAMPA

RESEARCH AREAS

Mechatronics • Robotics • Machine Vision • Automation • Control Systems • Artificial Intelligence • Blockchain • Production Systems • Material Flow • Project Management

DEPARTMENT HEAD Prof. Podržaj Primož, PhD

DEPARTMENT MEMBERS Assist. Prof. Berlec Tomaž, PhD, Assist. Prof. Bračun Drago, PhD, Assist. Corn Marko, PhD, Prof. Diaci Janez, PhD, Assist. Prof. Jenko Marjan, PhD, Juriševič Anja, Kavčič Tadeja, Kelvišar Matic, Assist. Kozamernik Nejc, Assoc. Prof. Kušar Janez, PhD, Assist. Malus Andreja, Pleterski Jan, Assist. Požrl Tomaž, PhD, Puc Jernej, Assist. Prof. Rihar Lidija, PhD, Assist. Rožman Nejc, Rupert Dominik, Assist. Selak Luka, PhD, Assist. Škulj Gašper, PhD, Assist. Prof. Vrabič Rok, PhD, Assist. Žužek Tena, Jasna Gornik

ORIGINAL SCIENTIFIC ARTICLES

PIRNAR, Žan, FINŽGAR, Miha, PODRŽAJ, Primož. Performance evaluation of rPPG approaches with and without the region-of-interest localization step. Applied sciences, ISSN 2076-3417, Apr. 2021, vol. 11, iss. 8, str. 1-17.

CIMERMANČIČ, Davorin, KUŠAR, Janez, BERLEC, Tomaž. A procedure for the introduction of leanness into a company. Central European Journal of Operations Research, ISSN 1435-246X, 2021, str. 1-31.

VRABIČ, Rok, ERKOYUNCU, John, FARSI, Maryam, ARIANSYAH, Dedy. An intelligent agent-based architecture for resilient digital twins in manufacturing. CIRP annals, ISSN 0007-8506, 2021, vol. 70, iss. 1, str. 349-352.

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KOZJEK, Dominik, MALUS, Andreja, VRABIČ, Rok. Reinforcement-learning-based route generation for heavy-traffic autonomous mobile robot systems. Sensors, ISSN 1424-8220, Jul. 2021, vol. 21, iss. 14, str. 1-19.

ŠKULJ, Gašper, VRABIČ, Rok, PODRŽAJ, Primož. A wearable IMU system for flexible teleoperation of a collaborative industrial robot. Sensors, ISSN 1424-8220, Sep. 2021, vol. 21, iss. 17, str. 1-19.

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MABKHOT, Mohammed M., FERREIRA, Pedro, MAFFEI, Antonio, PODRŽAJ, Primož, MĄDZIEL, Maksymilian, ANTONELLI, Dario, LANZETTA, Michele, BARATA, Jose, BOFFA, Eleonora, FINŽGAR, Miha, PAŚKO, Łukasz, MINETOLA, Paolo, CHELLI, Riccardo, NIKGHADAM-HOJJATI, Sanaz, WANG, Xi Vincent, PRIARONE, Paolo C., LITWIN, Paweł, STADNICKA, Dorota, LOHSE, Niels. Mapping industry 4.0 enabling technologies into united nations sustainability development goals. Sustainability, ISSN 2071-1050, Mar. 2021, vol. 13, iss. 5, f. 1-35.

ŽUŽEK, Tena, GOSAR, Žiga, KUŠAR, Janez, BERLEC, Tomaž. A new product development model for SMEs : introducing agility to the plan-driven concurrent product development approach. Sustainability, ISSN 2071-1050, 2021, vol. 13, iss. 21, str. 1-22.

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PODRŽAJ, Primož. Linearna teorija krmiljenja sistemov. 1. izd. Ljubljana: Fakulteta za strojništvo, 2021.

DOCTORAL DISSERTATION

JORDAN, Eva. Transition from individual to lean and agile mass production. Mentor izr. prof. dr. Janez Kušar.

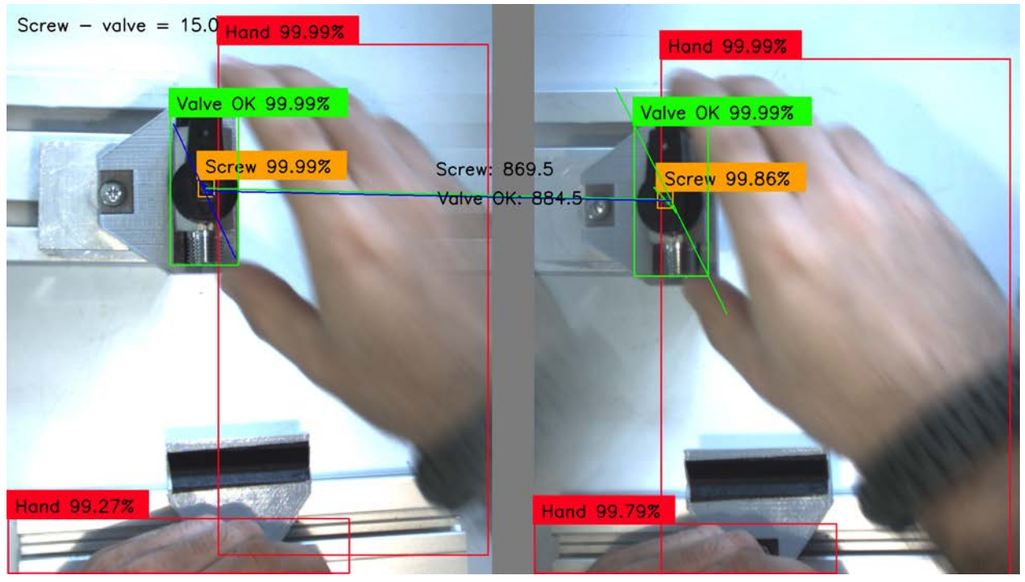
PROJECTS

Erasmus + MAESTRO – Manufacturing Education for Sustainable fourth Industrial Revolution. Primož Podržaj. 1. 9. 2018 – 31. 8. 2021

Erasmus + ICCT – Interactive course for Control Theory. Primož Podržaj. 1. 9. 2018 – 31. 8. 2021

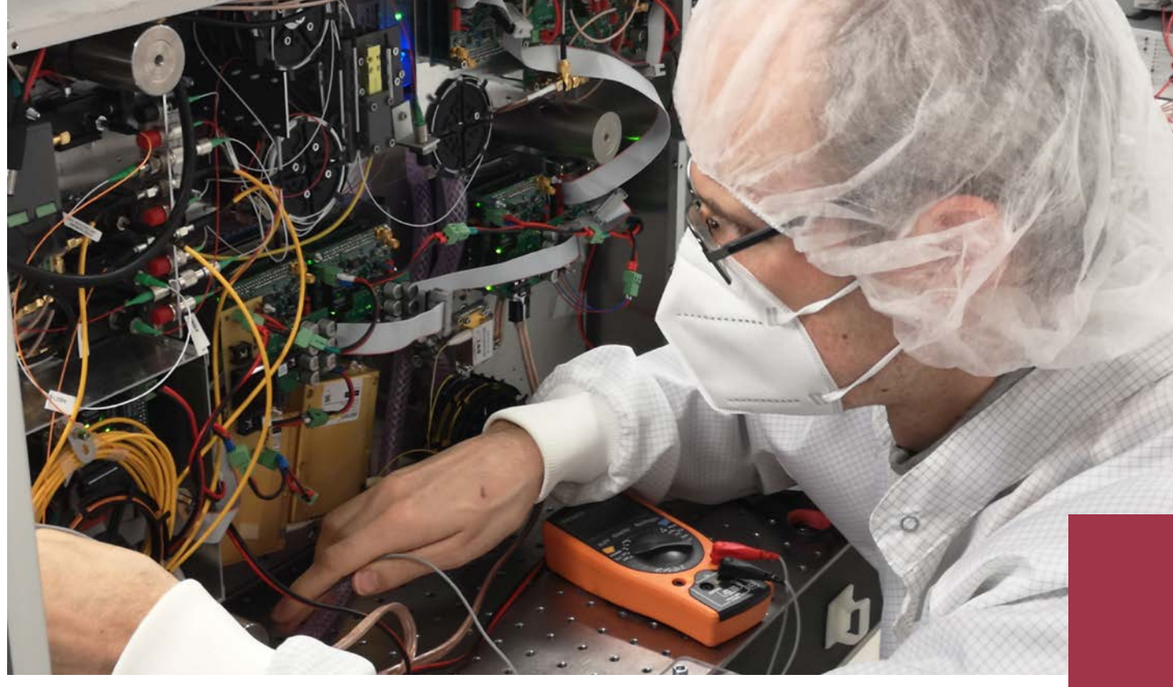
Erasmus+ REACH – Reinforcing access to cross border employment at Palestinian higher education institutions-PHEIs. Rok Vrabič. 15. 11. 2019 – 14. 11. 2022

PRODUCTION SYSTEMS, LASER TECHNOLOGIES AND MATERIALS WELDING - PLAS



Renesas Electronics Europe. Development, documentation and execution of Virtual Renesas MCU Rally. Rok Vrabič. 1. 11. 2020 – 31. 1. 2021

Slovenian Research Agency. Development of a self-learning system for optimizing the driving rules of autonomous transport vehicles and their temporally and spatially coordinated activities. Rok Vrabič. 1. 10. 2021 – 30. 9. 2024



Laboratory for photonics and laser systems
FOLAS

RESEARCH AREAS

Laser sources • Fiber and hybrid lasers • Photonics • Optical fiber processing • Laser transfer printing • Laser micro- and nano-processing • Laser treatment and diagnostic in medicine • High speed photography • Laser interferometric methods • Optodynamics

DEPARTMENT HEAD Prof. Rok Petkovšek, PhD

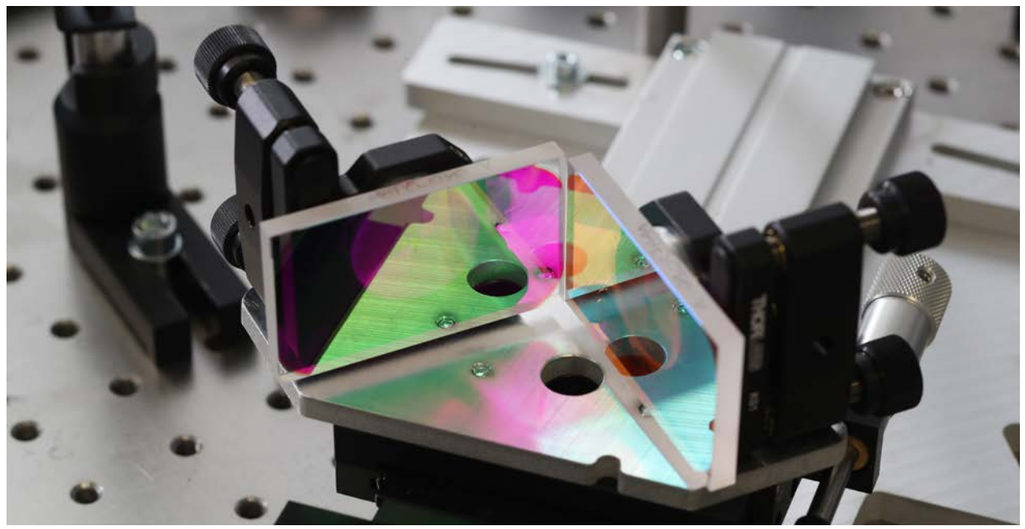
DEPARTMENT MEMBERS Assist. Prof. Vid Agrež, PhD, Assist. Darja Horvat, PhD, Assist. Žiga Lokar, PhD, Res. Assoc. Jaka Mur, PhD, Assist. Jaka Petelin, PhD, Assist. Uroš Orthaber, PhD, Assist. Luka Černe, PhD, Assist. Jernej Jan Kočica, Assist. Matevž Marš, Jasna Gornik

ORIGINAL SCIENTIFIC ARTICLES

PETELIN, Jaka, ČERNE, Luka, MUR, Jaka, AGREŽ, Vid, KOČICA, Jernej Jan, SCHILLE, Jörg, LOESCHNER, Udo, PETKOVŠEK, Rok. Pulse-on-demand laser operation from nanosecond to femtosecond pulses and its application for high-speed processing. Advanced optical technologies, ISSN 2192-8576, 2021, vol. 10, iss. 4/5, str. 305-314.

PODLIPEC, Rok, MUR, Jaka, PETELIN, Jaka, ŠTRANCAR, Janez, PETKOVŠEK, Rok. Method for controlled tissue theranostics using a single tunable laser source. Biomedical optics express, ISSN 2156-7085, 2021, vol. 12, no. 9, str. 5881-5893.

PODBEVŠEK, Darjan, LOKAR, Žiga, PODOBNIKAR, Jure, PETKOVŠEK, Rok, DULAR, Matevž. Experimental evaluation of methodologies for single transient cavitation bubble generation in liquids. Experiments in fluids, ISSN 0723-4864, Aug. 2021, vol. 62, iss. 8, str. 1-28.



PETELIN, Jaka, LOKAR, Žiga, HORVAT, Darja, PETKOVŠEK, Rok. Localized measurement of a sub-nanosecond shockwave pressure rise time. IEEE transactions on ultrasonics, ferroelectrics, and frequency control, ISSN 0885-3010, Sep. 2021, str. 1-9.

ČERNE, Luka, ŠUŠNJAR, Peter, PETKOVŠEK, Rok. Compensation of optical nonlinearities in a femtosecond laser system in a broad operation regime. Optics and laser technology, ISSN 0030-3992, Mar. 2021, vol. 135, str. 1-9.

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ČERNE, Luka, PETELIN, Jaka, PETKOVŠEK, Rok. Adaptive nonlinear phase compensation in a femtosecond hybrid laser with varying pulse repetition rate. Photonics, ISSN 2304-6732, Sep. 2021, vol. 8, iss. 9, f. 1-10.

LOKAR, Žiga, PETKOVŠEK, Rok, DULAR, Matevž. Cavitation bubble dynamics in a vicinity of a thin membrane wetted by different fluids. Scientific reports, ISSN 2045-2322, 2021, vol. 11, f. [1-7].

PATENTS

ORTHABER, Uroš, VEDLIN, Boris, VREČKO, Andrej. Laser therapeutic device for ophthalmology : United States patent US 10,888,461 B2, 2021-01-12. Alexandria: United States Patent and Trademark Office, 2021.

PROJECTS

Slovenian Research Agency. Ultrashort pulses on demand. Rok Petkovšek. 1.7.2018 – 30.6.2021

Slovenian Research Agency – Spatial and temporal shaping of laser light for minimally invasive ophthalmic procedures. Tomaž Požar. 1.7.2018 – 30.6.2021

Slovenian Research Agency. Generation of ultra-short laser pulses for very high speed and highly adaptable parallel microprocessing. Rok Petkovšek. 1. 10. 2021 – 30. 9. 2024

Laboratory for Heat Treatment and Materials Testing LATOP

RESEARCH AREAS

Heat treatment • Laser surface hardening • Shot peening of surfaces • Surface integrity • Measurement of residual stresses • Determination of microstructures • Modelling of casting processes • Determination of tool life

DEPARTMENT HEAD Prof. Roman Šturm, PhD

DEPARTMENT MEMBERS Assist. Prof. Zoran Bergant, PhD, Assist. Prof. Tomaž Kek, PhD, Assist. Prof. Uroš Trdan, PhD, Assist. Janez Sušnik, PhD, Assist. Sebastjan Žagar, PhD, Assist. Bor Mojškerc, PhD, Assist. Dunja Ravnikar, PhD, Vane Kralj, Anja Vrhovec, Assist. Jan Šmalc, Dušanka Grubor Železnik

ORIGINAL SCIENTIFIC ARTICLES

MOJŠKERC, Bor, RAVNIKAR, Dunja, ŠTURM, Roman. Experimental characterisation of laser surface remelting via acoustic emission wavelet decomposition. Journal of Materials Research and Technology, ISSN 2238-7854, Nov./Dec. 2021, vol. 15, str. 3365-3374.

ŽAGAR, Sebastjan, MARKOLI, Boštjan, NAGLIČ, Iztok, ŠTURM, Roman. The influence of age hardening and shot peening on the surface properties of 7075 aluminium alloy. Materials, ISSN 1996-1944, May 2021, vol. 14, iss. 9, str. 1-11.

Laboratory for Welding LAVAR

RESEARCH AREAS

Technologies of material joining and assembly (arc welding, laser welding, friction stir welding, resistance welding, ultrasonic welding) • Technologies of thermal cutting • Wire arc additive manufacturing • Materials science • Production technologies • Weldability of metallic materials and polymers • Welding machines and devices • Additive and auxiliary welding materials • Chemical and metallurgical processes in welding

DEPARTMENT HEAD Assoc. Prof. Damjan Klobčar, PhD

DEPARTMENT MEMBERS Prof. Borut Kosec, PhD, Assist. Matej Pleterski, PhD, Assist. Maja Lindič, Assist. Aljaž Ščetinec, Ana Lazar, Uroš Klopčič, Jaka Lavrih, Dušanka Grubor Železnik

ORIGINAL SCIENTIFIC ARTICLES

LEŠNJAK, Matic, KOSEC, Borut, KARPE, Blaž, JANJIĆ, Goran, GOJIĆ, Mirko, BERNETIČ, Jure, KOSEC, Gorazd. Thermal properties of armour steel protac 600. Advanced technologies and materials, ISSN 2620-0325, 2021, vol. 46, no. 2, str. 33-36.

KENDA, Miha, KLOBČAR, Damjan, NAGODE, Aleš, BRAČUN, Drago. Analysis and prevention of weld crater cracking in circumferential laser microwelding of automotive pressure sensors. Engineering failure analysis, ISSN 1350-6307, Oct. 2021, vol. 128, str. 1-14.

ŠČETINEC, Aljaž, KLOBČAR, Damjan, BRAČUN, Drago. In-process path replanning and online layer height control through deposition arc current for gas metal arc based additive manufacturing. Journal of manufacturing processes, ISSN 1526-6125, Apr. 2021, vol. 64, str. 1169-1179.

KENDA, Miha, KLOBČAR, Damjan, BRAČUN, Drago. Condition based maintenance of the two-beam laser welding in high volume manufacturing of piezoelectric pressure sensor. Journal of manufacturing systems, ISSN 0278-6125, Apr. 2021, vol. 59, str. 117-126.

DJURIC, Aleksija, MILČIĆ, Dragan, KLOBČAR, Damjan, MARKOVIĆ, Biljana. Multi-objective optimization of the resistance spot-welding process parameters for the welding of dual-phase steel DP500 = Večobjektna optimizacija procesnih parametrov za uporovno točkovno varjanje dvofaznega jekla vrste DP500. Materiali in tehnologije, ISSN 1580-2949, mar.-apr. 2021, letn. 55, št. 2, str. 201-206.

ČEVNIK, Gabrijela, MEDVED, Jože, NAGODE, Aleš, GOJIĆ, Mirko, KOSEC, Borut, BIZJAK, Milan. Catastrophic oxidation of AISI M4 alloy = katastrofalna oksidacija zlitine AISI M4. Materiali in tehnologije, ISSN 1580-2949, 2021, let. 55, št. 4, str. 585-590.

ČEVNIK, Gabrijela, MEDVED, Jože, NAGODE, Aleš, GOJIĆ, Mirko, KOSEC, Borut, BIZJAK, Milan. Catastrophic oxidation of AlSi M4 alloy = Katastrofalna oksidacija zlitine AlSi M4. Materiali in tehnologije, ISSN 1580-2949, jul-avg. 2021, letn. 55, št. 4, str. 585-590.

GODEC, Matjaž, MALEJ, Simon, FEIZPOUR, Darja, DONIK, Črtomir, BALAŽIC, Matej, KLOBČAR, Damjan, PAMBAGUIAN, L., CONRADI, Marjetka, KOCIJAN, Aleksandra. Hybrid additive manufacturing of Inconel 718 for future space applications. Materials characterization, ISSN 1044-5803, 2021, vol. 172, str. 1-16.

VENCL, Aleksandar, KANDEVA, Mara, ZADOROZHNAYA, Elena, SVOBODA, Petr, MICHALEC, Michal, MILIVOJEVIĆ, Aleksandar, TRDAN, Uroš. Studies on structural, mechanical and erosive wear properties of ZA-27 alloy-based micro-nanocomposites. Proceedings of the Institution of Mechanical Engineers. Part L, Journal of materials - design and applications, ISSN 1464-4207, Jul. 2021, vol. 235, iss. 7, str. 1509-1518.

CONRADI, Marjetka, KOSEC, Tadeja, PODGORNIK, Bojan, KOCIJAN, Aleksandra, KOVAČ, Janez, KLOBČAR, Damjan. An effect of laser texturing pattern on the tribocorrosion properties of Ti6Al4V alloy in a simulated physiological solution. Surface innovations, ISSN 2050-6260, 1-11.

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PROJECTS

Erasmus + APTIME - Additive Process Technology Integration with Management and Entrepreneurship. Damjan Klobčar. 04.10.2019 – 03.10.2022

PRODUCTION SYSTEMS, LASER TECHNOLOGIES AND MATERIALS WELDING - PLAS

14 OPTODYNAMICS

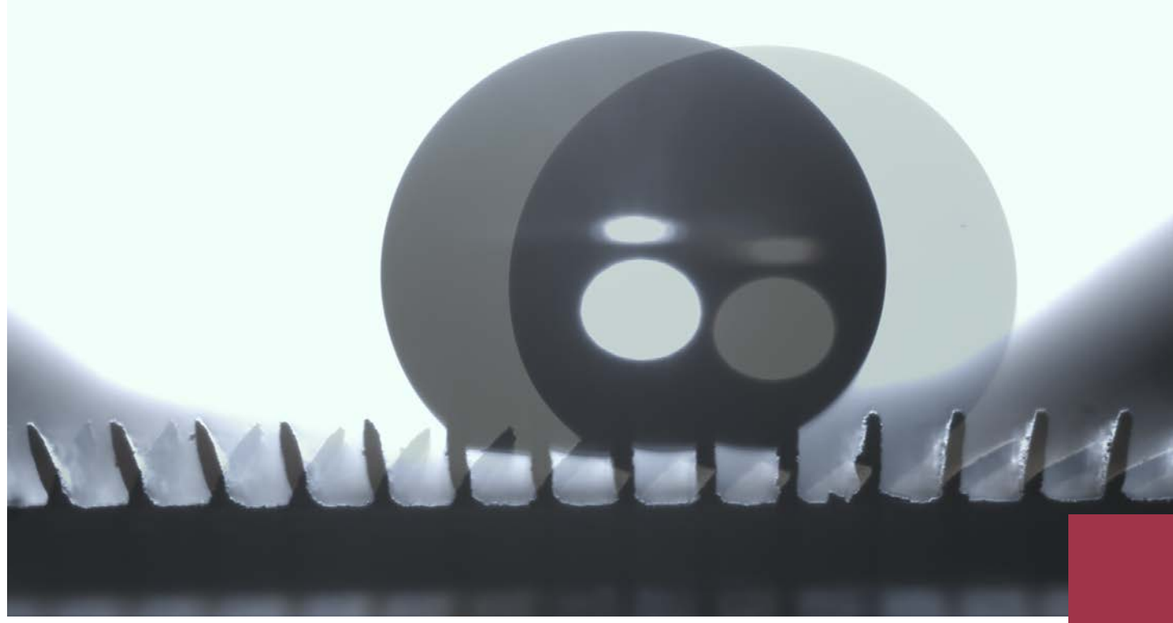
Optodynamics explores the dynamic aspects of light-to-substance interaction, which are the basis of most laser machining processes and laser-based medical interventions. Since optodynamic responses are an important source of information on the interaction between light and matter, their simultaneous detection and analysis can provide effective control over all laser processes.

The recent discovery of the programme group's researchers on characteristics of mechanical waves induced due to reflection of light is the basis for an important progress in resolving the dilemmas regarding the momentum of light in transparent media. Basic research into optodynamics leads to new applied research.

The programme also enables the development of new approaches in research on:

- laser-induced mass transfer;
- manipulation of nanoparticles;
- microfluidics;
- laser micro- and nanoprocessing;
- laser-based non-destructive testing and its transfer into practice.

The program is also oriented towards the further development and optimisation of new, more efficient and safer medical laser systems. The results of the programme are closely related to the Master's and Doctoral education programs at Faculty of Mechanical Engineering.



Laboratory for Laser Techniques LASTEH

RESEARCH AREAS

Laser measuring methods • Laser triangulation • Fiber-optic sensors • Fast photography • Interferometry • Laser machining processes • Laser micro and nano structuring • Adaptive control of laser processes • Medical laser procedures • Optodynamics

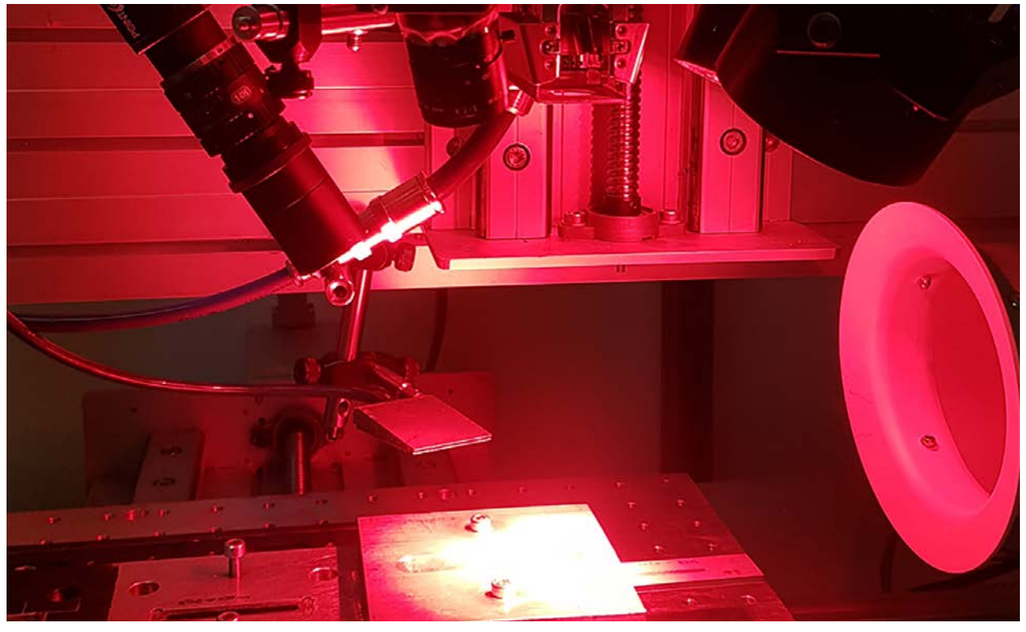
DEPARTMENT HEAD Assoc. Prof. Matija Jezeršek, PhD

DEPARTMENT MEMBERS Assoc. Prof. Peter Gregorčič, PhD, Assist. Aleš Babnik, PhD, Assist. Urban Pavlovčič, PhD, Assist. Ladislav Grad, PhD, Assist. Nejc Lukač, PhD, Assist. Luka Hribar, Assist. Daniele Vella, PhD, Assist. Jure Košir, Assist. Matjaž Kos, Assist. Matej Senegačnik, Assist. Gaia Kravanja, Assist. Tine Brežan, Jasna Gornik

ORIGINAL SCIENTIFIC ARTICLES

GREGORČIČ, Peter. Comment on "Bioinspired reversible switch between underwater superoleophobicity/superaerophobicity and oleophilicity/aerophilicity and improved antireflective property on the nanosecond laser-ablated superhydrophobic titanium surfaces". ACS applied materials & interfaces, ISSN 1944-8244, Jan. 2021, vol. 13, iss. 2, str. 2117-2127.

KRAVANJA, Gaia, BELYAEVA, Inna A., HRIBAR, Luka, DREVENŠEK OLENIK, Irena, JEZERŠEK, Matija, SHAMONIN, Mikhail. Tunable drop splashing on magnetoactive elastomers. Advanced materials interfaces, ISSN 2196-7350, June 2021, vol. 8, iss. 11, str. 1-7.



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VELLA, Daniele, BARBOSA, Marcelo B., TREVISANUTTO, Paolo E., VERZHBITSKIY, Ivan, ZHOU YONG, Justin, WATANABE, Kenji, TANIGUCHI, Takashi, KAJIKAWA, Kotaro, EDA, Goki. In-plane field-driven excitonic electro-optic modulation in monolayer semiconductor. Advanced optical materials, ISSN 2195-1071, Dec. 2021, str. 1-8.

KOŠIR, Jure, VELLA, Daniele, LUKAČ, Matjaž, JEZERŠEK, Matija. Towards personalized and versatile monitoring of temperature fields within heterogeneous tissues during laser therapies. Biomedical optics express, ISSN 2156-7085, 2021, vol. 12, iss. 7, str. 4530-4543.

ROGELJ, Luka, SIMONČIČ, Urban, TOMANIČ, Tadej, JEZERŠEK, Matija, PAVLOVČIČ, Urban, STERGAR, Jošt, MILANIČ, Matija. Effect of curvature correction on parameters extracted from hyperspectral images. Journal of biomedical optics, ISSN 1083-3668, 2021, vol. 26, iss. 9, str. 096003-1-096003-21.

LUKAČ, Matjaž, ZORMAN, Anže, LUKAČ, Nejc, PERHAVEC, Tadej, TAŠIČ MUC, Blaž. Characteristics of non-ablative resurfacing of soft tissues by repetitive Er:YAG laser pulse irradiation. Lasers in surgery and medicine, ISSN 0196-8092, [in press] 2021, 13 str.

JEZERŠEK, Matija, LUKAČ, Nejc, LUKAČ, Matjaž. Measurement of simulated debris removal rates in an artificial root canal to optimize laser-activated irrigation parameters. Lasers in surgery and medicine, ISSN 0196-8092, Mar. 2021, vol. 53, iss. 3, str. 411-417.

LUKAČ, Matjaž, OLIVI, Giovanni, CONSTANTIN, Mihnea, LUKAČ, Nejc, JEZERŠEK, Matija. Determination of optimal separation times for dual-pulse SWEEPS laser-assisted irrigation in different endodontic access cavities. Lasers in surgery and medicine, ISSN 0196-8092, Sept. 2021, vol. 53, iss. 7, str. 998-1004.

KOS, Matjaž, ARKO, Erih, KOSLER, Hubert, JEZERŠEK, Matija. Penetration-depth control in a remote laser-welding system based on an optical triangulation loop. Optics and lasers in engineering, ISSN 0143-8166. [Print ed.], Apr. 2021, vol. 139, str. 1-14.

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PAVLOVČIČ, Urban, ARKO, Peter, JEZERŠEK, Matija. Simultaneous hand-eye and intrinsic calibration of a laser profilometer mounted on a robot arm. Sensors, ISSN 1424-8220, Feb. 2021, vol. 21, iss. 4, f. 1-23.

SENEGAČNIK, Matej, KUNIMOTO, Kohei, YAMAGUCHI, Satoshi, KIMURA, Koki, SAKKA, Tetsuo, GREGORČIČ, Peter. Dynamics of laser-induced cavitation bubble during expansion over sharp-edge geometry submerged in liquid - an inside view by diffuse illumination. Ultrasonics Sonochemistry, ISSN 1350-4177, May 2021, vol. 73, str. 1-16.

PATENTS

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PROJECTS

Company Fotona - Research and development of laser medical systems. Matija Jezeršek. 1.9.2018 – 1.9.2021

Slovenian Research Agency. Laser-induced subsurface microdestruction of tissue (LasDes). Matija Jezeršek. 1.7.2019 – 30.6.2022

Slovenian Research Agency. Laser micro and nano structuring for development of biomimetic metallic surfaces with unique properties (LaMiNaS). Peter Gregorčič. 1.7.2019 – 30.6.2022

Slovenian Research Agency. New Conventional and Additive Manufactured Biodegradable Fe-Mn alloy with Tailored Biodegradability. Peter Gregorčič. 1.7.2019 – 30.6.2022

Ministry of Education, Science and Sport - Laser Process Research for the Clinics of the Future. Matija Jezeršek. 1.05.2019 - 31.03.2022.

Slovenian Research Agency. Engineering of future innovative and smart hybrid materials by combining laser-functionalized metals and living cells (LaserInSMArT). Peter Gregorčič. 1. 10. 2021 – 30. 9. 2024

AWARDS AND ACHIEVEMENTS

Assoc. prof. Peter Gregorčič, PhD, became a member of Strategic council for digitalization of the Republic of Slovenia.

UNIT FOR SUPPLEMENTARY DIVISION EDZ

The Faculty of Mechanical Engineering also hosts the Unit for Supplementary Division, which is not part of research groups, but operates independently as an organisational unit. The Unit for Supplementary Division covers the areas of mathematics and sports as the key supplementary factors contributing to the teaching process.

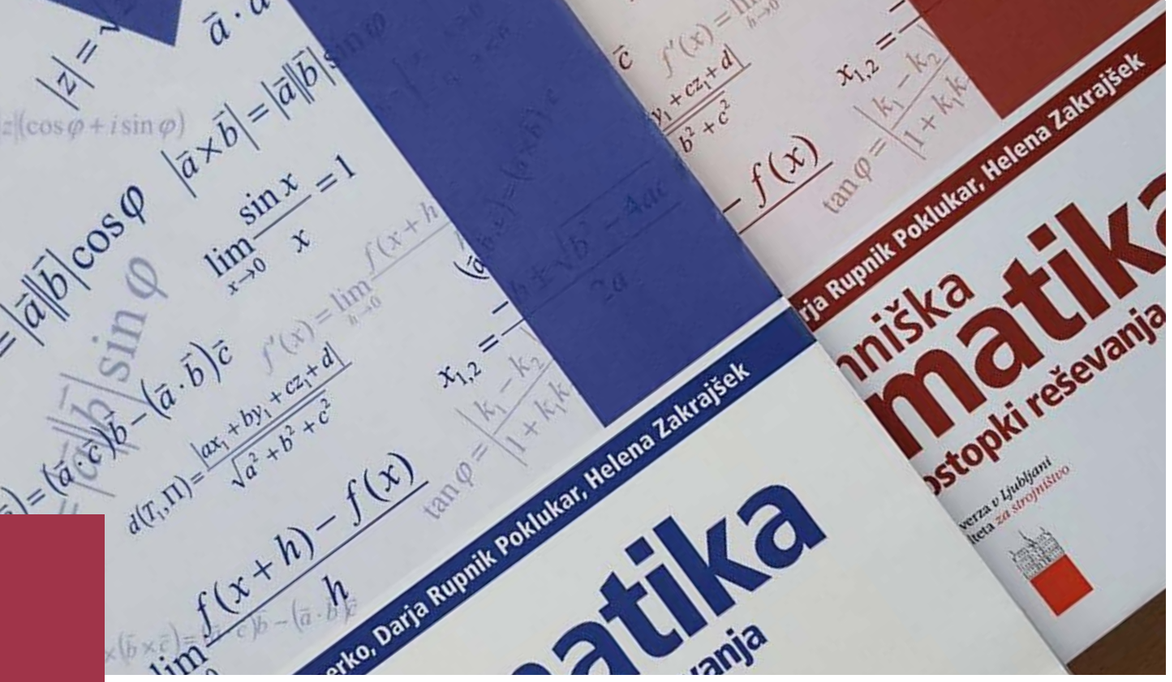
Photo: Ana Kregar

Unit for supplementary division EDZ

MEMBERS Jože Bratuž, Lect. Žiga Bratuž, Lect. Iztok Novak, Lect. Aleš Lavrič

ORIGINAL SCIENTIFIC ARTICLE

BRATUŽ, Žiga, ŠTEKL, Jaroš, GOLJA, Aleš, KRPAN, Maja, KAVČIČ, Žan, ZOVKO, Vinko. Physical activity and psychological wellbeing of students of the University of Ljubljana during the COVID-19 pandemic = Telesna dejavnost in psihološko blagostanje študentov Univerze v Ljubljani med pandemijo COVID-19. Kinesiologia Slovenica : scientific journal on sport, ISSN 1318-2269.



Mathematics Research Team RSMAT

DEPARTMENT HEAD Prof. Janez Žerovnik, PhD

DEPARTMENT MEMBERS Assist. Prof. Aljoša Peperko, PhD, Assist. Prof. Boštjan Gabrovšek, PhD, Assist. Tina Novak, PhD, Assist. Prof. Darja Rupnik Poklukar, PhD, Assist. Helena Zakrajšek, PhD, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

NOVAK, Tina, ŽEROVNIK, Janez. Real forms of the complex Neumann system: a method for finding real roots of polynomial Us([lambda]). Journal of Computational and Applied Mathematics, ISSN 0377-0427, Jul. 2021, vol. 390, str. 1-13.

SHAO, Zehui, ERVEŠ, Rija, JIANG, Huiqin, PEPERKO, Aljoša, WU, Pu, ŽEROVNIK, Janez. Double Roman graphs in P(3k,k). Mathematics, ISSN 2227-7390, Feb. 2021, vol. 9, iss. 4, f. 1-18.

ŽEROVNIK, Janez, HERAKOVIČ, Niko. A new application of the generalized traveling salesman problem in industry 4.0 and 5.0. Multiple Criteria Decision Making, ISSN 2084-1531, 2021, vol. 16, str. 153-163.

PEPERKO, Aljoša. Inequalities for the spectral radius and essential spectral radius of positive operators on Banach sequence spaces. Positivity, ISSN 1385-1292, Sep. 2021, vol. 25, iss. 4, str. 1659-1675.

GABROVŠEK, Boštjan. An invariant for colored bonded knots. Studies in applied mathematics, ISSN 0022-2526, April 2021, vol. 146, iss. 3, str. 586-604.

ERVEŠ, Rija, ŽEROVNIK, Janez. On 2-rainbow domination number of generalized Petersen graphs P(5k, k). Symmetry, ISSN 2073-8994, May 2021, vol. 13, iss. 5 (809), str. 1-12.

ERVEŠ, Rija, ŽEROVNIK, Janez. On 3-rainbow domination number of generalized Petersen graphs P(6k,k). Symmetry, ISSN 2073-8994, Oct. 2021, vol. 13, iss. 10 (1860), str. 1-11.

UNIVERSITY, HIGHER EDUCATION OR SHORT-TERM HIGER EDUCATION TEXTBOOK WITH REVIEW

ŽEROVNIK, Janez, GABROVŠEK, Boštjan, RUPNIK POKLUKAR, Darja, ZAKRAJŠEK, Helena. Analiza. 1. izd. Ljubljana: Fakulteta za strojništvo, 2021.

ŽEROVNIK, Janez, GABROVŠEK, Boštjan, RUPNIK POKLUKAR, Darja. Analiza in navadne diferencialne enačbe. 1. izd. Ljubljana: Fakulteta za strojništvo, 2021.

PROJECTS

Slovenian Research Agency. Stochastic models for logistics of industrial processes. Janez Žerovnik. 1.9.2020 - 31.8.2023

UNIT FOR SUPPLEMENTARY DIVISIO

PROMOTION OF MECHANICAL ENGINEERING

Mechanical engineering offers many possibilities for participation and opportunities for creative solutions that are useful and interesting for people and their environment. The task of mechanical engineers is to transform ideas into products that enable them to help shape modern reality. The Faculty of Mechanical Engineering of the University of Ljubljana actively follows modern trends, promotes mechanical engineering in all its forms, organizes events, conferences and exhibitions, conducts workshops and publishes periodicals. Through its active work in the public sphere, the Faculty popularizes mechanical engineering and spreads awareness of the importance of technical sciences in everyday life.

INFORMATIVA

Once a year, before the Information Days, Informativa provides an overview of educational programs available in Slovenia and abroad in one place - from secondary schools to higher and postgraduate programs, additional education and training, language courses, lifelong learning, etc. Because of COVID-19 Informative took place online and the Faculty of Mechanical Engineering presented itself at this virtual fair for education and professions, as part of the University of Ljubljana.

PROMOTION OF MECHANICAL ENGINEERING IN SECONDARY SCHOOLS AND GYMNASIA

The FME pays special attention to promoting mechanical engineering in secondary schools and gymnasia, with the goal of making young people aware of the importance of this field. By joining the Inženirke in inženirji bomo! (We will be engineers!) project, young people's enthusiasm for engineering, technology and innovation is further strengthened. By the end of 2021 FME organized several on-line presentations for 14 secondary schools.

MECHANICAL ENGINEERING SUMMER CAMP

Mechanical Engineering is creative and we want to show this to pupils from the 6th grade of primary school to the 3rd year of secondary school. To this end, every August we organize the Mechanical Engineering Summer Camp. In 2021, we organized it for the 8th consecutive year, which indicates that it is becoming a tradition. Despite the corona virus, we had a record attendance of a whopping 84 participants, almost 15 percent of whom were girls. At the Summer School of Mechanical Engineering, participants are divided into small groups and they get to participate in thematic workshops such as hydraulic arm, 3D printing, portable weather station, remote-controlled aircraft construction, USB drink and air cooling, where participants learn about and make products to take home at the end of the workshop.

STUDENT CONFERENCE ON ENGINEERING - ŠTeKam

Every year in September, we enable young people to take their first step into the scientific world by presenting papers at the ŠTeKam student conference on engineering. The conference is open, which means that students from all faculties can participate, and from 2020 we have also given students from the final year of secondary schools and gymnasia the opportunity to take part. Students may also claim their participation in the conference as a remarkable achievement, a prerequisite for receiving the Zois Scholarship. All papers are published in the conference's comprehensive proceedings and entered into the Cobiss system. In 2021 26 papers arrived and 17 were presented.

MECHANICAL ENGINEERING DAYS

The Mechanical Engineering Days event is held every September in Bistra in cooperation with the Technical Museum of Slovenia and offers visitors an insight into the attractive world of engineering. During the week, the program is mainly intended for the pre-registered groups of 6th to 9th grade students and high school students, and on Sunday for individual visitors interested in the world of mechanical engineering. This time, visitors were able to take a closer look at the exceptional projects of students and established experts from the FME UL and learn many interesting things about drones, automated diagnostics, Formula Student team Ljubljana, weather forecasting, polymer materials, tribology and many other technologies.

OPEN FACULTY

Because of covid-19 many students of mechanical enigineering didn't have the chance to get to know the faculty were they study Therefore FME organized a special day Open Faculty were all the laboratories opened their doors and welcomed new students to take a look at what researchers of FME do. Students had the opportunity to ask questions, get interested in many projects and even maybe take part in them later.

AMBASSADOR OF SCIENCE OF THE REPUBLIC OF SLOVENIA

Dr. Saša Bajt, Head of the X-ray Optics group at DESY, Hamburg, Germany, was awarded the title of Ambassador of Science of the Republic of Slovenia for significant achievements in promoting and developing Slovenian scientific and development activities abroad. The Faculty of Mechanical Engineering nominated Dr. Bajt for the award by resolution of the Senate on 18 March 2021, based on her fruitful, long-standing collaboration with the Faculty in fluid dynamics in sample delivery in intense laser light. She involves the faculty extremely intensively in projects related to the leading experimental infrastructure at DESY, and it provides hands-on training for many of the faculty's undergraduate, masters and doctoral students.

NEW FACULTY OF MECHANICAL ENIGINEERING

The representatives of the UL FME, supported by the Rector of the University of Ljubljana, Prof. Dr. Gregor Majdič, met with the Minister of Education, Science and Sport, Dr. Simona Kustec, the Minister for Digital Transformation of the Republic of Slovenia, Mark Boris Andrijanič, and the Minister without portfolio, responsible for Development and EU Cohesion Policy, Zvonko Černač, at the Ministry of Education, Science and Sport on Friday, 17 December. The main topic of the meeting was the review of the status of the project to construct a new complex of the UL FME. Minister Dr. Simona Kustec advocated that the project be co-financed from the European cohesion funds. The ministers agreed with the representatives of the Faculty to oversee further operational tasks for the successful implementation of the construction project. With including the construction of the new complex UL FME in the cohesion projects, construction will start as early as next year and be completed by 2025.

Foto: Sadar+Vuga

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