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Annual report 2023 | Ljubljana, 2024 | ISSN 1580-1411 | Not for sale

TABLE OF CONTENTS

UNIVERSITY OF LJUBLJANA FACULTY OF MECHANICAL ENGINEERING

FACULTY MANAGEMENT

Dean
Prof. Dr. Mihael Sekavčnik

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

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

Secretary
Dr. Tone Češnovar

Vice Dean for Research and International Relations
Prof. Dr. Janko Slavič

SUPPORTING SERVICES

Faculty secretariat	Andreja Koban Domitrovič
Student office	Nika Vardjan Naglič
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Human resource department	Anja Novak
Department of international cooperation, scientific and research work	mag. Tanja Mavrič Rušt
Department of Economic Affairs and Communications	Katja Pustovrh
Library	Zorka Kešelj
Technical and maintenance department	Aleš Hočevar
IT department	Vida Trček
Publishing department	mag. Pika Škraba, Roman Putrih

FOLLOWING THE CHOSEN PATH

In 2023, the Faculty of Mechanical Engineering (FME) continued its trajectory towards becoming one of the top-performing academic institutions in the field of mechanical engineering in the country, as evidenced by the performance indicators that will be briefly highlighted below. FME plays a pivotal role in attracting the most prestigious national and international research projects, as well as in transferring knowledge through its highly qualified graduates, Masters and Doctors of Science. Furthermore, the initiative has served to reinforce the awareness of strategic business partners that collaboration with FME and its laboratories contributes significantly to their success in international markets and generates greater added value per employee. This development orientation is enabling FME to consolidate its position among the leading faculties at the University of Ljubljana (UL) in terms of its visibility and influence in society.

In the year 2023, we have renewed our academic programmes at all levels of study. This has provided students of all years with thoroughly updated modern study content. Crucially, students can now choose from a large number of elective courses during their studies, allowing them to tailor their studies to their own interests and thus strengthen their desired competences. This educational approach is highly demanding, which is why we have been successfully utilising the Studo app to assist students in designing and optimising their personalised timetables.

In the past year, we have continued the process of digitising study content within two ULTRA pilot projects with a total value of EUR 2.1 million. These are the Digital and Sustainable Society-oriented Mechanical Engineering Degree Programme and the Open Laboratory for Multidisciplinary and Intercultural Creativity. In the context of these pilot projects, the initial phase has been completed, during which modern digital solutions have been introduced in six projects within the field of higher education. Furthermore, the project has facilitated the introduction of six technology demonstrators, which will enable students the opportunity to engage in laboratory exercises independently. In the forthcoming year, our objective is also to provide six professional training courses for lifelong learning in the micro-evidence system.

The Open Lab, Peskovnik, is up and running. It is comprised of 51 full-time members who pursue their technical ideas and reinforcing the values of the Open Lab at the same time. Students form a community of students from all over the UL, exchange knowledge and skills and put their ideas into practice in group and individual projects. Among the completed projects, I would like to draw attention to the following: Development of a high-speed 3D printer and a Modular 4-axis CNC foam

cutter, an Ultrasonic gramophone record cleaner, a VTOL airplane, etc. A total of 60 workshops have been delivered by students from nine different UL members. Among the team projects, the Edvard Rusjan Team has traditionally distinguished itself by its exemplary international performance. In 2023, they achieved a commendable second-place in the international competition of teams from the most prestigious engineering universities in the world.

Photo: Črt Piksi

The strategic objectives set out in the FME Strategy to create collaborative research platforms in the four focus areas have led to a strengthening of inter-laboratory collaboration in the preparation of research project applications as well as collaboration on market development projects. The success of our activities can be attributed to our networking in research platforms and our simultaneous involvement in the industrial environment. This enabled FME to respond to the ARIS call for proposals and be awarded the coordination of the EUR 5.2 million research project Greentech – Green Transition in the Production and Use of Products. Furthermore, our institution was successful in winning the EUR 4.8 million HyBRreED project, which aimed to develop resilient chemical energy storage with hydrogen and batteries.

The visibility and recognition of FME is also increasing in the wider public sphere. This is the result of systematic and long-term oriented efforts to promote excellent results in all areas of FS operation and targeted initiatives to popularise mechanical engineering. Once more, this is attributable to the exemplary collaboration of management, shared services, and laboratory heads.

The volume of research activity is increasing in a positive direction, as evidenced by the following data in addition to the previously mentioned projects (GreenTech and HyBReED):

I. 31.5 million Euros in revenue from research, development and education,
II. 3.2 million Euros in revenue from development activities in direct cooperation with industry,
III. 6.3 million Euros of investments in research equipment and ongoing maintenance,
IV. 8 successful applications to ARRS research projects,
V. successful applications of international research projects,
VI. 229 publications of original scientific papers,
VII. 10% increase in clean citations per WoS database,
VIII. 16 FME awards for outstanding publications awarded to colleagues under the age of 35,
IX. University Prešeren Award for a student,
X. UL award for the best research achievement,
XI. two 1st places in the Rector's Awards competition for the best innovation in 2023.

The common denominator of the timely preparation of projects for new construction (PZI, IP) and securing funding from the European Commission is again the selfless cooperation of the entire FS collective and the unwavering determination, sacrifice and conviction of the FS management and its construction committee. In 2023, all activities for the preparation of the project documentation (PZI – project implementation plan and IP – investment programme) were carried out in accordance with the established timetable and without any delays. In this process, the management, in collaboration with the FME Building Committee, has demonstrated exemplary conduct in their engagement with the Investment Service at the UL and all the ministries involved.

Photo: Sadar+Vuga

The FME has achieved notable outcomes in all areas of its operations through meticulous, strategic, and methodical efforts. The changing legislation in the field of higher education (the new ZVIS) and research (the ZZRID), as well as the increasingly demanding socio-economic and human resources situation in society, present the FME management with new challenges. These are being successfully addressed with the established way of working. It is our firm belief that the results achieved thus far can be built upon to effect positive change in society. We are convinced that our efforts will contribute to the advancement of society in a manner that will make it one of the most successful economically developed and all-round innovative and inclusive societies.

Dean of the Faculty of Mechanical Engineering

Prof. Dr. Mihael Sekavčnik

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 40,000 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 has been ranked among the top 500 universities by the prestigious Academic Ranking of World Universities (ARWU); it is placed 416th in The Center for World University Rankings (CWUR), listed in the 801-1000 group in the Times Higher Education (THE) ranking, and the 591-600 group in the Quacquarelli Symonds 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.

Photo: UL FME Archive

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 Dr. Milan Vidmar, 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

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 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 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

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 2022, 33 laboratories and a Unit for Supplementary Division operated within the scope of 16 chairs.

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 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 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

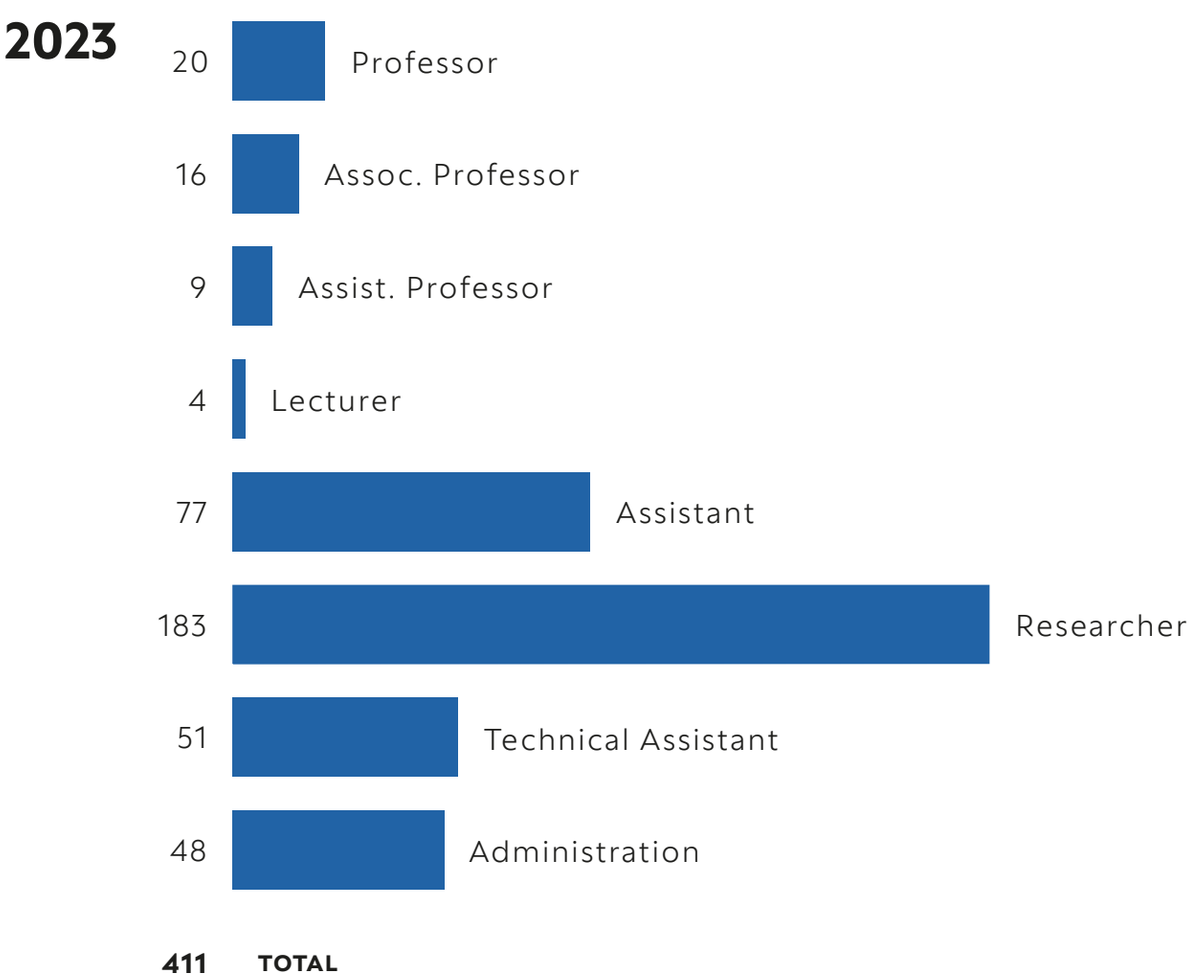
Mathematics Research Team RSMAT

Unit for Supplementary Division EDZ

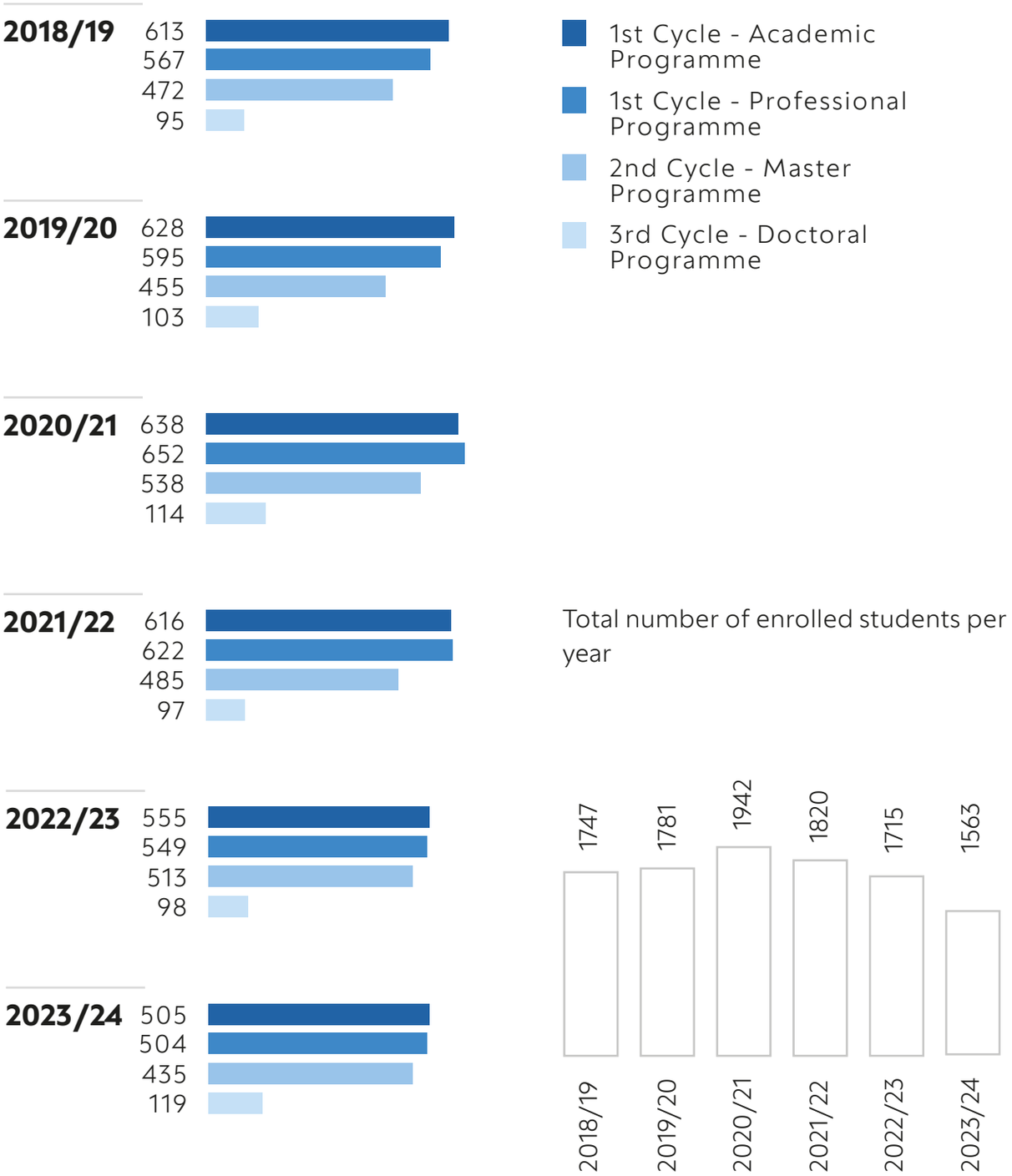
18

THE FACULTY OF MECHANICAL ENGINEERING IN NUMBERS

EMPLOYEE STRUCTURE

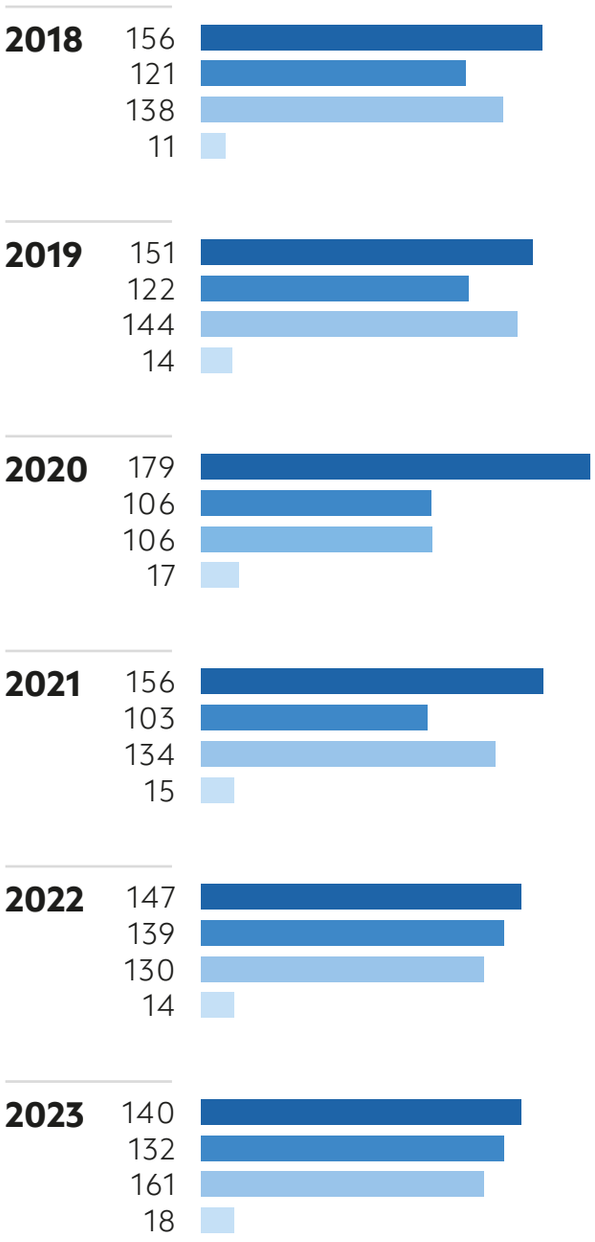


NUMBER OF ENROLLED STUDENTS



Total number of enrolled students per year

NUMBER OF GRADUATES



1st Cycle - Academic Programme

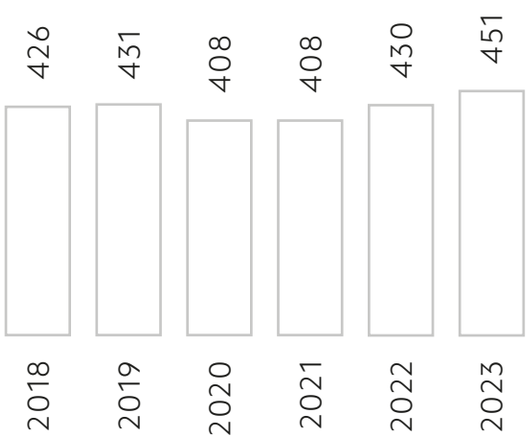
1st Cycle - Professional Programme

2nd Cycle - Master Programme

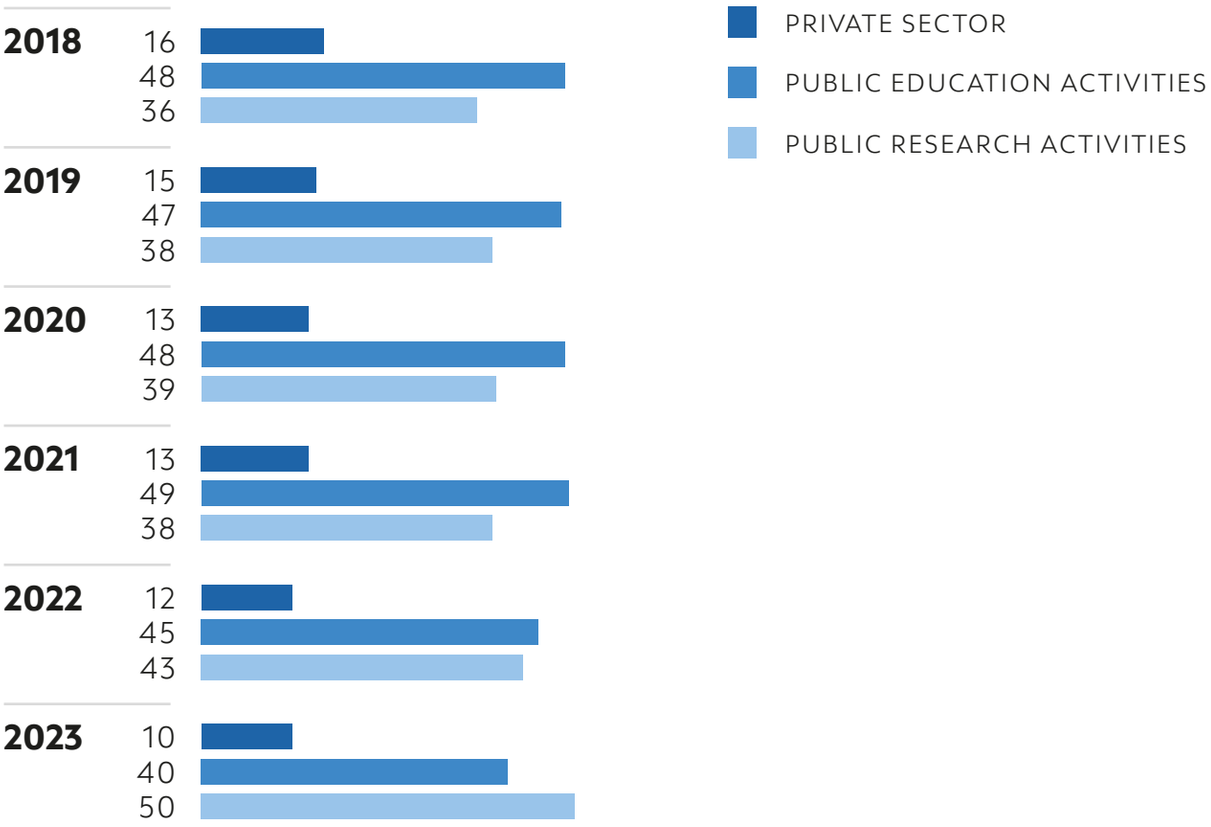
spec. + MSc (old prog.)

3rd Cycle - Doctoral Programme

Total number of graduates per year



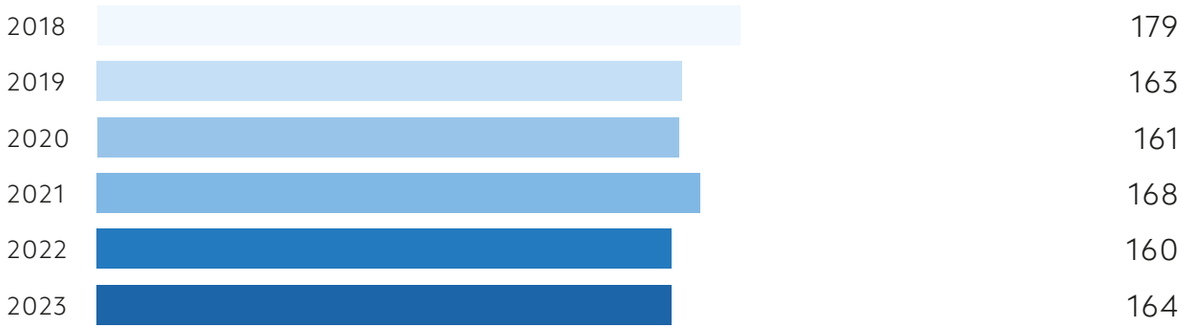
FINANCING STRUCTURE IN %



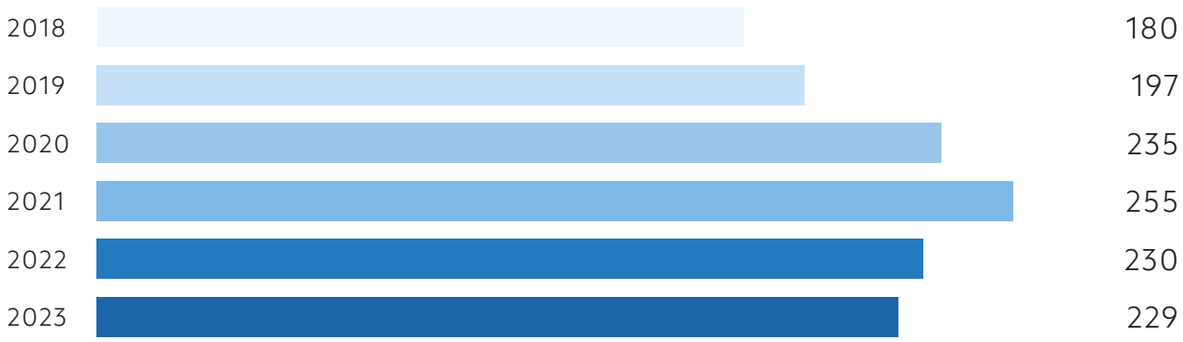
NUMBER OF INTERNATIONAL RESEARCH PROJECTS

Programm	2018	2019	2020	2021	2022	2023
Obzorje Evropa	0	0	0	0	8	26
Horizon 2020	11	11	12	12	13	6
ERDF - European regional develoment fond	9	10	4	2	0	1
ERA-NET M-era.Net	1	1	1	0	2	2
Life+	1	1	1	1	1	1
Erasmus +	6	9	8	9	13	15
European Defence Fund (EDF)	0	0	0	0	2	2
European defence agency (EDA)	0	1	1	1	1	3
European space agency (ESA)	1	1	0	0	1	4
Eureka	1	1	1	1	1	0
EIT – European Institute od Innoavation & Technology	2	2	2	3	2	3
COST	8	8	7	7	6	5
Other	5	5	**7**	9	16	13
ARRS – international projects	1	1	**2**	3	4	3
Total	**45**	**50**	**44**	**45**	**66**	**84**

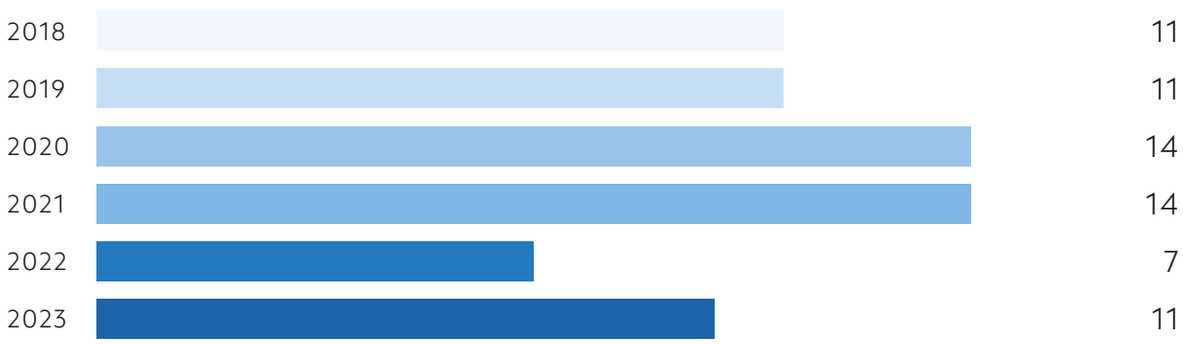
NUMBER OF MARKET-ORIENTED PROJECTS WITH THE INDUSTRY



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 fourth and third 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

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


Ventil / Letnik 30 / 2024 / 1 / Februar
REVIJA ZA FLUIDNO TEHNIKO, AVTOMATIZACIJO IN MEHATRONIKO
VENTIL
ISSN 1318 - 7279
Letnik 30 / 2024 / 1 / Februar
Fakulteta za strojništvo z novo raziskovalno opremo
Smernice za konstruiranje nestandardnih čepov
Izločanje zraka iz rabljenih mineralnih hidravličnih olj
Vzdrževanje hidravličnih naprav
industrijska
olja in maziva
OLMA
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OLMA 77
SINCE 1947
Univerza v Ljubljani
Fakulteta za strojništvo
FESTO
POCLAIN Hydraulics
Parker
lanco
Sinergija premikanja. Hidravlika. Pnevmatika. Linearna tehnika.
PODKRIŽNIK
SEAL & TRADE d.o.o.
ppt commerce
OPL
hpe
OMEGA AIR
more than air

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 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. The graduates acquire the degree of Bachelor of Applied Science in Mechanical Engineering (graduate's professional degree).

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.

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. Fuctionaliesed fluids for advanced enery systems
10. Mechanics in Engineering
11. Sustainable Polymer Materials and Technologies
12. Advanced production technologies for high quality and sistainable production
13. Production systems, laser technologies and materials welding - PLAS
14. Optodynamics
15. Fusion technologies
16. Decentralized solutions fort he digitalization of industry and smart cities and communities

GREENTECH

Developing the factories and products of the future for the green transition

The GREENTECH research programme has been awarded funding under the Recovery and Resilience Plan's call for proposals to co-fund longer-term, large-scale collaborative research and innovation programmes in the TRL 3-6 range.

GREENTECH brings together the best scientific expertise with the best industrial partners to help Slovenian companies make the green transition at two levels: the production process and the products. GREENTECH is a research programme that will enable the interconnection of breakthrough solutions across the value chain of the R&D manufacturing process – from R&D solutions, to technology solutions in manufacturing, to energy-efficient appliance solutions based on EU materials. The research programme will first have an impact on the green transition in Slovenia, and then extend its impact to the European Union and the planet as a whole.

We estimate that over a ten-year period, when the solutions are fully implemented in the EU market, the research programme will help to reduce CO2 emissions by more than 17 million tonnes, energy consumption by almost 9 billion kWh and material consumption by around 800,000 tonnes, through savings in the production process and greener products.

The consortium includes Gorenje, d.o.o., Fotona, d.o.o., Domel, d.o.o., LPKF, d.o.o., Yaskawa Slovenija d.o.o., Danfoss Trata, d.o.o., Kronoterm, d.o.o. and Medius, d.o.o., as well as the research organisations Faculty of Social Sciences (UL) and the University of Ljubljana (UP). The lead partner is the Faculty of Mechanical Engineering (UL).

The research programme is worth €5.2 million and is co-funded with €3.75 million.

“UL for a Sustainable Society – ULTRA”

The project "UL for a Sustainable Society – ULTRA" aims to implement pilot projects that address the challenges of the green and digital transition in different fields of study through networking and collaboration of several members of the University of Ljubljana. The UL pilot projects will enable the redesign of higher education professional programmes to embed much-needed digital skills and competencies for sustainable development into the curricula and contribute to accelerating the green and digital transition to Society 5.0.

Between 1 July 2022 and 31 December 2025, the University of Ljubljana will implement 11 pilot projects to update the curricula of 29 professional higher education programmes. As part of the ULTRA project, the Faculty of Mechanical Engineering of the UL is the promoter of the pilot project Open Laboratory for Multidisciplinary and Multicultural Creativity and the Digital and Sustainable Engineering Degree Programme project.

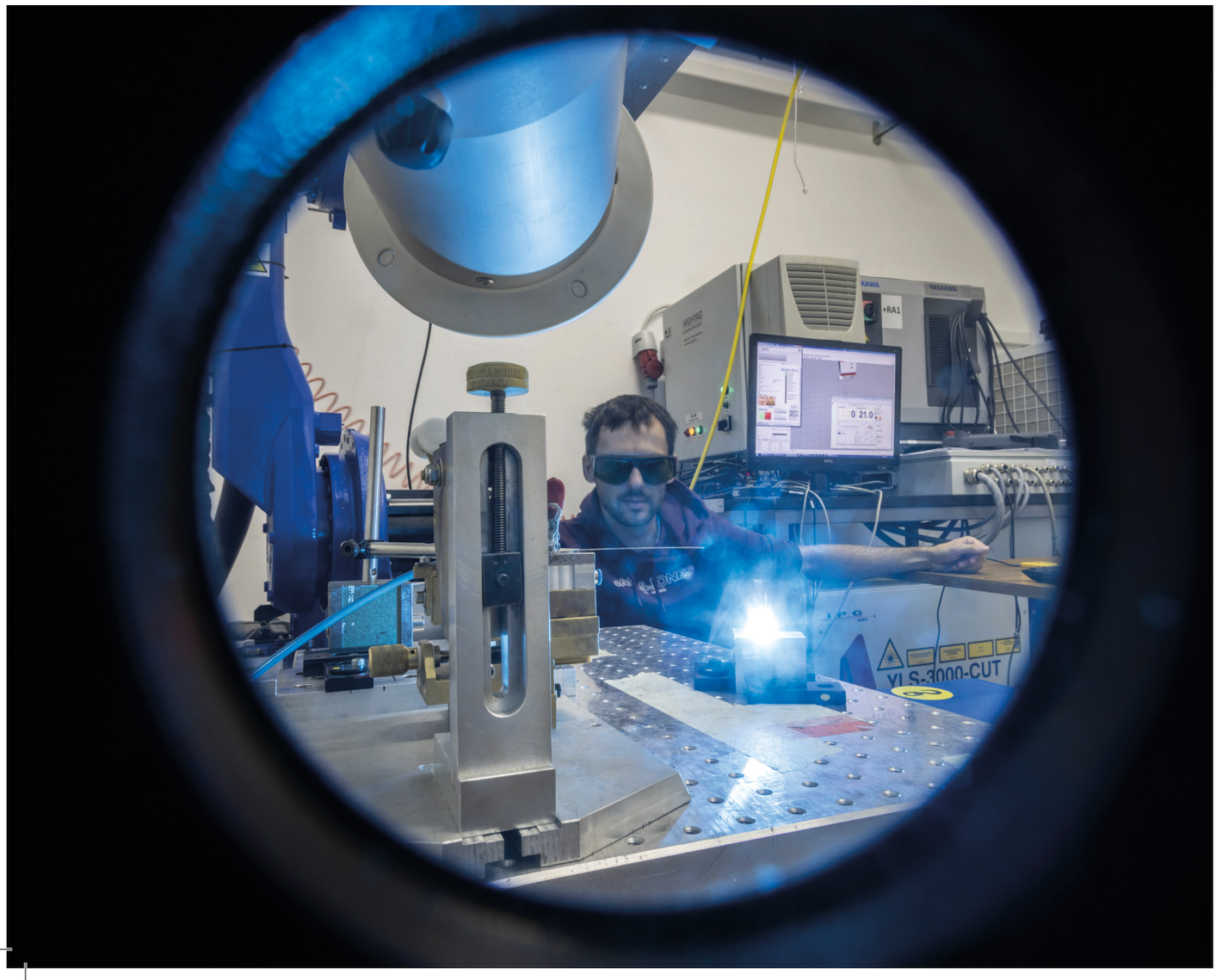
One of the main objectives of the Open Lab pilot project is to create spaces, information and communication technologies and software that will enable students at the University of Ljubljana to research, learn and create. More broadly, the Open Lab is also a hub of ideas where students can work in international teams to learn about wider societal needs and challenges related to the green transition, digitalisation and working in a multicultural environment. The project has received funding of almost €830,000 for the successful implementation of all activities and the establishment of both the relevant infrastructure and the communication strategy, which the Faculty of Social Sciences are preparing as part of the project.

Figure 1: Equipment in the Technology Demonstrator classroom, designed for hands-on training on modern industrial equipment.

With the second pilot project, the Faculty of Mechanical Engineering aims to adapt its curricula and programmes to meet the needs of acquiring relevant competencies for the green and digital transition. Therefore, the first fundamental objective of the Digital and Sustainable Engineering pilot project is to complement the content of the ENGINEERING higher education programme with socio-economic content related to sustainable development and the green transition. The second objective relates to the introduction of two demonstration modules: an Additive Technology Expert and a Future Green Technology Evaluation Expert, which will enable external stakeholders to acquire the relevant competencies for the green and digital transition in the industry. The third and final objective is to fully digitise learning content using modern information and communication tools and to use advanced methods and digital tools to deliver the learning process. To successfully achieve its goals, the project has secured €1 million in funding under the “UL for a Sustainable Society – ULTRA” programme.

PRESENTATION OF PROGRAMME GROUPS AND ACTIVITIES OF LABORATORIES

Photo: Željko Stevanić, IFP d.o.o.



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.

Photo: Željko Stevanić, IFP d.o.o.

Laboratory for Modelling Machine Elements and Structures LAMEK

RESEARCH AREAS

•Technical Product Documentation (TPD) • Geometric Product Specifications (GPS) • Geometric dimensioning and tolerancing (GDT) • Mechanics of structures and machines • Structures, machine elements and materials modelling • Composite and SMA structures • Development and design of machines and production systems • Blast and ballistic response of structures • Vehicle engineering and transportation research • Traffic safety and accident analysis • Biomechanics

DEPARTMENT HEAD Assoc. Prof. dr. Robert Kunc

DEPARTMENT MEMBERS Assist. Prof. dr. Miha Ambrož, Assist. Prof. dr. Simon Krašna, Assist. Prof. dr. Jovan Trajkovski, Assist. Prof. dr. Samo Zupan, Assist. Prof. dr. Andrej Žerovnik, Asist. dr. Matej Kranjec, Aleksander Novak, Slobodanka Ivanjić Kostrešević, Jernej Korinšek, Assist. Luka Roblek, Assist. Narendra Singh, Assist. Urban Žnidaršič, Renata Piščanec

ORIGINAL SCIENTIFIC ARTICLES

AMBROŽ, Miha, PERNAA, Johannes, HAATAINEN, Outi, AKSELA, Maija. Promoting STEM education of future chemistry teachers with an engineering approach involving single- board computers. Applied sciences. ISSN 2076-3417, 2023, vol. 13, iss. 5, str. 1-15

KELLER, Arne, KRAŠNA, Simon. Accelerations of public transport vehicles : a method to derive representative generic pulses for passenger safety testing. Frontiers in future transportation. ISSN 2673-5210, Jan. 2023, vol. 4, str. 1-12

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Photo: Željko Stevanić, IFP d.o.o.

phase-field fracture theory. Journal of composites science. ISSN 2504-477X, Jan. 2023, vol. 7, iss. 1, str. 1-20

GLJUŠĆIĆ, Matej, FRANULOVIĆ, Marina, ŽEROVNIK, Andrej. Finite element evaluation of failure in additively manufactured continuous fiber-reinforced composites. Journal of multiscale modelling. ISSN 1756-9745, 2023, vol. 14, iss. 1, str. 1-15

KOPYLOV, Semen, PHANOMCHOENG, Gridsada, AMBROŽ, Miha, PETAN, Žiga, KUNC, Robert, QIU, Yi. Improvements to a vehicle's ride comfort by controlling the vertical component of the driving force based on in-wheel motors. Journal of vibration and control :JVC. ISSN 1077-5463, Sept. 2023, vol. 29, iss. 17/18, str. 4001-4014

PROJECTS

SMM d.o.o. Research work. Robert Kunc. Ongoing since 1.1.2016

Slovenian Research and Innovation Agency. Road traffic safety - Development of new road traffic safety assessment methodology. Robert Kunc. 1.10.2022 - 30.9.2024

European Defence Agency. HybriDT II. Hybrid drive train demonstrator – Phase 2. Miha Ambrož, Tomaž Katrašnik. 6. 9. 2023 – 5. 12. 2024

PATENT

VOJE, Andrej, KUNC, Robert. An underwater scooter for divers = Unterwasser-Scooter für Taucher = Scooter sous-marin pour plongeurs : European patent specification EP 3 837 026

B1, 2023-12-06. [Munich]: European Patent Office, 2023.

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.

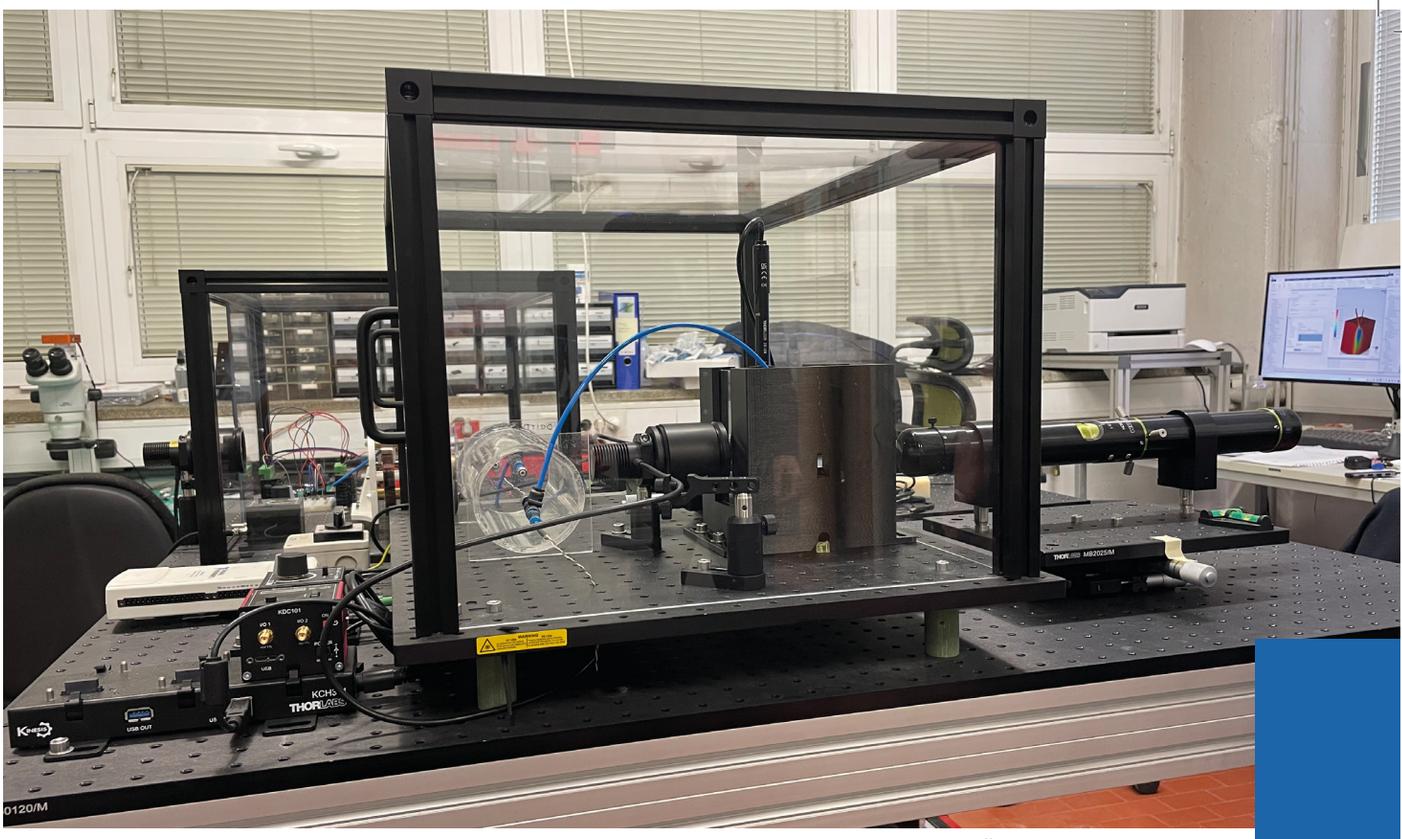


Photo: Željko Stevanić, IFP d.o.o

Laboratory for Fluid Dynamics and Thermodynamics LFDT

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. dr. Božidar Šarler

DEPARTMENT MEMBERS Assist. Prof. dr. Anton Bergant, Assist. Prof. dr. Andrej Bombač, Assist. Prof. dr. Matjaž Perpar, Assist. Prof. dr. Boštjan Mavrič, Assist. dr. Zahoor Rizwan, Res. Assoc. dr. Zlatko Rek, Assist. dr. Umut Hanoglu, Res. Assoc. dr. Katarina Mramor, Res. Assoc. dr. Miha Kovačič, Res. Assoc. dr. Robert Vertnik, Res. Assoc. dr. Qingguo Liu, Matic Cotič, Assist. Rana Khush Bakhat, Assist. Gašper Vuga, Assist. Ajda Kunavar, Assist. dr. Tadej Dobravec, Assist. Izaz Ali, Assist. Kovačič Krištof, Assit. Bor Zupan, Zdenka Rupič

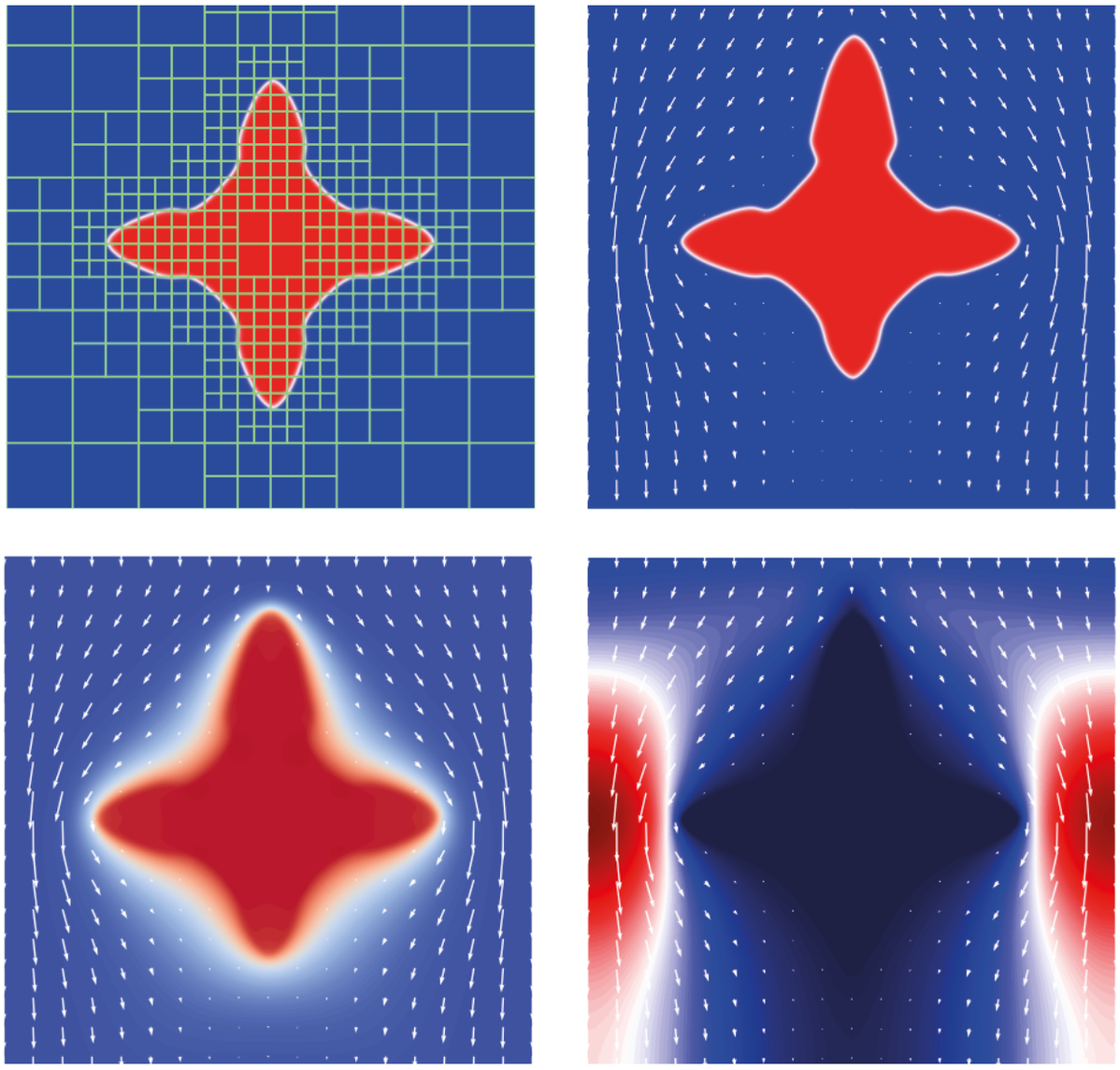
ORIGINAL SCIENTIFIC ARTICLES

BREZOVAR, Teja, HUDOVORNIK, Grega, PERPAR, Matjaž, LUŠTRIK, Matevž, DREU, Rok. The effect of design and size of the fluid-bed equipment on the particle size-dependent trend of particle coating thickness and drug prolonged-release profile. AAPS PharmSciTech. ISSN 1530-9932, 2023, vol. 24, iss. 4, art. 93, 16 str.

KOVAČIČ, Miha, ŽUPERL, Uroš, GUSEL, Leo, BREZOČNIK, Miran. Reduction of surface defects by optimization of casting speed using genetic programming : an industrial case study. Advances in production engineering & management. ISSN 1854-6250, Dec. 2023, vol. 18, no. 4, str. 501-511

ZUPAN, Bor, PEÑA-MURILLO, Gisel Esperanza, ZAHOOR, Rizwan, GREGORC, Jurij, ŠARLER, Božidar, KNOŠKA, Juraj, GAÑÁN-CALVO, Alfonso M., CHAPMAN, Henry N., BAJT, Saša. An experimental study of liquid micro-jets produced with a gas dynamic virtual nozzle under the influence of an electric field. Frontiers in molecular biosciences. ISSN 2296-889X, Jan. 2023, vol. 10, str. 1-10

DOBRAVEC, Tadej, MAVRIČ, Boštjan, ZAHOOR, Rizwan, ŠARLER, Božidar. A coupled domain–boundary



Phase field without fluid circulation (top-left), phase field with circulation (top-right), temperature field (bottom-left) and absolute velocity value (bottom-right).

type meshless method for phase-field modelling of dendritic solidification with the fluid flow. International journal of numerical methods for heat & fluid flow. ISSN 0961-5539, Jun. 2023, vol. 33, iss. 8, str. 2963-2981

URBANOWICZ, Kamil, JING, Haixiao, BERGANT, Anton, STOSIAK, Michal, LUBECKI, Marek. Progress in analytical modeling of water hammer. Journal of fluids engineering : Transactions of the ASME. ISSN 0098-2202, Aug. 2023, vol. 145, iss. 8, str. 1-12

URBANOWICZ, Kamil, BERGANT, Anton, STOSIAK, Michal, KARPENKO, Mykola, BOGDEVIČIUS, Marijonas. Developments in analytical wall shear stress modelling for water hammer phenomena. Journal of sound and vibration. ISSN 0022-460X, Oct. 2023, vol. 562, str. 1-22

KOVAČIČ, Miha, ŽUPERL, Uroš. Continuous caster final electromagnetic stirrers position optimization using genetic programming. Materials and manufacturing processes. ISSN 1042-6914, May 2023, vol. 38, iss. 12, str. 1-9

HANOGLU, Umut, ŠARLER, Božidar. Influence of casting defects on damage evolution and potential failures in hot rolling simulation system. Metallurgia Italiana. ISSN 0026-0843, 2023, n. 2, str. 48-52

ŽUPERL, Uroš, KOVAČIČ, Miha. Artificial neural network system for predicting cutting forces in helical-end milling of laser-deposited metal materials. Tehnički glasnik. ISSN 1846-6168, 2023, vol. 17, no. 2, str. 223-230

URBANOWICZ, Kamil, HALUCH, Igor, BERGANT, Anton, DEPTUŁA, Adam, SLIWINSKI, Pawel. Initial investigation of wave interactions during simultaneous valve closures in hydraulic piping systems. Water resources management. ISSN 1573-1650, 2023, vol. 37, str. 5105-5125

PROJECTS

Slovenian Research and Innovation Agency. Development of innovative meshless methods for multiphysics and multiscale simulation of cutting-edge technologies. Božidar Šarler. 1.10.2022 - 30.9.2025

Slovenian Research and Innovation Agency. Advanced meshless modelling and simulation of microstructure evolution for the top-quality metal products. Tadej Dobravec. 1.10.2022 - 30.9.2024

DESY Hamburg - Innovative methods for imaging with the use of x-ray free electron laser and synchrotron sources - III. Božidar Šarler. 13.4.2022 - 12.4.2026

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

Slovenian Research and Innovation Agency. Modelling for thermal control of Plasma Facing Components (PFCs) in fusion reactors. Božidar Šarler. 1.3.2020 – 28.2.2023

Danieli & C. Officine Mechaniche S.p.A. Development of Process Deign Code (PDC) for VSCC (Vertical Semi-Continuous Casting). Božidar Šarler. 23.3.2023 – 31.5.2023

AWARDS AND ACHIEVEMENTS

Assist. Kovačič Krištof received an Prešeren Prize for for outstanding achievements in science.

Assist. Gašper Vuga, assist. dr. Tadej Dobravec, assist. Bor Zupan and assist. prof. dr. Boštjan Mavrič received an Award from the Faculty of Mechanical Engineering to colleagues under the age of 35 for outstanding research achievements.

03 ENERGY ENGINEERING

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

1. 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.

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

3. 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.

4. 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.

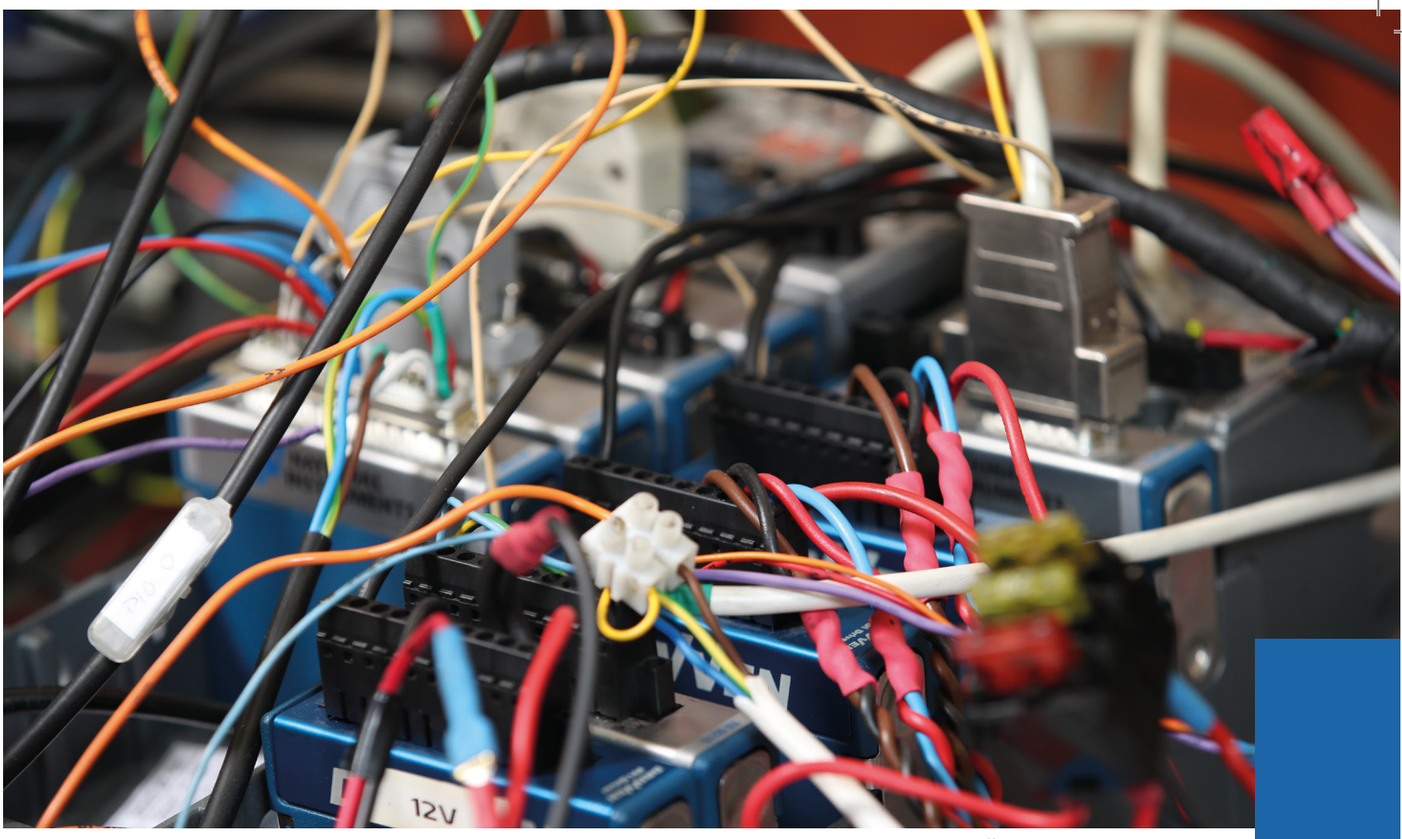


Photo: Željko Stevanić, IFP d.o.o.

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. dr. Tomaž Katrašnik

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

ORIGINAL SCIENTIFIC ARTICLES

KATRAŠNIK, Tomaž, MOŠKON, Jože, ZELIČ, Klemen, MELE, Igor, RUIZ-ZEPEDA, Francisco, GABERŠČEK, Miran. Entering voltage hysteresis in phase-separating materials : revealing the electrochemical signature of the intraparticle phase-separated state. Advanced materials. ISSN 1521-4095, Aug. 2023, vol. 35, iss. 31, str. 1-18

KREGAR, Ambrož, ZELIČ, Klemen, KRAVOS, Andraž, KATRAŠNIK, Tomaž. Educational scale-bridging approach towards modelling of electric potential, electrochemical reactions, and species transport in PEM fuel cell. Catalysts. ISSN 2073-4344, Jul. 2023, vol. 13, iss. 7, str. 1-31

DE GREEF, Johan, HOANG, Quynh N., VANDEVELDE, Raf, MEYNENDONCKX, Wouter, BOUCHAAR, Zouhir, GRANATA, Giuseppe, VERBEKE, Mathias, ISHTEVA, Mariya, SELJ Tine, VAN CANEGHEM, Jo, VANIERSCHOT, Maarten. Towards waste-to-energy-and- materials processes with advanced thermochemical combustion intelligence in the circular economy. Energies. ISSN 1996-1073, Feb. 2023, vol. 16, iss. 4, str. 1-19

FAUSSONE, Gian Claudio, SELJAK, Tine, JASIUKAITYTE, Edita, ŽVAR BAŠKOVIČ, Urban,

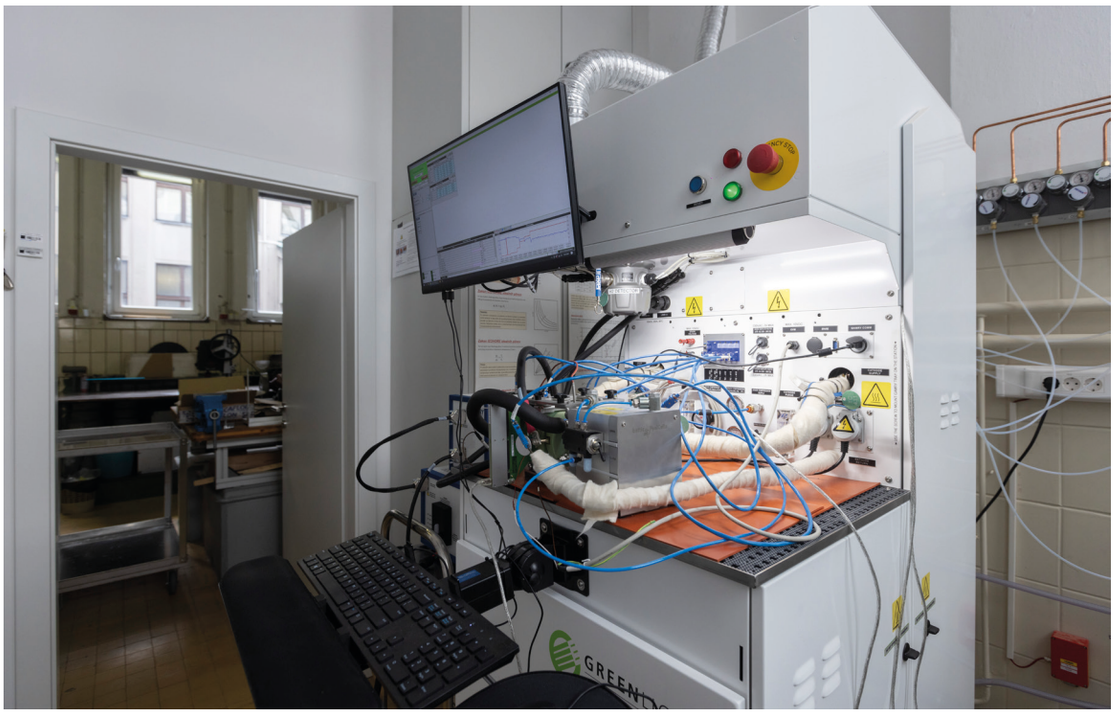


Photo: Željko Stevanić, IFP d.o.o

KATRAŠNIK, Tomaž, GRILC, Miha, FAUSSONE, Gian Claudio. Pyrolysis oil from post- consumer packaging and its ageing : physical and chemical properties and drop-in performance in a power generating unit. Energy reports. ISSN 2352-4847, Nov. 2023, vol. 10, str. 613-627

ZELIČ, Klemen, MELE, Igor, BHOWMIK, Arghya, KATRAŠNIK, Tomaž. Phase separating electrode materials - chemical inductors. Energy storage materials. ISSN 2405-8297, Feb. 2023, vol. 56, str. 489-494

FEDOROVA, Anna A., LEVIN, Oleg V., ELISEEVA, Svetlana N., KATRAŠNIK, Tomaž, ANISHCHENKO, Dmitrii V. Investigating the coating effect on charge transfer mechanisms in composite electrodes for lithium-ion batteries. International journal of molecular sciences. ISSN 1422-0067, May 2023, vol. 24, iss. 11, str. 1-20

KREGAR, Ambrož, KATRAŠNIK, Tomaž. Elucidating mechanistic background of the origin and rates of peroxide formation in low temperature proton exchange fuel cells. Journal of electrochemical science and engineering. ISSN 1847-9286, 2023, vol. 13, no. 5, str. 753-770

ŽVAR BAŠKOVIČ, Urban, KATRAŠNIK, Tomaž, FAUSSONE, Gian Claudio, GRILC, Miha, SELJAK, Tine. Ultra-low emission power generation utilizing chemically stabilized waste plastics pyrolysis oil in RCCI combustion concept. Journal of environmental management. ISSN 1095-8630, Oct. 2023, vol. 344, str. 1-13

KRAVOS, Andraž, VOGLAR, Tit, KREGAR, Ambrož, KATRAŠNIK, Tomaž. Hybrid methodology for parametrisation of proton exchange membrane fuel cell model for diagnostics and control applications. Journal of the Electrochemical Society. ISSN 1945-7111, Nov. 2023, vol. 170, no. 11, str. 1-13

PROJECTS

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

Horizon 2020. MORELife. Material, Operating strategy and REliability optimisation for LIFEtime improvements in heavy duty trucks. Tomaž Katrašnik. 1.9.2021 - 31.8.2024

Slovenian Research and Innovation 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. 1.9.2021 - 31.8.2024

Slovenian Research and Innovation Agency. Multiscale modelling of degradation phenomena in membrane electrode assemblies of proton exchange membrane fuel cells produced of advanced materials. Tomaž Katrašnik. 1.2.2022 - 31.1.2024

Horizon Europe. INDY. Energy Independent and Efficient Deployable Military Camps. Tomaž Katrašnik. 1.12.2022 – 31.1.2025

Horizon Europe. PULSELION. Pulsed Laser igitaliza tEchnology for soLid State battery igitalizatio supported by igitalization. Tomaž Katrašnik. 1.9.2022 - 31.8.2026

Horizon Europe. ADVAGEN. Development of ADVAnced next GENeration Solid-State batteries for Electromobility Applications. Tomaž Katrašnik. 1.8.2022 - 31.7.2026

Austrian Research Promotion Agency (FFG). MoSiLiB. Modeling and development of silicon- tin sulfide composite anodes for generation 3b lithium-ion batteries. Tomaž Katrašnik. 1.6.2022 - 31.5.2025

European Defence Agency. ELUVAT I. Innovative electric light utility all-terrain vehicle for defence purposes based on in-wheel electro motors. Tomaž Katrašnik. 3.2.2022 - 2.2.2023

Horizon Europe. NEXTCELL. Towards the next generation of high performance li-ion battery cells. Tomaž Katrašnik. 1.1.2023 – 31.12.2026

Horizon Europe. BLESSED. Bridging Models at Different Scales To Design New Generation Fuel Cells for Electrified Mobility. Tomaž Katrašnik. 1.2.2023 – 31.1.2027

Horizon Europe. FASTEST. Fast-track hybrid testing platform for the development of battery systems. Tomaž Katrašnik. 1.6.2023 – 31.5.2026

Horizon Europe. NEXTBMS. NEXT-generation physics and data-based Battery Management Systems for optimised battery utilization. Tomaž Katrašnik. 1.6.2023 – 30.11.2026

Horizon Europe. MEAsureD. Advanced MEAs ensuring high efficiency HDV. Tomaž Katrašnik. 1.6.2023 – 31.5.2026

Horizon Europe. NAHV. North Adriatic Hygrogen Valley. Tomaž Katrašnik. 1.9.2023 – 31.8.2029

Horizon Europe. RealHyFC. Reliable durable high power hydrogen fueled PEM Fuel Cell stack. Tomaž Katrašnik. 1.6.2023 – 31.5.2026

European Defence Agency. HybriDT II. Hybrid drive train demonstrator – Phase 2. Miha Ambrož, Tomaž Katrašnik. 6.9.2023 – 5.12.2024

DOCTORAL DISERTATION

KRAVOS, Andraž. Thermodynamically based reduced dimensionality proton exchange membrane fuel cell model for observer based monitoring and control: dostoral thesis. Mentor Tomaž Katrašnik

PATENTS

KATRAŠNIK, Tomaž, ZELIČ, Klemen, CHOWDHURY, Amor, PAČNIK, Ivo, MELE, Igor, KRAVOS, Andraž. Computer-implemented method for diagnosing states of a battery : United States patent : US 11,835,583 B1, Dec. 5, 2023. [S. l.]: Unated States Patent and Trademark Office - USPTO, 2023.

AWARDS AND ACHIEVEMENTS

Assist. dr. Urban Žvar Baškovič received an award of the Faculty of Mechanical Engineering for excellence in teaching.

Assist. dr. Klemen Zelič and asist. dr. Urban Žvar Baškovič received an Award from the Faculty of Mechanical Engineering to colleagues under the age of 35 for outstanding research achievements.

Prof. dr. Tomaž Katrašnik, doc. dr. Chowdhury Haque Amer Amor, Assist. dr. Klemen Zelič, Igor Mele, Assist. Andraž Kravos , Ivo Pačnik received a Rector's award for the best innovation of University of Ljubljana.

Prof. dr. Tomaž Katrašnik, doc. dr. Chowdhury Haque Amer Amor, Assist. dr. Klemen Zelič, Igor Mele, Assist. Andraž Kravos, Ivo Pačnik received an award of the Innovation Fund of the University of Ljubljana.

Prof. dr. Tomaž Katrašnik received the award for the best research achievement of the University of Ljubljana in 2023

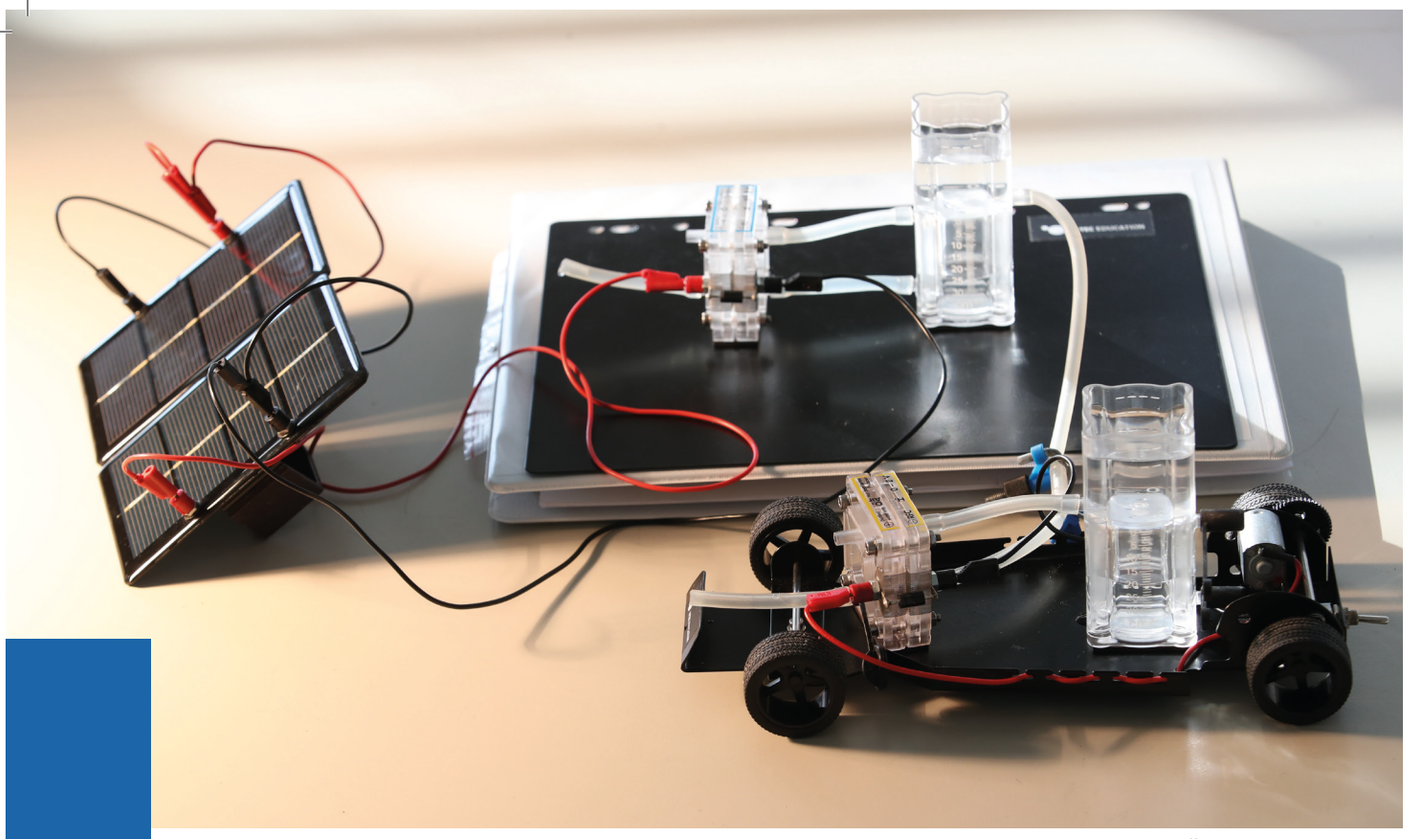


Photo: Željko Stevanić, IFP d.o.o

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. dr. Mihael Sekavčnik

DEPARTMENT MEMBERS Assoc. Prof. dr. Andrej Senegačnik, Assist. Prof. dr. Boštjan Drobnič, Assist. Prof. dr. Mitja Mori, Res. Assoc. dr. Igor Kuštrin, Assist. dr. Andrej Lotrič, Assist. dr. Rok Stropnik, Assist. Jure Gramc, Assist. Emilija Todorovski, Assist. Filip Todorovski, Assist. Mihael Boštjan Končar, Assist. Domen Hojkar, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

MORI, Mitja, IRIBARREN, Diego, CREN, Julie, COR, Emmanuelle, LOTRIČ, Andrej, GRAMC, Jure, DROBNIČ, Boštjan, REY, Laurent, CAMPOS CARRIEDO, Felipe, PUIG- SAMPER, Gonzalo, BARGIACCHI, Eleonora, DUFOUR, Javier, STROPNIK, Rok. Life cycle sustainability assessment of a proton exchange membrane fuel cell technology for ecodesign purposes. International journal of hydrogen energy. ISSN 1879-3487, 2023, vol. 48, iss. 99, str. 39673-39689

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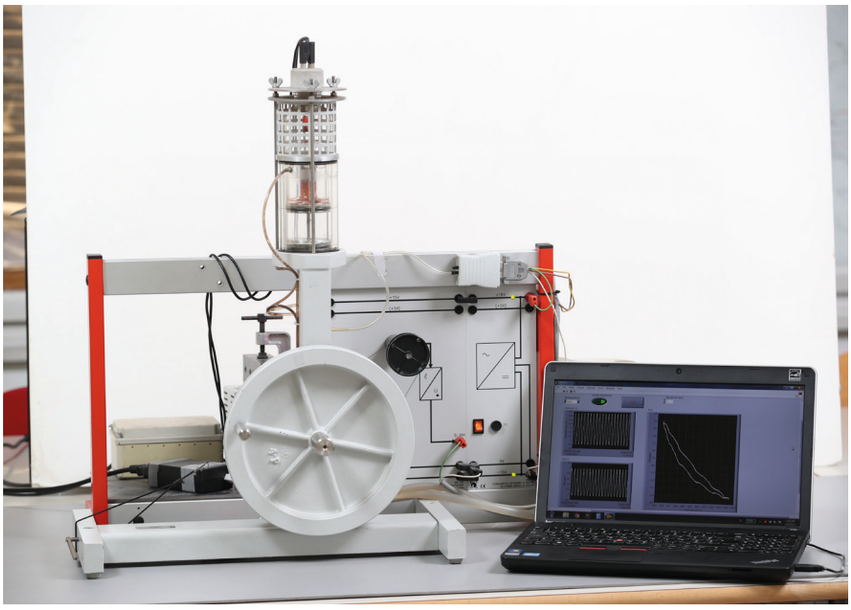

Photo: Željko Stevanić, IFP d.o.o

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PROJECTS

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Slovenian Research and Innovation Agency. PROMETHEIA - Processes for metal-to-char encapsulation. Mihael Sekavčnik. 1.12.2021 - 30.11.2025

Horizon 2020. BEST4Hy. SustainaBIE SoluTions FOR recycling of end of life Hydrogen technologies. Mitja Mori. 1.1.2021 - 31.12.2023

Horizon Europe. SENERGY NETS. Increase the Synergy among different ENERGY NETworkS. Mitja Mori. 1.9.2022 - 30.08.2026

Termoelektrarna Šoštanj, Strokovna podpora za preverjanje učinkov dolgoročne vzdrževalne pogodbe za blok 6. Mihael Sekavčnik. 1.4.2022 - 31.3.2025

Slovenian Research and Innovation Agency, Ministry of Defence. Carbon footprint of Ministry of Defence. Mitja Mori. 1.10.2022 - 30.09.2023

Horizon Europe. HYScale. Economic green hydrogen production at scale via a novel, critical raw material free, highly efficient and low-capex advanced alkaline membrane water electrolysis technology. Mitja Mori. 1.6.2023-31.5.2027

Horizon Europe. SINGLE. Electrified Single Stage Ammonia Cracking to Compressed Hydrogen. Mitja Mori. 1.5.2023-30.4.2026

Horizon Europe. SURE2COAT. Sustainable surface treatments of complex shape components for transsectorial industrial innovation. Mitja Mori. 1.1.2023 – 31.12.2025

Horizon Europe. PilotSOEL. Advanced Processes Enabling Low cost and High Performing Large Scale Solid Oxide Electrolyser Production. Rok Stropnik. 1.6.2023-31.5.2026

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Mitja Mori. 1.1.2024 – 30.6.2026

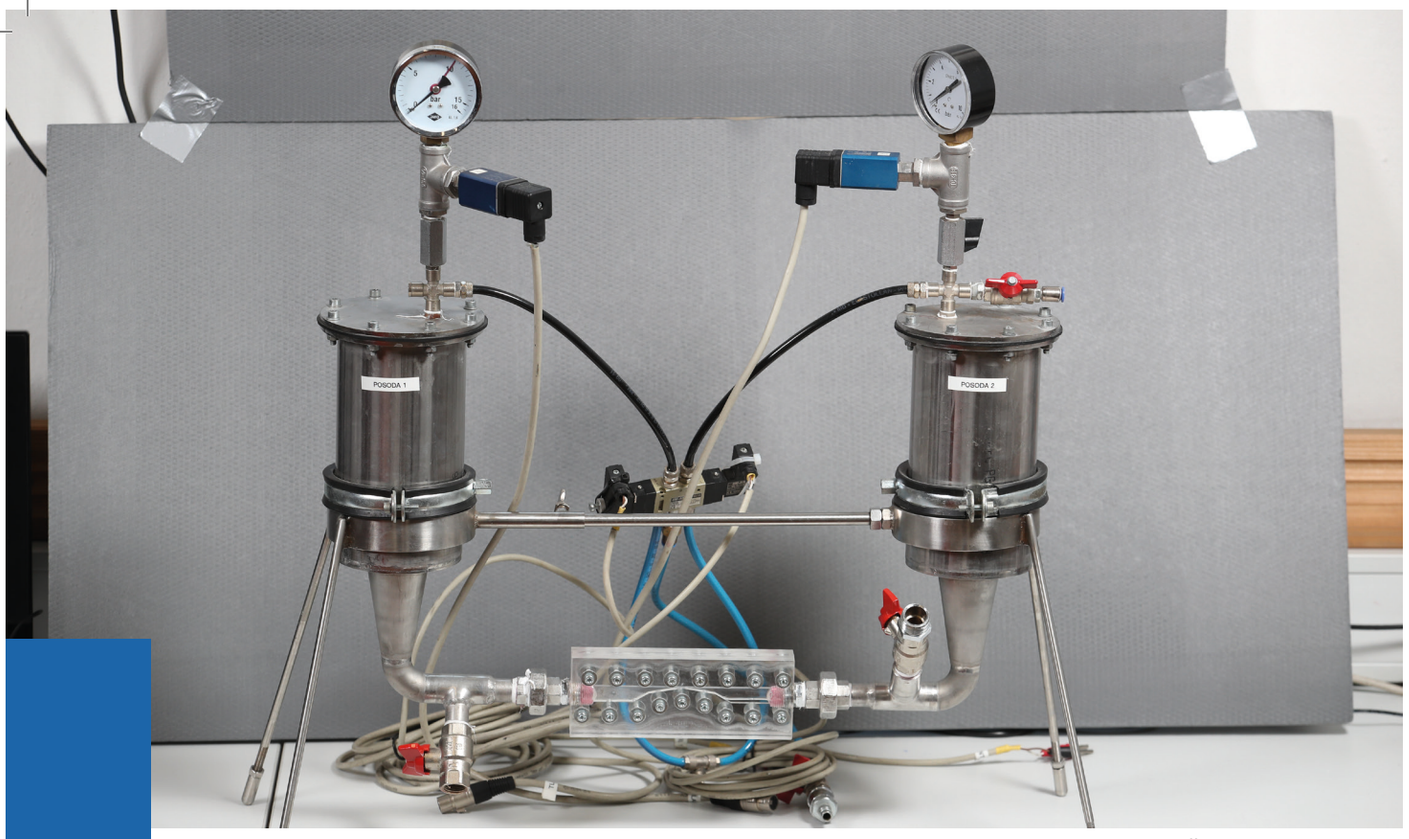

Photo: Željko Stevanić, IFP d.o.o

Laboratory for Hydraulic Machines LVTS

RESEARCH AREAS

Fluid mechanics • Turbine machines • Computer aided visualisation

DEPARTMENT HEAD Prof. dr. Marko Hočevar

DEPARTMENT MEMBERS Prof. dr. Matevž Dular, Assist. Prof. dr. Benjamin Bizjan, Assist. Prof. dr. Martin Petkovšek, Assist. Prof. dr. Lovrenc Novak, Res. Assoc. dr. Mojca Zupanc, Assist. Jurij Gostiša, Assist. Jure Zevnik, Ind. Dev. MSc Tone Godeša, Sr. Dev. Aleš Malneršič, Dev. Matej Sečnik, Assist. Žiga Pandur, Assist. dr. Primož Drešar, Asist. Jernej Ortar, Biljana Stojković, Jr. Res. Žan Boček, Žiga Gruden, Rossello Juan Manuel, Žak Sovec, Jr. Res. Zupanc Andraž, Darja Jeločnik

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KOPAČ, Tilen, BOČEK, Žan, VAN MIDDEN, Katarina Petra, KLEMENČIČ, Marina, RUČIGAJ, Aleš. Encapsulation of living photosynthetic organisms in alginate-gelatin hydrogels for controlled cell growth and oxygen production. Biochemical engineering journal. ISSN 1369-703X, Oct. 2023, vol. 199, str. 1-10

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Photo: Željko Stevanić, IFP d.o.o

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PROJECTS

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Slovenian Research and Innovation 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

Slovenian Research and Innovation Agency. eCATS. Controlling extreme cavitation conditions by laser tailoring of surface functionalities. Martin Petkovšek. 1.10.2021 - 30.9.2024

Slovenian Research and Innovation Agency. Controlled generation of microbubbles and exploration of their physics for exploitation in chemistry, biology and medicine. Matevž Dular. 01.10.2021 - 30.9.2024

Slovenian Research and Innovation Agency. Low emission household tumble drying with evaluation of damage to textile materials Marko Hočevar- 1.10.2021 - 30.9.2024

Horizon Europe. H-HOPE. Hidden Hydro Oscillating Power for Europe. Marko Hočevar. 1.11.2022 - 31.10.2026

Horizon Europe – CAVIPHY. Exploitation of extreme cavitation conditions for wastewater treatment. Matevž Dular. 1.8.2022 - 31.1.2024

Horizon Europe. NASCAP. Nanobubbles Stabilization for Cleaning Applications. Matevž Dular. 20.6.2022 - COST. NEXUSNET. Network on water-energy-food nexus for a low- carbon economy in Europe and beyond. Marko Hočevar. 22.9.2021-21.9.2025

COST. PEN@Hydropower. Pan-European Network for Sustainable Hydropower. Marko Hočevar. 14.9.2022-13.9.2026

Erasmus+. EVERYONE. Exchange of renewable energy harvesting experience in Europe for improving competence of young engineers. Marko Hočevar. 1.9.2023-28.2.2026

Ministry of Agriculture, Forestry and Food – EIP. MOTIKA. Pospešeno okopavanje zelenjave. Marko Hočevar. 19.5.2022 - 18.5.2025

Plinovodi d.o.o. Nadgradnja preizkuševališča za kontrolo polimerov za turbinske plinomere na MMRP CERŠAK 2B in MRP. Marko Hočevar. 20.11.2023 – 31.12.2023

Slovenian Research and Innovation Agency. Causma. Removal of selected antimicrobials by plasma-cavitation hybrid technology from water matrices of varying complexity. Martin Petkovšek. 1.10.2022 - 30.9.2025

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Marko Hočevar. 1.1.2024 – 30.6.2026

DOCTORAL DISSERTATION

GOSTIŠA, Jurij. Incorporation of hydrodynamic cavitation into wastewater treatment : doctoral thesis. Mentor Matevž Dular

PATENT

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Photo: UL FME Archive

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. dr. Jurij Prezelj
DEPARTMENT MEMBERS Assist. Luka Čurović, Assist. Prof. dr. Jure Murovec, Assist. Železnik Anže, Assist. Nejc Cerkovnik, Andrej Hvastja, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

ŽELEZNIK, Anže, MUROVEC, Jure, ČUROVIĆ, Luka, CERKOVNIK, Nejc, PREZEL], Jurij. Transmission loss measurement of recycled granular material using wave decomposition by impulse response extraction based on deconvolution. Applied acoustics. ISSN 0003-682X, Aug. 2023, vol. 211, str. 1-10

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MUROVEC, Jure, ČUROVIĆ, Luka, ŽELEZNIK, Anže, PREZEL], Jurij. Automated identification and assessment of environmental noise sources. Heliyon. ISSN 2405-8440, Jan. 2023, vol. 9, iss. 1, str. 1-17

PROJECTS

Slovenian Research and Innovation Agency. Acoustic monitoring of urban noise and biodiversity for green future using IoT-Sound-Radar and AI for event classification. Jurij Prezelj. 1.10.2023 – 30.9.2026

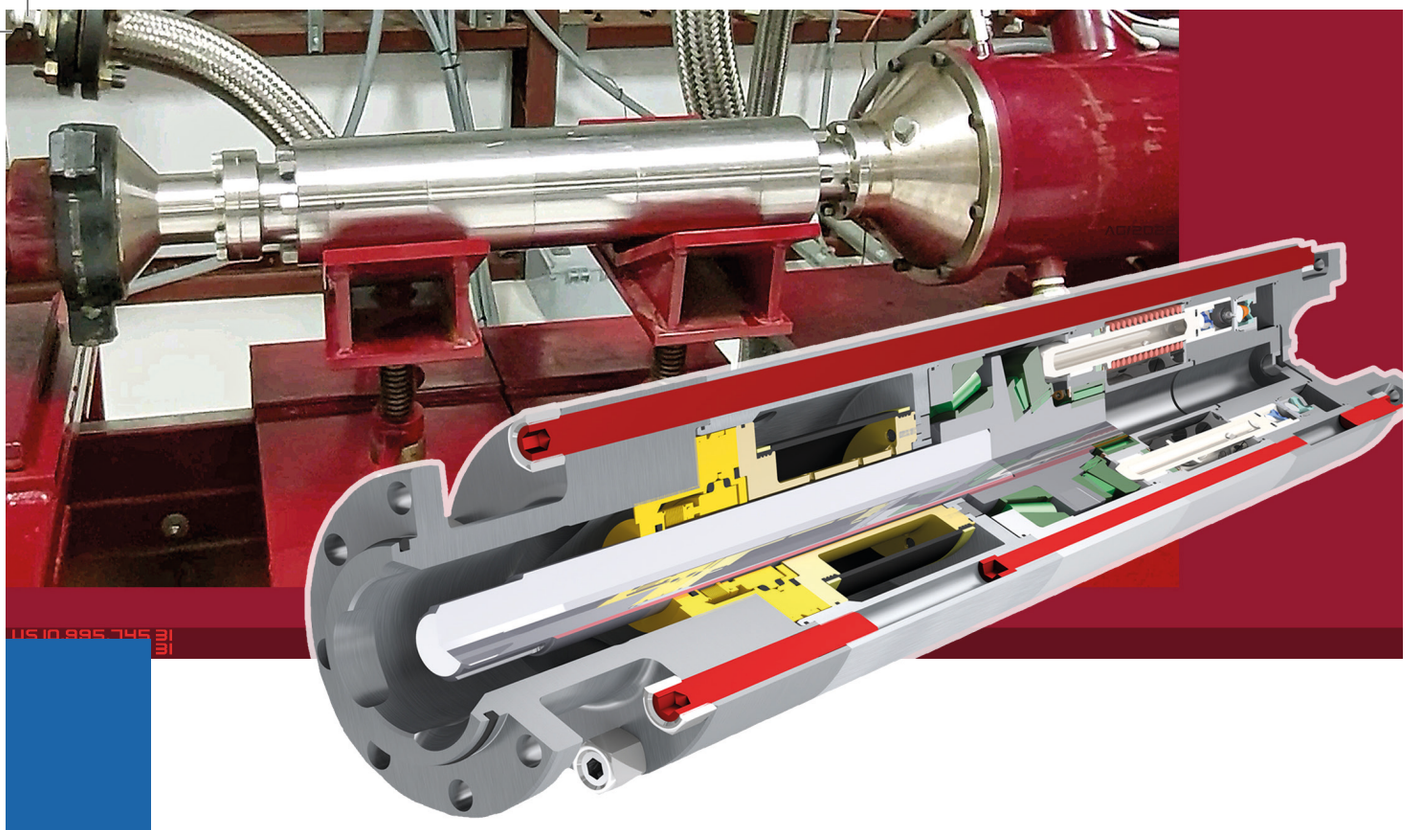
CORSAI (USA – California) - Noise control and Psychoacoustics of cooling fans. Jurij Prezelj. 2022-2023

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.



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Laboratory for Machine Elements LASEM

RESEARCH AREAS

Machine element • Operational strength • Development evaluations

DEPARTMENT HEAD Prof. dr. Marko Nagode

DEPARTMENT MEMBERS Assist. Prof. dr. Simon Oman, Assist. dr. Ivan Okorn, Assist. Tadej Kocjan, Assist. dr. Branislav Panić, Asisst. dr. Andrej Škrlec, Assit. Sanel Avdić, Renata Piščanec

ORIGINAL SCIENTIFIC ARTICLES

NAGODE, Marko, PANIĆ, Branislav, KLEMENC, Jernej, OMAN, Simon. Fault detection and classification with the rebmix R package. Computers & industrial engineering. ISSN 0360-8352, Nov. 2023, vol. 185, str. 1-12

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OMAN, Simon, NAGODE, Marko, KLEMENC, Jernej, GOSAR, Aleš. Razvoj črpalne enote za črpanje surove nafte iz velikih globin. Ventil : revija za fluidno tehniko in avtomatizacijo. ISSN 1318-7279, Jun. 2023, letn. 29, št. 3, str. 182-193

PROJECTS

Erasmus +. LiDeSuM. Lightweight Design for Sustainable Mobility. Marko Nagode. 1.10.2022 - 31.12.2023

Emri d.o.o. TIantie- vibroizolacija tirov na betonski plošči. Jernej Klemenc. 4.7.2023 – 3.2.2024

Texas Institute of Science. Downhole Pump: Modification of Pump version V1 for Field Test. Simon Oman. 20.3.2023 - 31.12.2024

DOCTORAL DISERTATION

KOCJAN, Tadej. Coupled model for nucleation and crack growth in elastometric materials: doctoral thesis. Mentor Marko Nagode

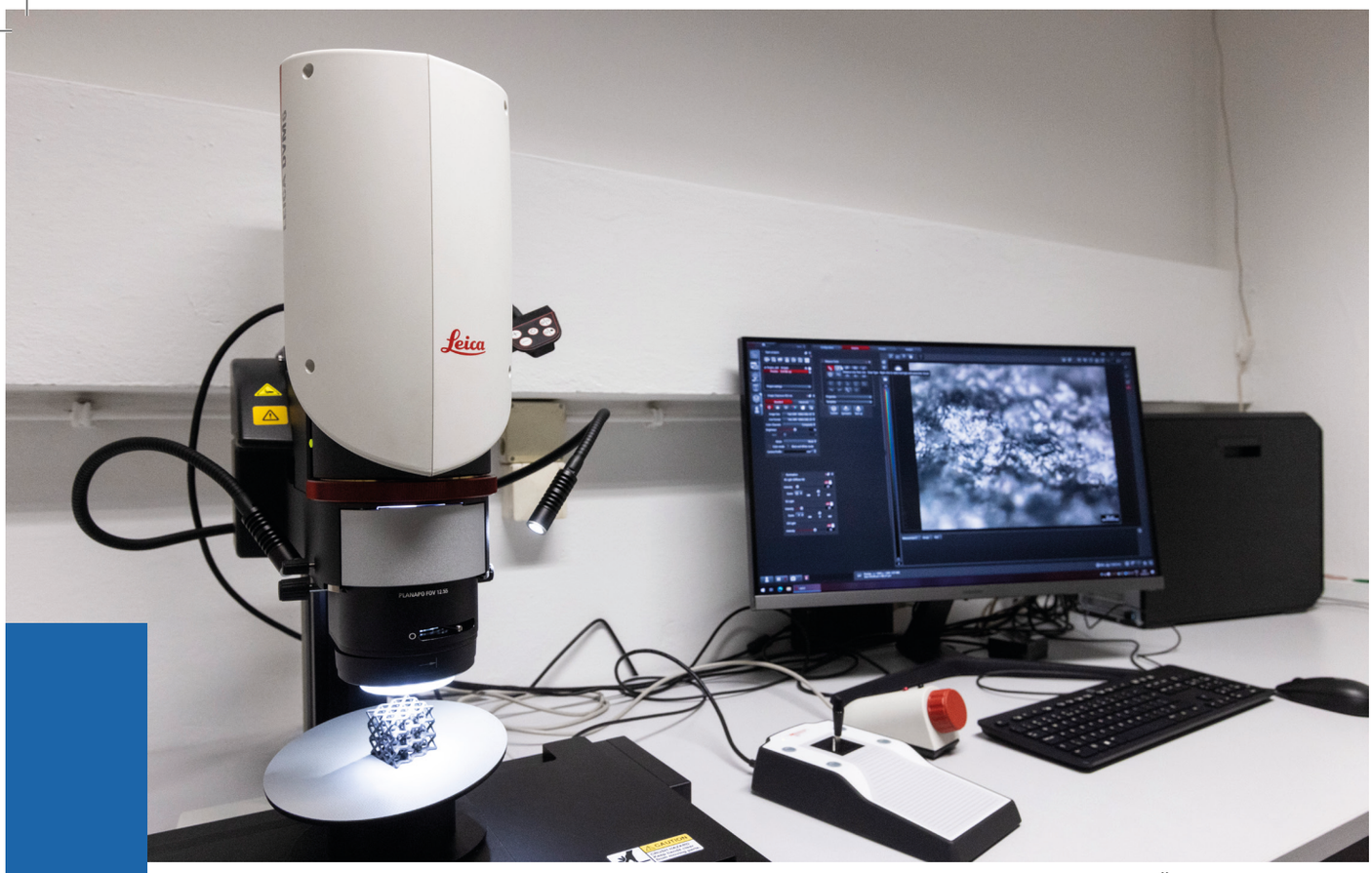

Photo: Željko Stevanić, IFP d.o.o

Laboratory for Structure Evaluation LAVEK

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. dr. Jernej Klemenc

DEPARTMENT MEMBERS Assoc. Prof. dr. Domen Šeruga, Assist. dr. Dejan Tomažinčič, Assist. dr. Peter Zobec, Assist. dr. Aleš Gosar, Assist. Jure Kajbič, Assist. Aljaž Litrop, Nikonov Anatolij, Renata Piščanec

ORIGINAL SCIENTIFIC ARTICLES

KLEMENC, Jernej, HUMAR, Miha, FAJDIGA, Gorazd. Influence of insect damage to the fatigue life of an old larch wood. Construction & building materials. ISSN 1879-0526, 2023, vol. 375, 1 spletni vir (1 datoteka pdf ([13] str.))

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DOCTORAL DISERTATION

ZOBEC, Peter. Fatigue life prediction of products by considering manufacturing history and incremental damage calculation : doctoral thesis. Mentor Jernej Klemenc

PROJECTS

Emri d.o.o. Tlantie- vibroizolacija tirov na betonski plošči. Jernej Klemenc. 4.7.2023 – 3.2.2024

Texas Institute of Science. Downhole Pump: Modification of Pump version V1 for Field Test. Simon Oman. 20.3.2023 - 31.12.2024

Erasmus +. LiDeSuM. Lightweight Design for Sustainable Mobility. Domen Šeruga. 1.10.2022 - 31.12.2023

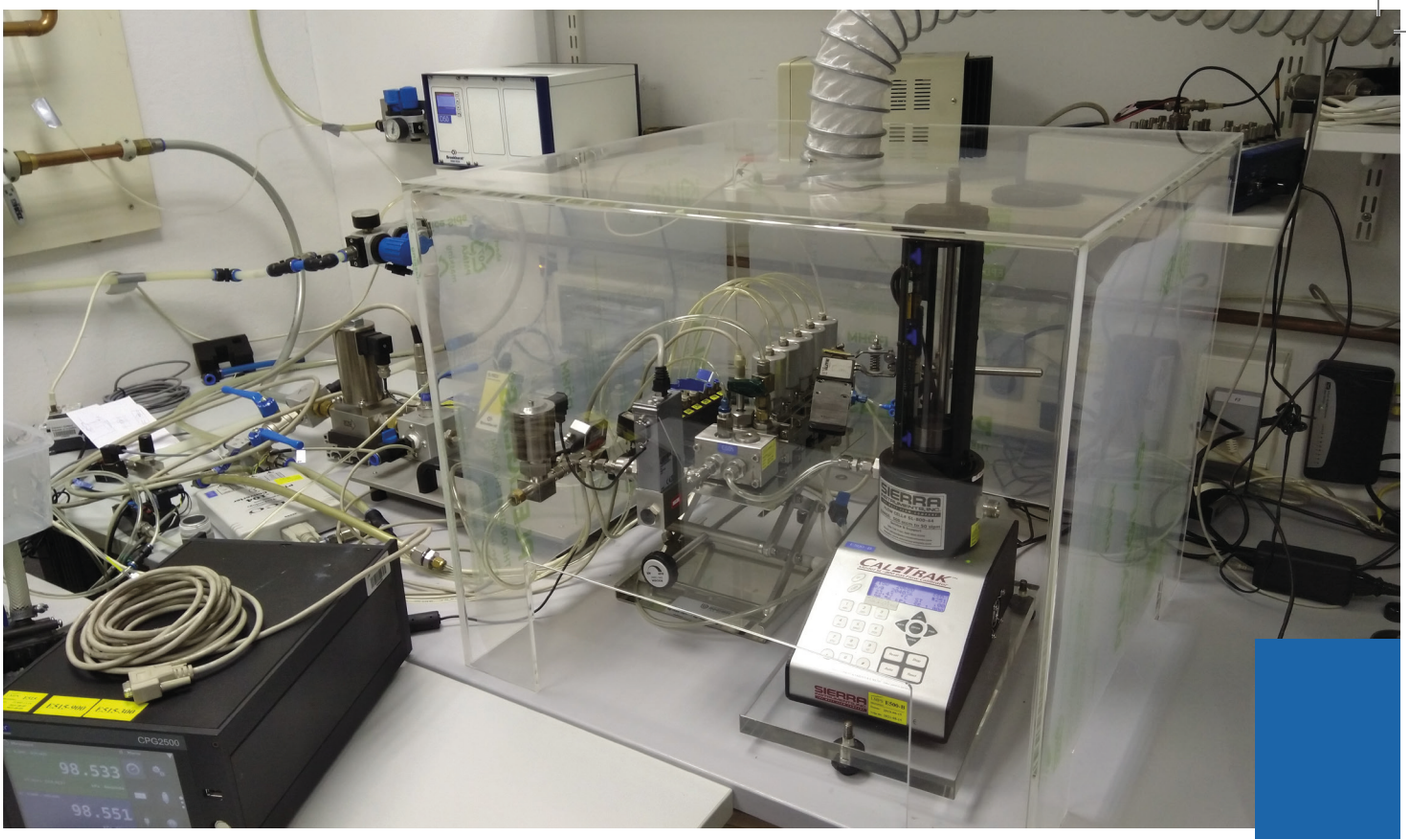
Slovenian Research and Innovation Agency. Development of a cellular composite with the ability to transform cells by a selected activation mechanism. Z2-50081. Dejan Tomažinčič. 01.10.2023 - 30.09.2025

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.



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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. dr. Jože Kutin

DEPARTMENT MEMBERS Assist. Prof. dr. Gregor Bobovnik, Assist. Prof. dr. Andrej Svete, Marjan Pohl, Peter Sambol, Assist. Primož Žibret, Assist. Benjamin Novak, Zdenka Rupič, Katja Tajč

ORIGINAL SCIENTIFIC ARTICLES

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DOCTORAL DISSERTATION

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PROJECTS

Slovenian Research and Innovation Agency. Advanced shock tube system for high-frequency primary dynamic pressure calibration. J2-3054. Andrej Svete. 1.10.2021 - 30.9.2024

The European Association of National Metrology Institutes. MetHyInfra. Metrology infrastructure for high-pressure gas and liquified hydrogen flows. Jože Kutin. 1.6.2021 - 31.5.2024

European Partnership on Metrology. Met4H2. Metrology for the hydrogen supply chain. Gregor Bobovnik. 1.10.2022 – 30.9.2025

Photo: Željko Stevanić, IFP d.o.o.

Laboratory for Heating Technology LTT

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. dr. Iztok Golobič

DEPARTMENT MEMBERS Assist. Prof. dr. Matevž Zupančič, Assist. Prof. dr. Matic Može, Assist. dr. Ivan Sedmak, Assist. Jure Berce, Assist. Mattia Bucci, Assist. Armin Hadžić, Assist. Samo Jereb, Assist. Klara Arhar, Zdenka Rupič

ORIGINAL SCIENTIFIC ARTICLES

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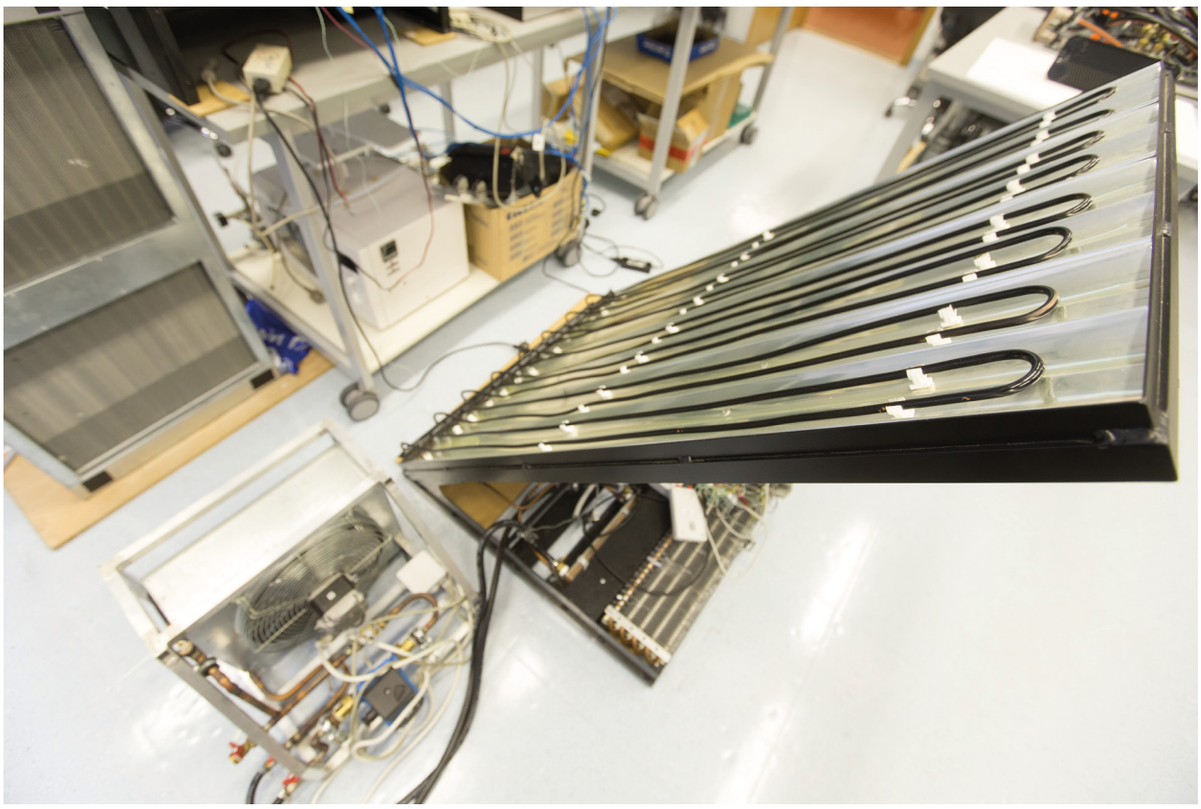

Photo: Željko Stevanić, IFP d.o.o.

PROJECTS

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

Slovenian Research and Innovation Agency. BEST. Boiling Enhancement by Surface Texturing. Iztok Golobič. 1.1.2022 - 31.12.2025

Slovenian Research and Innovation Agency. DroBFuSE. Interfacial phenomena of droplets and bubbles on functionalized surfaces investigated by advanced diagnostics for future environmental and enhanced heat transfer applications. Matevž Zupančič. 1.10.2023 - 30.9.2026

Melamin d.o.o. Razvoj procesnega priključka za identifikacijo snovi in prečrpavanje nevarnih surovin iz avtocistern. Iztok Golobič. 24.5.2023 - 31.12.2023

European Defence Agency. AMALIA. Additive Manufacturing of Metallic Auxetic Structures and Materials for Lightweight Armour. Iztok Golobič. 20.10.2022 - 19.10.2025

DOCTORAL DISSERTATION

ZAKŠEK, Peter. Enhanced heat transfer by pool boiling of binary mixtures on structured surfaces, doctoral thesis. Mentor Iztok Golobič.

Photo: Željko Stevanić, IFP d.o.o

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. dr. Andrej Kitanovski

DEPARTMENT MEMBERS Assist. Prof. dr. Jaka Tušek, Assist. dr. Dall`Olio Stefano, Assist. dr. Urban Tomc, Assist. dr. Žiga Ahčin, Assist. prof. dr. Katja Klinar, Sr. Dev. Nada Petelin, Assist. dr. Miha Bobič, Simon Bogić, Assist. Jan Cerar, Assist. Katja Vozel, Perne Jakob, Assist. Tomaž Pšeničnik, Assist. Blaž Velkavrh, Assist. Mihael Blatnik, Assist. Matevž Cimermančič, Darja Jeločnik, Nika Nežič

ORIGINAL SCIENTIFIC ARTICLES

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PETELIN, Nada, KALIN, Mitjan, KITANOVSKI, Andrej. A conceptual design of a thermal switch capacitor in a magnetocaloric device : experimental characterization of properties and simulations of operating characteristics. JPhys energy. ISSN 2515-7655, Jul. 2023, vol. 5, no. 3, str. 1-15

PROJECTS

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

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

Slovenian Research and Innovation Agency. COOL PRESS. Solid-state cooling with pressure: Developement of barocaloric cooling device. Jaka Tušek. 1.10.2022 - 30.9.2025

Horizon Europe. INDY. Energy Independent and Efficient Deployable Military Camps. Andrej Kitanovski. 1.12.2022 - 31.1.2025

Horizon Europe. SENERGY NETS. Increase the Synergy among different ENERGY NETworkS. Andrej Kitanovski. 1.9.2022 - 31.8.2026

LIFE. 3DIVERSE. Decentralization, Diversity and Dynamic load regulation – novel approaches to tangible energy transition with diversification of production sources. Andrej Kitanovski. 1.10.2022 - 30.9.2025

Infineon Technologies AG, Gorenje d.o.o. Joint Reverse Engineering Analysis. Andrej Kitavnovski. 28.10.2022 - 6.2.2023

Gorenje d.o.o. Raziskovalno razvojno sodelovanje na področju toplotno snovnih procesov v gospodinjskih aparatih (Aneks 2). Andrej Kitanovski. 23.2.2022 - 23.2.2024

MIZŠ - ERA-NET. Cool BatMan. Battery Thermal Managament System Based on High Power Density Digital Microfluidic Magnetocaloric Cooling. Urban Tomc. 1.11.2022 - 31.10.2025

Continental Automotive Technologies. DVE Development elastocaloric heat pump. Jaka Tušek. 28.9.2022 - 15.12.2023

Horizon 2020. SUPERCOOL. Superelastic Porous Structures for Efficient Elastocaloric Cooling. Jaka Tušek. 1.1.2019 - 31.12.2023

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Andrej Kitanovski. 1.1.2024 – 30.6.2026

DOCTORAL DISSERTATION

AHČIN, Žiga. Numerical and experimental analysis of active elastocaloric regenerators: doctoral thesis. Mentor Jaka Tušek

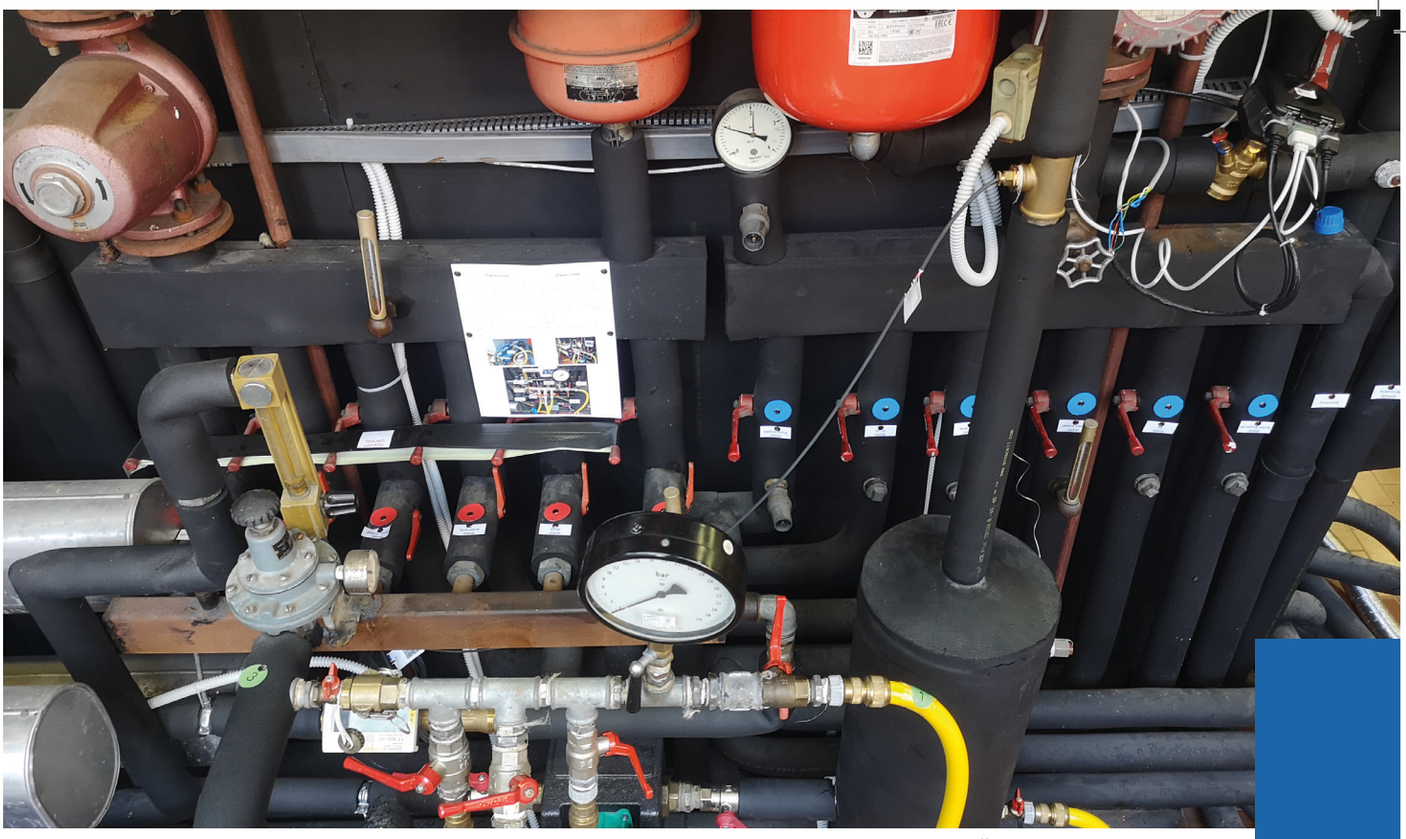

Photo: Željko Stevanić, IFP d.o.o.

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. dr. Uroš Stritih
DEPARTMENT MEMBERS Assoc. Prof. dr. Matjaž Prek, Assist. dr. Eneja Osterman, Assist. Urška Mlakar, Assist. Ajda Kunavar, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

BOŽIČEK, David, KUNIČ, Roman, KRAINER, Aleš, STRITIH, Uroš, DOVJAK, Mateja. Mutual influence of external wall thermal transmittance, thermal inertia, and room orientation on office thermal comfort and energy demand. Energies. ISSN 1996-1073, apr. 2023, vol. 16, iss. 8, art. 3524, str. 1-29

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PROJECTS

Horizon 2020. HEART. Holistic Energy and Architectural Retrofit Toolkit. Uroš Stritih. 1.10.2017 - 31.7.2022

Photo: Željko Stevanić, IFP d.o.o.

Laboratory for Sustainable Technologies in Buildings LOTZ

RESEARCH AREAS

Engineering sciences • Energy engineering • Renewable sources and technologies

DEPARTMENT HEAD Prof. dr. Sašo Medved

DEPARTMENT MEMBERS Assoc. Prof. dr. Ciril Arkar, Assist. dr. Eva Zavrl, Assits. Prof. dr. Primož Poredoš, Assist. MSc Suzana Domjan, Assist. Tej Žižak, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLES

SHAN, He, ZENG, Ziya, YANG, Xinge, POREDOŠ, Primož, YU, Jie, CHEN, Zhihui, WANG, Ruzhu. Harvesting thermal energy and freshwater from air through sorption thermal battery enabled by polyzwitterionic gel. ACS energy letters. ISSN 2380-8195. Nov. 2023, vol. 8, iss. 12, str. 5184–5191

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GALIČIČ, An, ROŽANEC, Jan, KUKEC, Andreja, CARLI, Tanja, MEDVED, Sašo, ERŽEN, Ivan. Identification of indoor air quality factors in Slovenian schools : national cross- sectional study. Processes. ISSN 2227-9717, 2023, vol. 11, iss. 13, str. 1-16

ZAVRL, Eva, TOMC, Urban, EL MANKIBI, Mohamed, DOVJAK, Mateja, STRITIH, Uroš. Parametric study of an active-passive system for cooling application in buildings improved with free cooling for enhanced solidification. Sustainable cities and society. ISSN 2210-6715, Dec. 2023, vol. 99, str. 1-18

DOCTORAL DISSERTATION

ZAVRL, Eva. Improvement of thermal comfort and efficient energy use in buildings based on active-passive systems for overheating reduction : doctoral dissertation. Mentor Uroš Stritih

PROJECTS

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

Slovenian Research and Innovation Agency. Living Walls for Future Sustainable Buildings and Cities. Ciril Arkar. 1.10.2022 - 30.9.2025

AWARDS AND ACHIEVEMENTS

Assist. dr. Eva Zavrl received an Award from the Faculty of Mechanical Engineering to colleagues under the age of 35 for outstanding research achievements.

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.

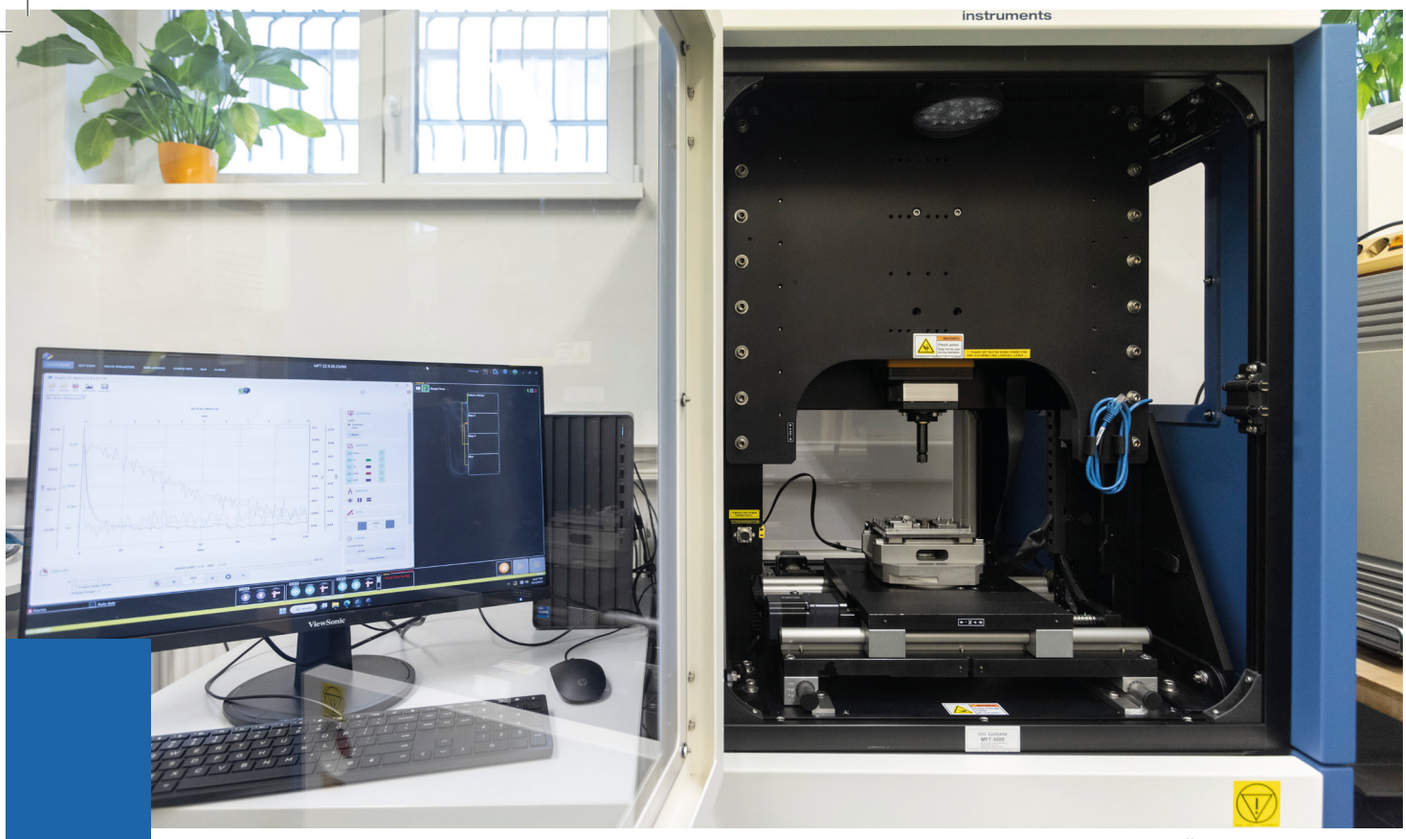

Photo: Željko Stevanić, IFP d.o.o.

Laboratory for tribology and interface nanotechnology TINT

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. dr. Mitjan Kalin

DEPARTMENT MEMBERS Assist. Prof. dr. Marko Polajnar, Assist. Prof. dr. Janez Kogovšek, Assist. dr. Arshad Muhammad Shahid, Assist. dr. Blaž Žugelj, Assist. dr. Lucija Čoga, Assist. Urban Klanjšček, Assist. Sebastjan Matkovič, Assist. Siddiqui Muhammad Shoaib Naseem, Franc Kopač, Assist. Petra Jan, Prashant Gangwani, Irfan Nadeem, Sr. Res. Assoc. Tomaž Požar, Jr. Res. dr. Osolnik Nejc, Assist. dr. Anastasia Sampdurova, Assist. Ajeeb Rayan, Assist. Mark Kuzman, Jožica Sterle

ORIGINAL SCIENTIFIC ARTICLES

BASTAKYS, Lukas, MARCINAUSKAS, Liutauras, MILIEŠKA, Mindaugas, KALIN, Mitjan, KEŽELIS, Romualdas. Tribological properties of Cr2O3, Cr2O3–SiO2–TiO2 and Cr2O3– SiO2–TiO2 -graphite coatings deposited by atmospheric plasma spraying. Coatings. ISSN 2079-6412, Feb. 2023, vol. 13, iss. 2, str. 1-17

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ANGHINONI, Bruno, MALACARNE, Luis Carlos, POŽAR, Tomaž, ASTRATH, Nelson Guilherme Castelli. Applying the angular spectrum representation to calculate the optical force density generated in dielectrics by tightly focused laser beams. International journal of modern physics C. ISSN 0129-1831, Jun. 2023, vol. 34, no. 12, str. 1-26

ASTRATH, Nelson Guilherme Castelli, ANGHINONI, B., FLIZIKOWSKI, Gabriel Antonio Siqueira, ZANUTO, V. S., MALACARNE, Luis Carlos, BAESSO, Mauro L., POŽAR, Tomaž, RAZANSKY, D. The role of electrostriction in the generation of acoustic waves by optical forces in water. Photoacoustics. ISSN 2213-5979, Feb. 2023, vol. 29, str. 1-7

KNEISSL, Lucas M., GONÇALVES, Gil, JOFFE, Roberts, KALIN, Mitjan, EMAMI, Nazanin. Mechanical properties and tribological performance of polyoxymethylene/short cellulose fiber composites. Polymer testing. ISSN 0142-9418, Nov. 2023, vol. 128, str. 1-12

GANGWANI, Prashant, KALIN, Mitjan, EMAMI, Nazanin. Does a compatibilizer enhance the properties of carbon fiber-reinforced composites?. Polymers. ISSN 2073-4360, Dec. 2023, vol. 15, iss. 23, str. 1-18

MARCINAUSKAS, Liutauras, MATHEW, Jacob Shiby, MILIEŠKA, Mindaugas, AIKAS, Mindaugas, KALIN, Mitjan. Influence of graphite content on the tribological properties of plasma sprayed alumina-graphite coatings. Surfaces and interfaces. ISSN 2468-0230, Jun. 2023, vol. 38, str. 1-13

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SIDDIQUI, M. Shoaib Naseem, POGAČNIK, Aljaž, KALIN, Mitjan. Influence of load, sliding speed and heat-sink volume on the tribological behaviour of polyoxymethylene (POM) sliding against steel = Muhammad Shoaib Naseem Siddiqui, Aljaz Pogacnik, Mitjan Kalin. Tribology international. ISSN 0301-679X, Feb. 2023, vol. 178, Part A, str. 1-12

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NADEEM, Irfan, MALOK, Matjaž, KOVAČ, Janez, YAQUB, Talha Bin, CAVALEIRO, A., KALIN, Mitjan. Superior macro-scale tribological performance of steel contacts based on graphene quantum dots in aqueous glycerol. Tribology international. ISSN 1879-2464, Mar. 2023, vol. 181, str. 1-15

ARSHAD, Muhammad Shahid, ČOGA, Lucija, GEUE, Thomas M., KOVAČ, Janez, CRUZ, Sandra, KALIN, Mitjan. The W-cluster reactive sites interaction model for WDLC coatings with ionic liquids. Tribology international. ISSN 0301-679X, 2023, vol. 185, str. 1-11

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PROJECTS

Erasmus+ (Erasmus Mundus). TRIBOS+. Joint European Master on Tribology of Surfaces and Interfaces. Mitjan Kalin. 1.9.2018 – 31.8.2024

Innovative Training Network on Green Tribology – Joint European Doctorate - Horizon 2020. GreenTRIBOS. Mitjan Kalin. 1.1.2020 - 31.12.2023

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

Slovenian Research and Innovation Agency. CODE-GM. Konstruiranje kontaktov na nano skali za visoko zmogljive, energetsko učinkovite in lahke komponente za zeleno mobilnost. Mitjan Kalin. 1.10.2022 – 30.9.2025

COMET K2. InTribology1. Tribology Intelligence – Customized Tribology for Industrial Innovation. Mitjan Kalin. 1.4.2020 – 31.3.2024

Photo: UL FME Archive

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. dr. Franc Majdič

DEPARTMENT MEMBERS Rok Jelovčan, Dev. Nejc Novak, Assist. dr. Ana Trajkovski, Assist. Jan Pustavrh, Jan Bartolj, Robert Horvat, Marko Polak, Jožica Sterle

PROJECTS

Ministry of Agriculture, Forestry and Food - EIP. MOTIKA. Pospešeno okopavanje zelenjave. Franc Majdič. 19.05.2022 - 18.05.2025

Slovenian Research and Innovation Agency. SOFT LOGGING. Mehko robotski hidravlični vpenjalni sistem hlodovine . Franc Majdič. 1.10.2023 - 30.9.2026

ORIGINAL SCIENTIFIC ARTICLES

TRAJKOVSKI, Ana, NOVAK, Nejc, PUSTAVRH, Jan, KALIN, Mitjan, MAJDIČ, Franc. Performance of polymer composites lubricated with glycerol and water as green lubricants. Applied sciences. ISSN 2076-3417, 2023, vol. 13, iss. 13, str. 1-15

NOVAK, Nejc, TRAJKOVSKI, Ana, KALIN, Mitjan, MAJDIČ, Franc. Degradation of hydraulic system due to wear particles or medium test dust. Applied sciences. ISSN 2076-3417, 2023, vol. 13, iss. 13, str. 1-20

PUSTAVRH, Jan, HOČEVAR, Marko, PODRŽAJ, Primož, TRAJKOVSKI, Ana, MAJDIČ, Franc. Comparison of hydraulic, pneumatic and electric linear actuation systems. Scientific reports. ISSN 2045-2322, 2023, vol. 13, str. 1-13

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BARBIŠ, Domen, NOVAK, Nejc, TRAJKOVSKI, Ana, MAJDIČ, Franc. Vpliv čistoče olja na trajnost delovanja hidravličnega potnega ventila. Ventil : revija za fluidno tehniko in avtomatizacijo. ISSN 1318-7279, Apr. 2023, letn. 29, št. 2, str. 96-104

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.

Photo: Željko Stevanić, IFP d.o.o

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. dr. Edvard Govekar

DEPARTMENT MEMBERS Assist. Prof. dr. Primož Potočnik, Assist. dr. Andrej Jeromen, Assist. Jaka Peternel, Assist. Jaka Simončič, Rehman Hammad Ur, Assist. Anish Nair, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

SELVARAJAN, L., VENKATARAMANAN, K., NAIR, Anish, SRINIVASAN, V.P. Simultaneous multi-response Jaya optimization and Pareto front visualization in EDM drilling of MoSi2 –SiC composites. Expert systems with applications. ISSN 0957-4174, Nov. 2023, vol. 230, str. 1-16

SELVARAJAN, L., VENKATARAMANAN, K., NAIR, Anish, CHOUDHURY, Bishub. Si3N4-TiN rotary EDM optimization by Mo-Jaya algorithm with Pareto optimal solution, analysis of micro-structural and geometrical tolerances. Journal of mechanical behavior of biomedical materials. ISSN 1878-0180, Sep. 2023, vol. 145, str. 1-17

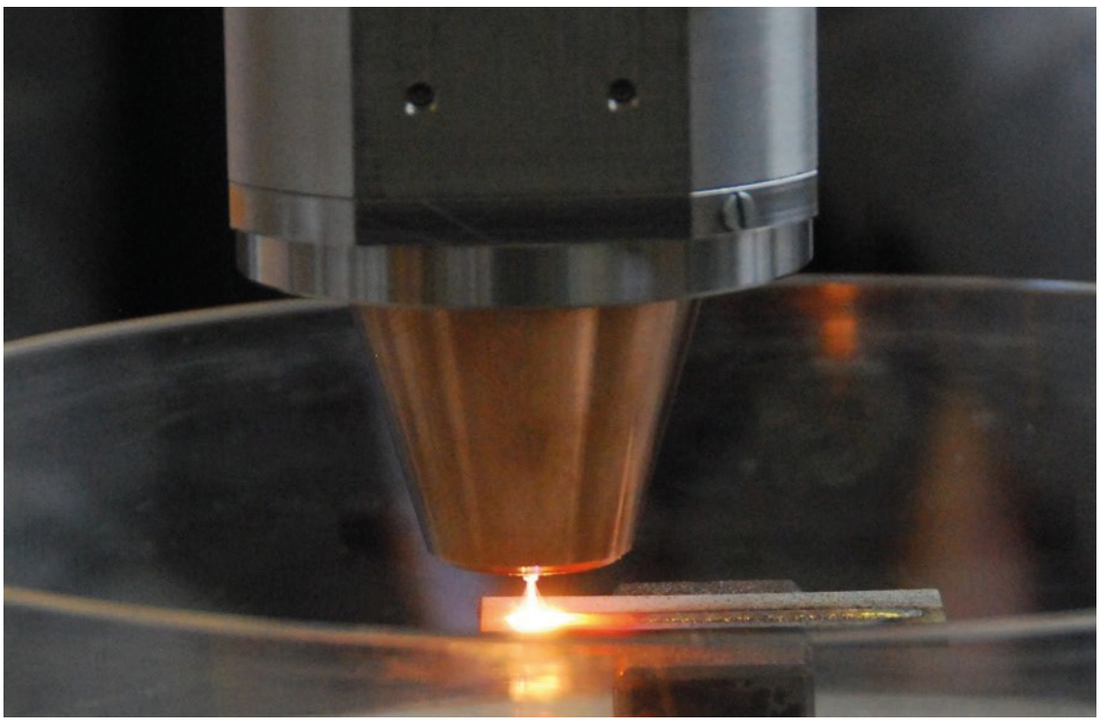


Photo: Željko Stevanić, IFP d.o.o

PROJECTS

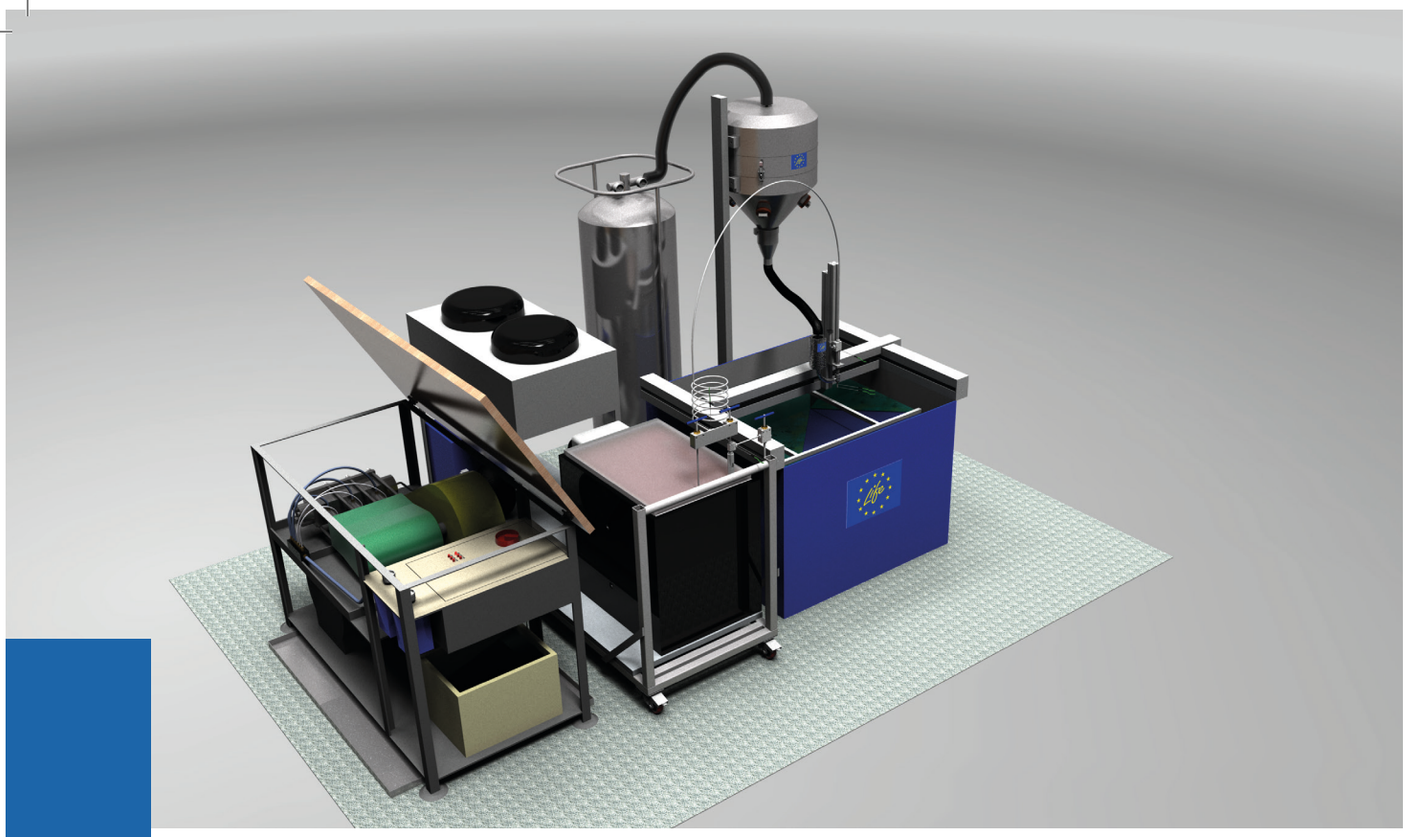
Horizon Europe. SEAMAC. Strengthening the Excellence of Additive Manufacturing Capabilities. Edvard Govekar. 1.1.2023 - 31.12.2025

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

• Non-traditional machining processes • Additive manufacturing and post-processing • Micromanufacturing technologies

DEPARTMENT HEAD Assoc. Prof. dr. Joško Valentinčič

DEPARTMENT MEMBERS Assist. Prof. dr. Andrej Lebar, Assist. Prof. dr. Henri Orbanić, Assist. Prof. dr. Izidor Sabotin, Assist. dr. Marko Jerman, Pavel Drešar, Edaklavan Koroth, Jithinraj, Tanja Plestenjak

ORIGINAL SCIENTIFIC ARTICLES

ŠADL, Matej, PRAH, Uroš, KOVACOVA, Veronika, DEFAY, Emmanuel, ROJAC, Tadej, LEBAR, Andrej, VALENTINČIČ, Joško, URŠIČ NEMEVŠEK, Hana. Multifunctional flexible ferroelectric thick-film structures with energy storage, piezoelectric and electrocaloric performance. Journal of materials chemistry. C, Materials for optical and electronic devices. ISSN 2050-7534, 2023, vol. 11, str. 10058-10068

PROJECTS

Horizon 2020 – ERA Chairs. COMPETE. Chair Of Micro Process Engineering and TEchnology. Joško Valentinčič. 1.9.2019 – 31.12.2024

Horizon Europe. SEAMAC. Strengthening the Excellence of Additive Manufacturing Capabilities. Joško Valentinčič. 1.1.2023 - 31.12.2025

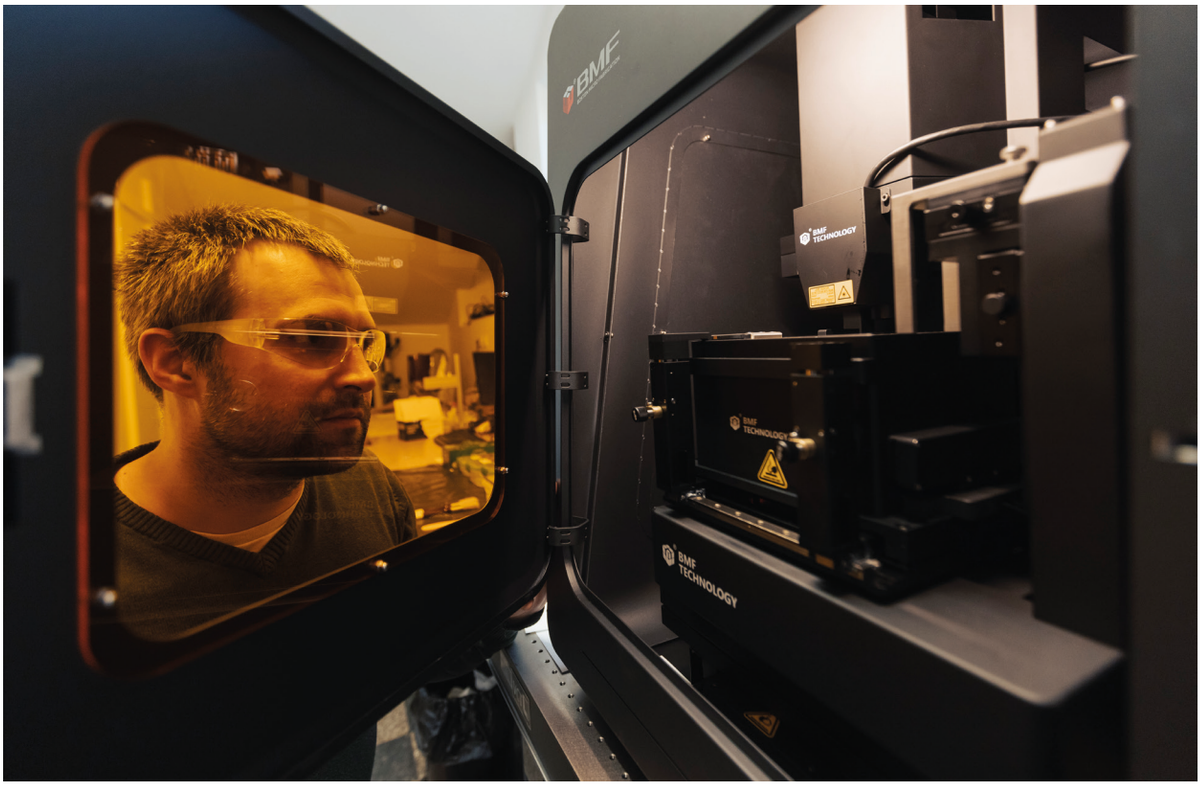


Photo: Željko Stevanić, IFP d.o.o.

PATENTS

KITANOVSKI, Andrej, TOMC, Urban, KLINAR, Katja, VALENTINČIČ, Joško, MAJDIČ, Franc, SABOTIN, Izidor, MENCINGER, Jure. Method for heat transfer in the embedded structure of a heat regenerator and the design thereof : patent CN 112654778 B, 2023-08-15. Beijing: China National Intellectual Property Administration (CNIPA), 2023.

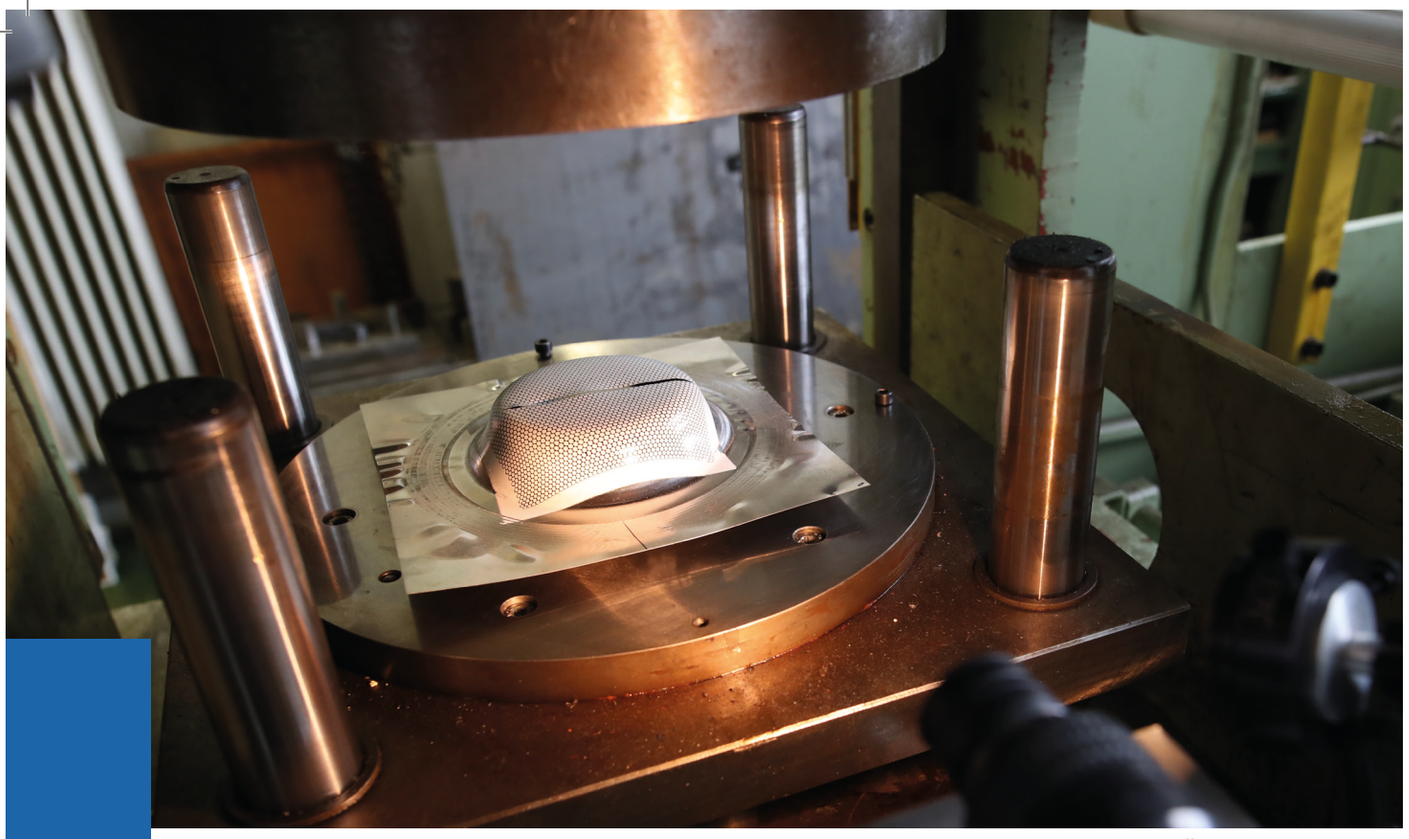


Photo: Željko Stevanić, IFP d.o.o.

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

ORIGINAL SCIENTIFIC ARTICLE

SEVŠEK, Luka, ŠEGOTA, Sandi Baressi, CAR, Zlatan, PEPELNJAK, Tomaž. Determining the influence and correlation for parameters of flexible forming using the random forest method. Applied soft computing. ISSN 1568-4946, 2023, vol. 144, str. 1-18

SATOŠEK, Roman, PEPELNJAK, Tomaž, STARMAN, Bojan. Characterisation of out-of-plane shear behaviour of anisotropic sheet materials based on indentation plastometry. International journal of mechanical sciences. ISSN 0020-7403, Sep. 2023, vol. 253, str. 1-15

PROJECTS

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

AWARDS AND ACHIEVEMENTS

Assist. Luka Sevšek received an award of the Faculty of Mechanical Engineering for excellence in teaching.

Laboratory for Handling, Assembly and Pneumatics LASIM

RESEARCH AREAS

• Industry 4.0 and 5.0 • Smart Factories • Digital Twins of Production and Logistics processes • IoT and 5G Technologies in Smart Factories • LPM-Lean Production Management Software • Production Logistics and Resources • Assembly and Handling • Smart Manual Workplaces and Ergonomics • Smart Hydraulic and Pneumatic Systems • Piezo engineering

DEPARTMENT HEAD Prof. dr. Niko Herakovič

DEPARTMENT MEMBERS Assist. Prof. dr. Marko Šimic, Assist. Prof. dr. Mihael Debevec, Assist. Prof. dr. Miha Pipan, Assist. dr. Hugo Zupan, Assist. dr. Matevž Resman, Edo Adrović, Assist. Denis Jankovič, Assist. Jure Filip Vuzem, Blaž Dobravec, Tanja Plestenjak

ORIGINAL SCIENTIFIC ARTICLE

JANKOVIČ, Denis, ŠIMIC, Marko, HERAKOVIČ, Niko. A data-driven simulation and Gaussian process regression model for hydraulic press condition diagnosis. Advanced engineering informatics : the science of supporting knowledge-intensive activities. ISSN 1474-0346, Jan. 2024, vol. 59, str. 1-22

PROJECTS

Slovenian Research and Innovation Agency. Research on the reliability and efficiency of edge computing in a smart factory using 5G technologies. Niko Herakovič. 1.10.2022 -30.9.2025

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Marko Šimic. 1.1.2024 – 30.6.2026

Horizon Europe. STAGE. Sustainable Transition to the Agile and Green Enterprise. Marko Šimic. 1.6.2022 - 31.5.2025

Horizon Europe. INNO2MARE. Strengthening the capacity for excellence of Slovenian and Croatian innovation ecosystems to support the digital and green transitions of maritime regions. Marko Šimic. 1.1.2023 – 31.12.2026

AWARDS AND ACHIEVEMENTS

Assist. Denis Jankovič received an Award from the Faculty of Mechanical Engineering to colleagues under the age of 35 for outstanding research achievements.

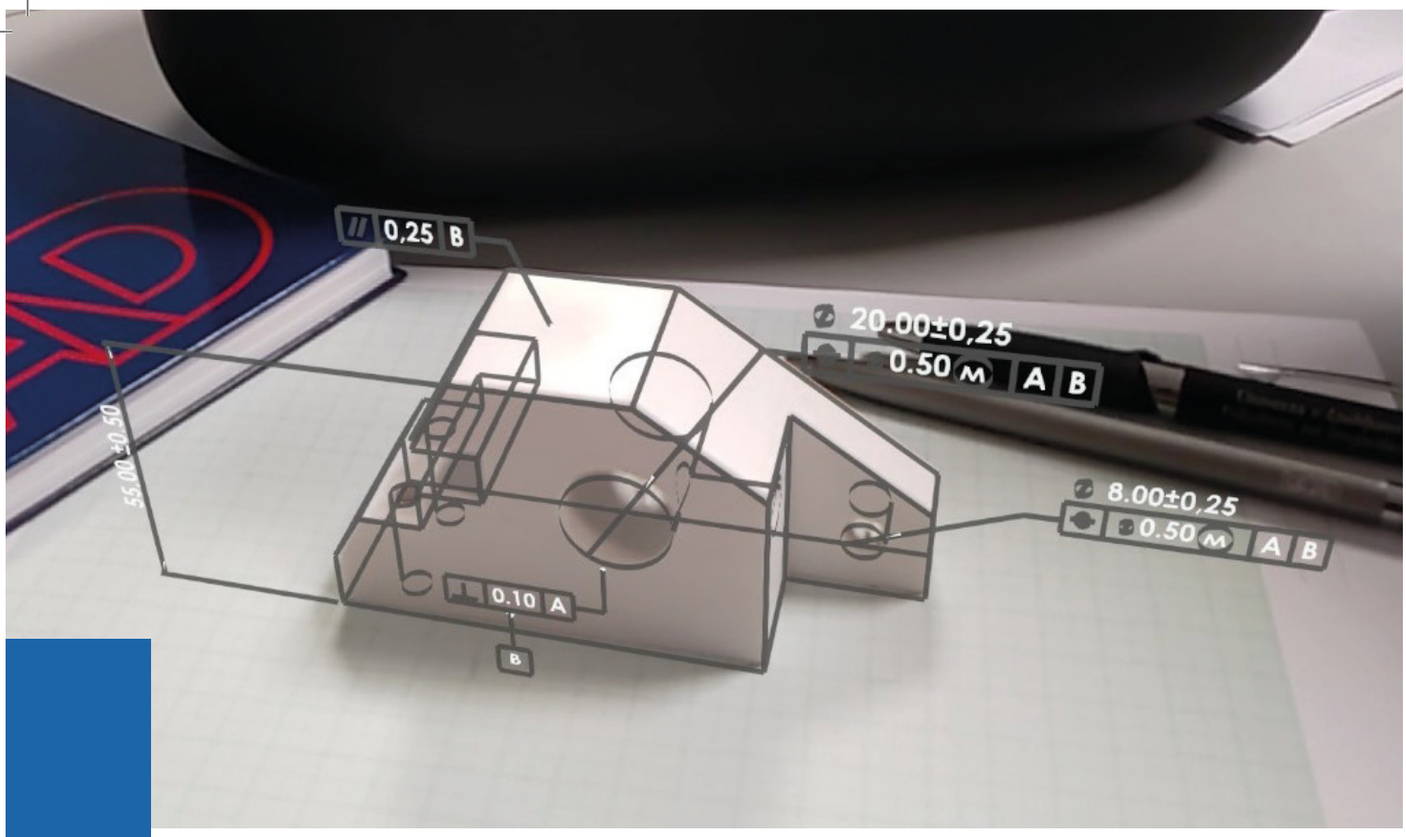
Prof. Dr. Niko Herakovič, Assoc. Prof. Dr. Miha Pipan, and Dr. Hugo Zupan received a Silver Recognition for the Digital LEAN Adria Dom Innovation, by the Chamber of Commerce and Industry of Slovenia, the Ministry of Economic Development and Technology, and the SPIRIT Agency.

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 • ComputerAided 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. dr. Nikola Vukašinović

DEPARTMENT MEMBERS Assoc. Prof. dr. Leon Kos, Assist. Prof. dr. Janez Benedičič, Assist. dr. Vanja Čok, Assist. dr. Ivan Demšar, Assist. dr. Pavel Tomšič, Assist. dr. Mojškerc Bor, Assist. dr. Ivona Vasileska, dr. Jernej Kovačič, Assist. dr. Stephan Costea, Matjaž Šubelj, Assist. Matic Brank, Assist. Luka Samsa, Aleš Durjava,Mateja Maffi, Alenka Maffi, Leon Bogdanovič, Prof. dr. Janez Povh, assist. Prof. dr. Tadej Kanduč, Assist. Prof. dr. Aleksander Grm, Assist. dr. Uroš Urbas, Assist. Daria Vlah, Gregor Simič, Gašper Omahen, Renata Piščanec

ORIGINAL SCIENTIFIC ARTICLES

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KODŽOMAN, Duje, PAVKO-ČUDEN, Alenka, ČOK, Vanja. Emotions and fashion: how garments induce feelings to the sensory system. Industria textilæa. ISSN 1222-5347, 2023, vol. 74, no. 3, str. 346-355

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FAITSCH, M., EICH, T., HARRER, Friedrich Harrer, WOLFRUM, E., BRIDA, Dominik, DAVID, Pierre, DUNNE, Mike, GIL, L., LABIT, B., STROTH, U., COSTEA, Stefan, DRENIK, Aleksander,

GYERGYEK, Tomaž, KOVAČIČ, Jernej, PANJAN, Matjaž, ZAPLOTNIK, Rok, et al., the ASDEX- Upgrade Team, the Eurofusion MST1 Team. Analysis and expansion of the quasi-continuous exhaust (QCE) regime in ASDEX Upgrade. Nuclear fusion. ISSN 1741-4326, Jul. 2023, vol. 63, no. 7, str. 1-15

HENDERSON, Stuart, BERNERT, M., BRIDA, Dominik, CAVEDON, M., DAVID, Pierre, DUX, R., FÉVRIER, Olivier, JARVINEN, A., KALLENBACH, A., KOMM, Michael, COSTEA, Stefan, DRENIK, Aleksander, GYERGYEK, Tomaž, KOVAČIČ, Jernej, PANJAN, Matjaž, ZAPLOTNIK, Rok, et al., the ASDEX-Upgrade Team, the Eurofusion MST1 Team. Divertor detachment and reattachment with mixed impurity seeding on ASDEX Upgrade. Nuclear fusion. ISSN 1741-4326, Avg. 2023, vol. 63, no. 8, str. 1-13

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KOMM, Michael, FAITSCH, M., HENDERSON, Stuart, BERNERT, M., BRIDA, Dominik, FÉVRIER, Olivier, JARVINEN, A., SILVAGNI, Davide, TSKHAKAYA, David, COSTEA, Stefan, DRENIK, Aleksander, GYERGYEK, Tomaž, KOVAČIČ, Jernej, PANJAN, Matjaž, ZAPLOTNIK, Rok, et al., the ASDEX-Upgrade Team, the Eurofusion MST1 Team. Mitigation of divertor edge localised mode power loading by impurity seeding. Nuclear fusion. ISSN 1741-4326, Dec. 2023, vol. 63, no. 12, str. 1-12

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MEINERI, C., MUSCENTE, Paola, THEILER, C., GALASSI, Davide, GYERGYEK, Tomaž, COSTEA, Stefan, KOVAČIČ, Jernej, DRENIK, Aleksander, ZAPLOTNIK, Rok, et al., TCV team1, the MST1 team. Numerical study of fully baffled Super-X L-mode discharges on TCV. Nuclear materials and energy. ISSN 2352-1791, Mar. 2023, vol. 34, str. 1-7

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HRGA, Timotej, POVH, Janez. Solving SDP relaxations of Max-Cut problem with large number of hypermetric inequalities by L-BFGS-B. Optimization letters. ISSN 1862-4472, June 2023, vol. 17, iss. 5, str. 1201-1213

HANSEN, Søren Kjer, NIELSEN, Stefan Kragh, STOBER, Jörg, COSTEA, Stefan, DRENIK, Aleksander, GYERGYEK, Tomaž, KOVAČIČ, Jernej, PANJAN, Matjaž, ZAPLOTNIK, Rok, et al., EUROfusion MST1 Team and ASDEX Upgrade Team. Relativistic analysis of upper hybrid wave propagation and trapping. Physics of plasmas. ISSN 1070-664X. Apr. 2023, vol. 30, iss. 4, str. 1-13

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ZORKO, Damijan, ŠTIGLIC, Jan, ČERNE, Borut, VUKAŠINOVIĆ, Nikola. The effect of center distance error on the service life of polymer gears. Polymer testing. ISSN 0142-9418, Jun. 2023, vol. 123, str. 1-13

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PROJECTS

Erasmus+. SCTrain. Supercomputing knowledge partnership. Pavel Tomšič. 1.12.2020 – 30.11.2023

Erasmus+. PRO HACKIN'. Product Hackathons for Innovative Development. Nikola Vukašinović 1.11.2021 - 1.11.2024

Erasmus+. CResDET. Crisis-Resistant Digital Education and Training. Nikola Vukašinović. 1.4.2021 - 31.3.2023

Horizon 2020. EUROfusion. Implementation of activities described in the Roadmap to Fusion during Horizon Europe through a joint programme of the members of the EUROfusion consortium. Nikola Vukašinović. 1.1.2021 - 31.12.2025

Horizon 2020. EUMaster4HPC. European Master for High Performance Computing. Janez Povh. 1.1.2022 - 31.12.2025

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. 1.12.2020 – 30.11.2023

International Fusion Energy Organization. Associate for shaping optimization of Internal Components. Nikola Vukašinovič. 1.3.2020 - 29.2.2024

Horizon Europe. Plasma-PEPSC. Plasma Exascale-Performance Simulations CoE – Pushing flagship plasma simulations codes to tackle exascale-enabled Grand Challenges via performance optimisation and codesign. Leon Kos. 1.2.2023 – 31.12.2026

International Fusion Energy Organization. ITER Pulse Design Simulator Workflow. Leon Kos. 24.1.2022 – 23.11.2023

Photo: UL FME Archive

Slovenian Research and Innovation Agency. Fast evaluation of tooth bending fatigue strength of polymer gears. Damijan Zorko. 1.10.2021 – 30.9.2023

Slovenian Research and Innovation 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

Horizon Europe. EXCELLERAT P2. European Centre of Excellence for Engineering Applications on HPC and associated technologies. Matic Brank. 1.1.2023 - 31.12.2026

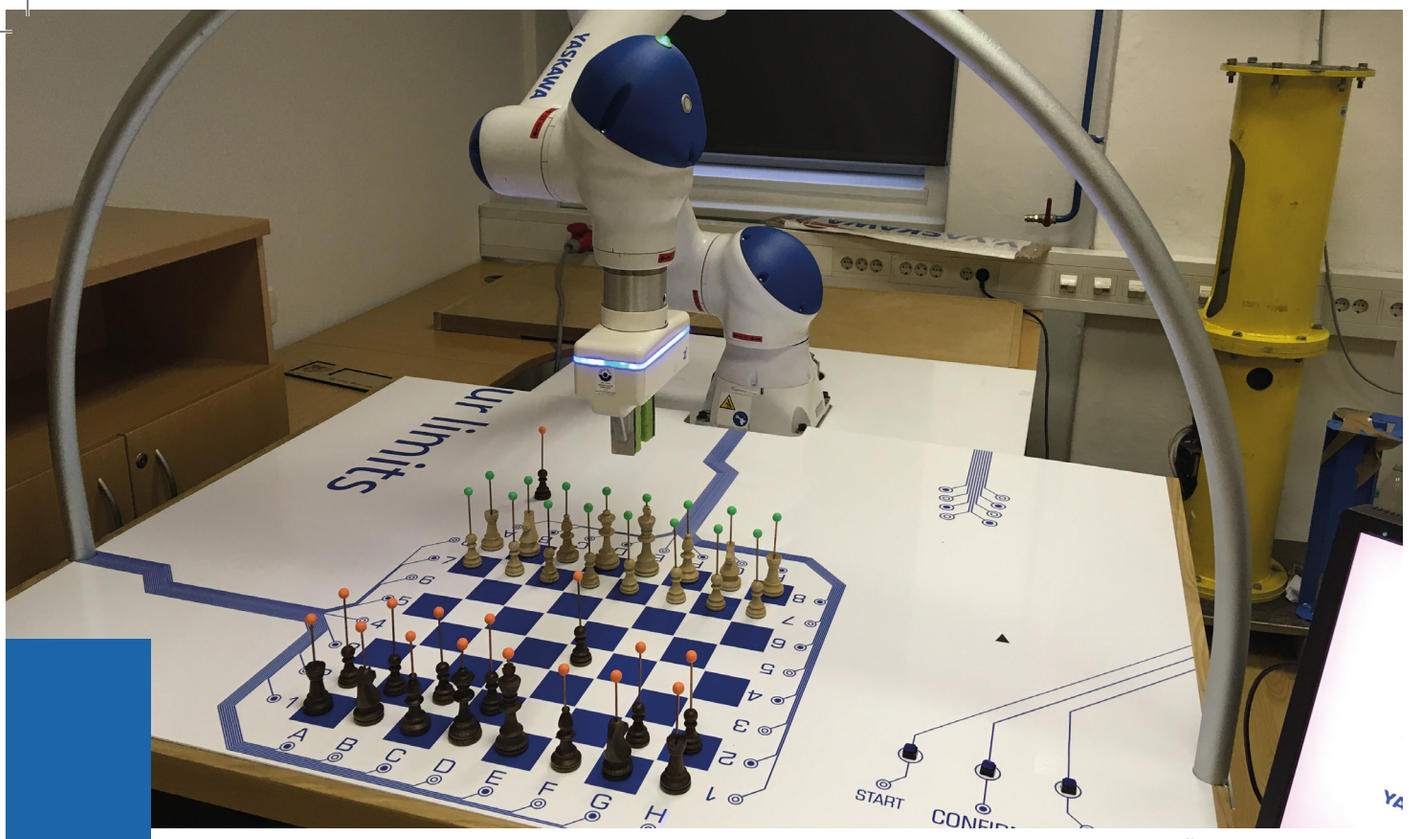

Photo: Željko Stevanić, IFP d.o.o.

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. dr. Boris Jerman
DEPARTMENT MEMBERS Assist. dr. Jurij Hladnik, MSc Franc Resman, Metod Čuk, Renata Piščanec

ORIGINAL SCIENTIFIC ARTICLES

HLADNIK, Jurij, JERMAN, Boris. Contribution of various loads to the convex shape of rock wool insulation slabs during production. Materials. ISSN 1996-1944, 2023, vol. 16, no. 19, str. 1-14

HLADNIK, Jurij, SVENŠEK, Daniel, JERMAN, Boris, SUPEJ, Matej. Mass point versus whole-body modelling of skiers for performance evaluation in alpine skiing. Scandinavian journal of medicine & science in sports. ISSN 0905-7188, Jun. 2023, vol. 33, iss. 6, str. 943-953

EKREN, Banu Y., LERHER, Tone, KÜÇÜKYAŞAR, Melis, JERMAN, Boris. Cost and performance comparison of tier-captive SBS/RS with a novel AVS/RS/ML. International Journal of Production Research. ISSN 0020-7543, 2023, str. 1-15

PROJECTS

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

Tajfun Planina d.o.o. Raziskovalno delo na področju transportnih sredstev in transportnih sistemov s poudarkom na izdelavi programa za krivulje nosilnosti nakladalnih žerjavov in na projektu dinamične tehtnice. Boris Jerman. 1.5.2023 - 30.11.2023

Tajfun Planina d.o.o. Raziskovalno delo na področju transportnih sredstev in transportnih sistemov. Boris Jerman. 1.1.2022 - 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.

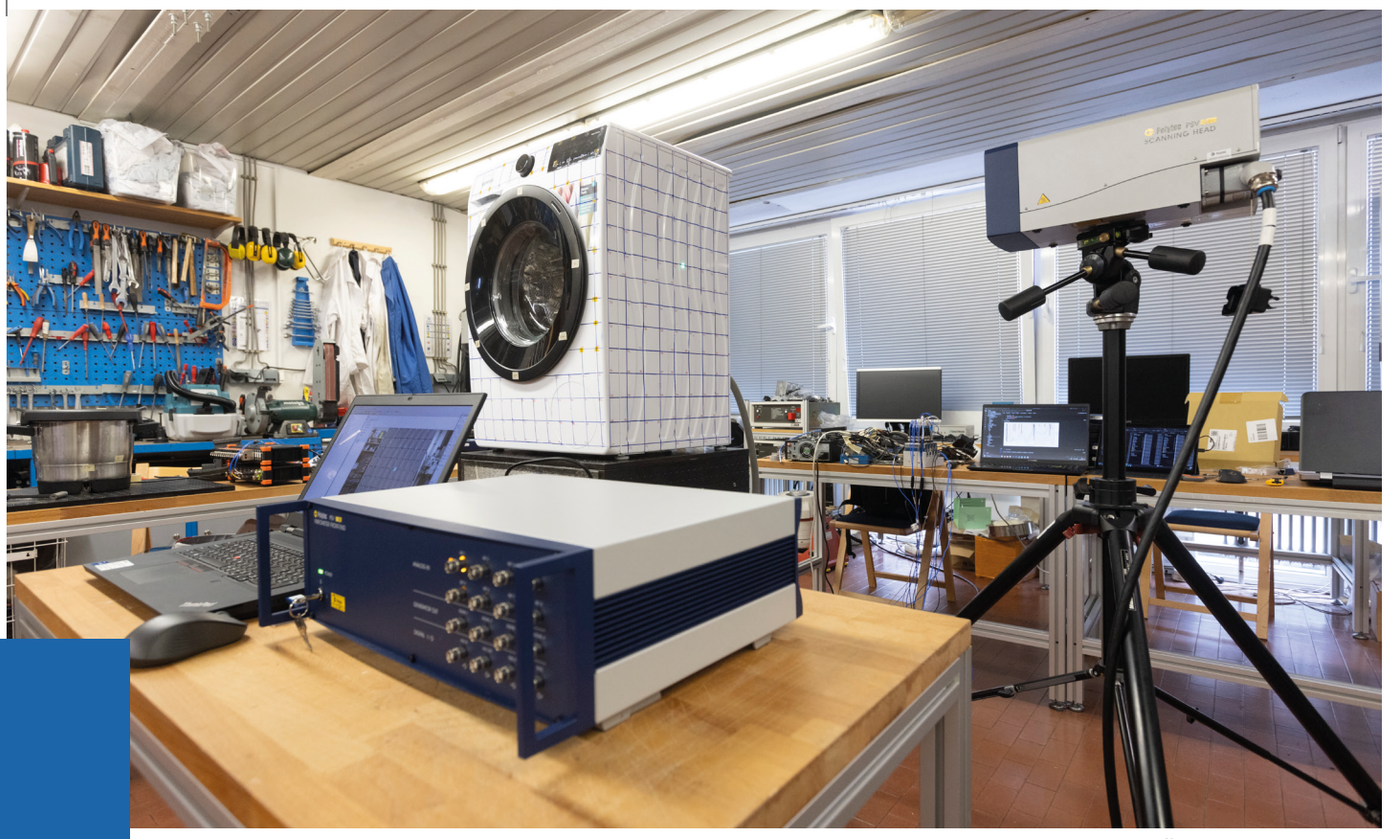

Photo: Željko Stevanić, IFP d.o.o.

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. dr. Miha Boltežar

DEPARTMENT MEMBERS Prof. dr. Janko Slavič, Prof. dr. Gregor Čepon, Assist. Prof. dr. Martin Česnik, dr. Vitoslav Bratuš, Assist. dr. Aleš Mihelič, Assist. dr. Tibor Barši Palmić, Assist. dr. Miha Kodrič, Assist. dr. Miha Pogačar, Assist. dr. Domen Gorjup, Assist. dr. Klemen Zaletelj, Assist. dr. Martin Furlan, Assist. dr. Domen Ocepek, Assist. Aleš Zorman, Assist. Tilen Košir, Assist. Gašper Krivic, Assist. Tim Vrtač, Assist. Jure Korbar, Assist. Luka Novak, Domen Kocbek, Gregor Ševerkar, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

KOŠIR, Tilen, SLAVIČ, Janko. Manufacturing of single-process 3D-printed piezoelectric sensors with electromagnetic protection using thermoplastic material extrusion. Additive manufacturing. ISSN 2214-8604, Jul. 2023, vol. 73, str. 1-12

ČESNIK, Martin, SLAVIČ, Janko, BOLTEŽAR, Miha. Accelerated vibration-fatigue characterization for 3D-printed structures : application to fused-filament-fabricated PLA samples. International journal of fatigue. ISSN 0142-1123, 2023, vol. 171, str. 1-12

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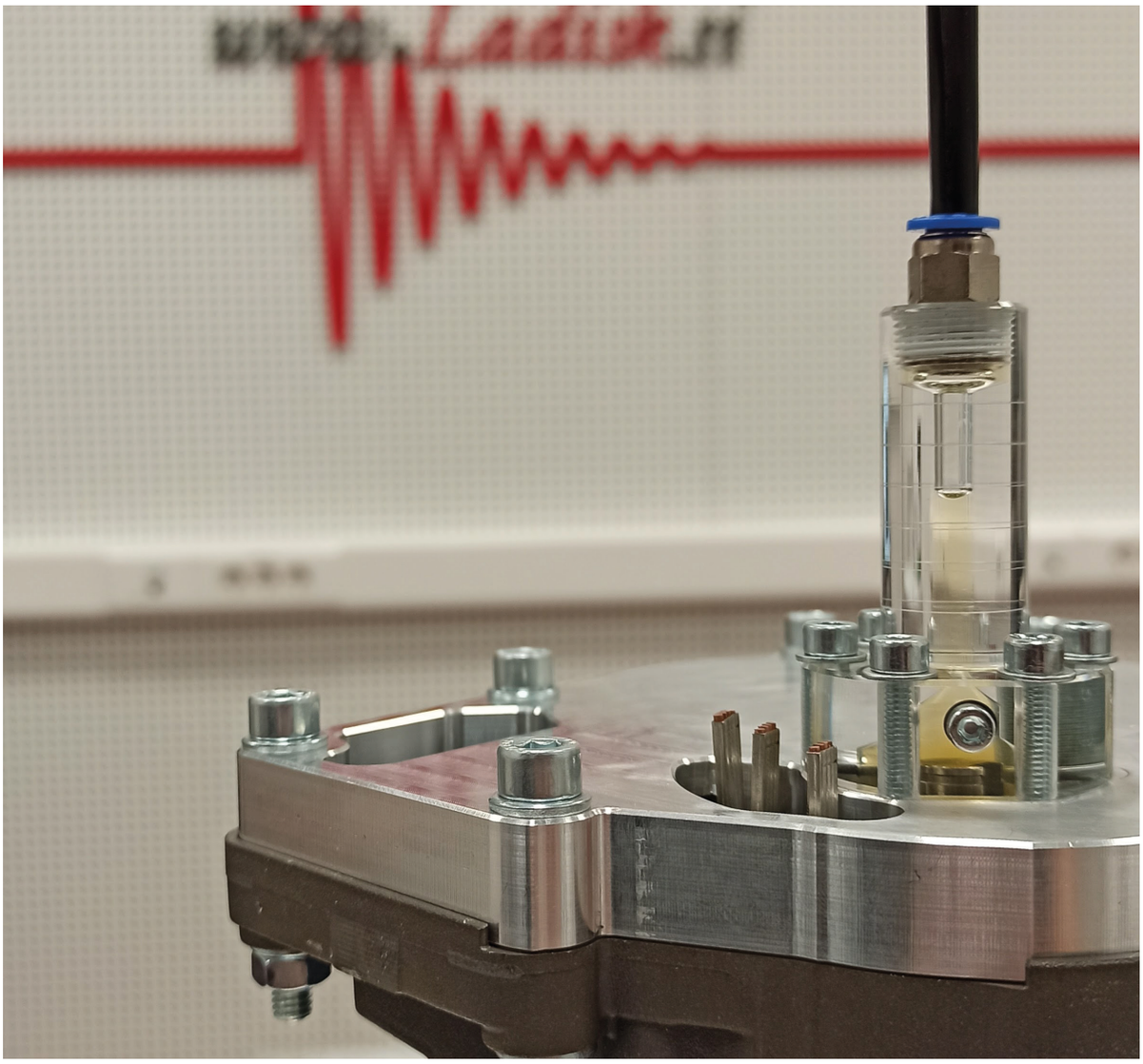

Photo: UL FME Archive

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OCEPEK, Domen, VRTAČ, Tim, ČEPON, Gregor, BOLTEŽAR, Miha. Estimation of the frequency response functions for operational assemblies using independent source characterization. Mechanical systems and signal processing. ISSN 0888-3270, Jan. 2023, vol. 182, str. 1-14

ZALETEL], Klemen, GORJUP, Domen, SLAVIČ, Janko, BOLTEŽAR, Miha. Multi-level curvature-based parametrization and model updating using a 3D full-field response. Mechanical systems and signal processing. ISSN 0888-3270, 2023, vol. 187, str. 1-15

ZORMAN, Aleš, SLAVIČ, Janko, BOLTEŽAR, Miha. Vibration fatigue by spectral methods : a review with open-source support. Mechanical systems and signal processing. ISSN 1096-1216, May 2023, vol. 190, str. 1-23

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KORBAR, Jure, OCEPEK, Domen, ČEPON, Gregor, BOLTEŽAR, Miha. Training artificial neural networks using substructuring techniques : application to joint identification. Mechanical systems and signal processing. ISSN 1096-1216, Sep. 2023, vol. 198, str. 1-18

ZALETEL], Klemen, SLAVIČ, Janko, ŠONC, Jaša, BOLTEŽAR, Miha. Strain experimental modal analysis of an Euler–Bernoulli beam based on the thermoelastic principle. Mechanical systems and signal processing. ISSN 1096-1216, Oct. 2023, vol. 201, str. 1-11

TOMAC, Ivan, SLAVIČ, Janko, GORJUP, Domen. Single-pixel optical-flow-based experimental modal analysis. Mechanical systems and signal processing. ISSN 1096-1216, Nov. 2023, vol. 202, str. 1-19

KRIVIC, Gašper, SLAVIČ, Janko. Simultaneous non-contact identification of the elastic modulus, damping and coefficient of thermal expansion in 3D-printed structures. Polymer testing. ISSN 0142-9418, Aug. 2023, vol. 125, str. 1-14

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RAZPOTNIK, Matej, BISCHOF, Thomas, BOLTEŽAR, Miha. The dynamics of tapered-roller bearings – a bottom-up validation study. Strojniški vestnik. ISSN 0039-2480, Jul.-Aug. 2023, vol. 69, no. 7/8, str. 289-298

PROJECTS

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

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

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

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

Mahle d.o.o. Modularni odprtokodni sistem za končno kontrolo izdelkov brez izmeta in za obdelavo velikih podatkov. Janko Slavič. 24.11.2023 - 30.6.2025

Domel d.o.o. Modularni odprtokodni sistem za končno kontrolo izdelkov brez izmeta in za obdelavo velikih podatkov. Janko Slavič. 10.11.2023 - 30.6.2025

Horizon Europe. DiCiM. Digitalised Value Management for Unlocking the potential of the Circular Manufacturing Systems with integrated digital solutions. Gregor Čepon. 1.1.2023 - 31.12.2026

Norway Grants. LEAP. Learning and demonstration alliance for designing and manufacturing sustainable industrial packaging from alternative lignocellulosic biomass. Gregor Čepon. 1.10.2022 - 30.4.2024

Iskra ISD Strugarstvo. Razvoj sistema za avtomatsko merjenje obrabe orodja. Gregor Čepon. 1.3.2022 - 31.1.2023

Gorenje d.o.o. Razvojno raziskovalno sodelovanje ter zakup kapacitet za numerične analize ter izvedbo meritev in preskusov. Gregor Čepon. 27.6.2021 - 27.6.2025

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Janko Slavič. 1.1.2024 – 30.6.2026

PATENTS

ČEPON, Gregor, KATANEC, Jože, ŠTIMULAK, Mitja, BOLTEŽAR, Miha, STARC, Blaž, BREGAR, Tomaž, MIHELIČ, Aleš. Method for natural frequency detection in a drum washing machine : EP3819417 (B1), 2023-01-11. Munich: European Patent Office, 2023

DOCTORAL DISSERTATION

BARŠI PALMIĆ, Tibor. Dynamic dielectric actuator 3D printed with thermoplastic material extrusion : doctoral thesis. Mentor Janko Slavič

OCEPEK, Domen. Experimental dynamic models of substructures in transfer path analysis methods : doctoral thesis. Mentor Gregor Čepon

KODRIČ, Miha. Hybrid modeling of dynamics substructuring in frequency domain : doctoral thesis. Mentor Gregor Čepon

ZALETEL], Klemen. High-speed camera-based model updating in structural dynamics : doctoral thesis. Mentor Janko Slavič

UNIVERSITY, HIGER EDUCATION OR SHORT-TERM HIGER EDUCATION TEXTBOOKS WITH REVIEW

SLAVIČ, Janko. Dinamika, mehanska nihanja in mehanika tekočin. 3. izd. Ljubljana: Fakulteta za strojništvo, 2023

ČEPON, Gregor, POGAČAR, Miha, KODRIČ, Miha. Statika in kinematika. 1. izd. Ljubljana: Fakulteta za strojništvo, 2023

AWARDS AND ACHIEVEMENTS

Prof. dr. Gregor Čepon received an award of the Faculty of Mechanical Engineering for excellence in teaching.

Assist. Tilen Košir, assist. Aleš Zorman, assist. Tim Vrtač, assist. dr. Klemen Zaletelj, assist. Gašper Krivic and assist. Jure Korbar received an Award from the Faculty of Mechanical Engineering to colleagues under the age of 35 for outstanding research achievements.

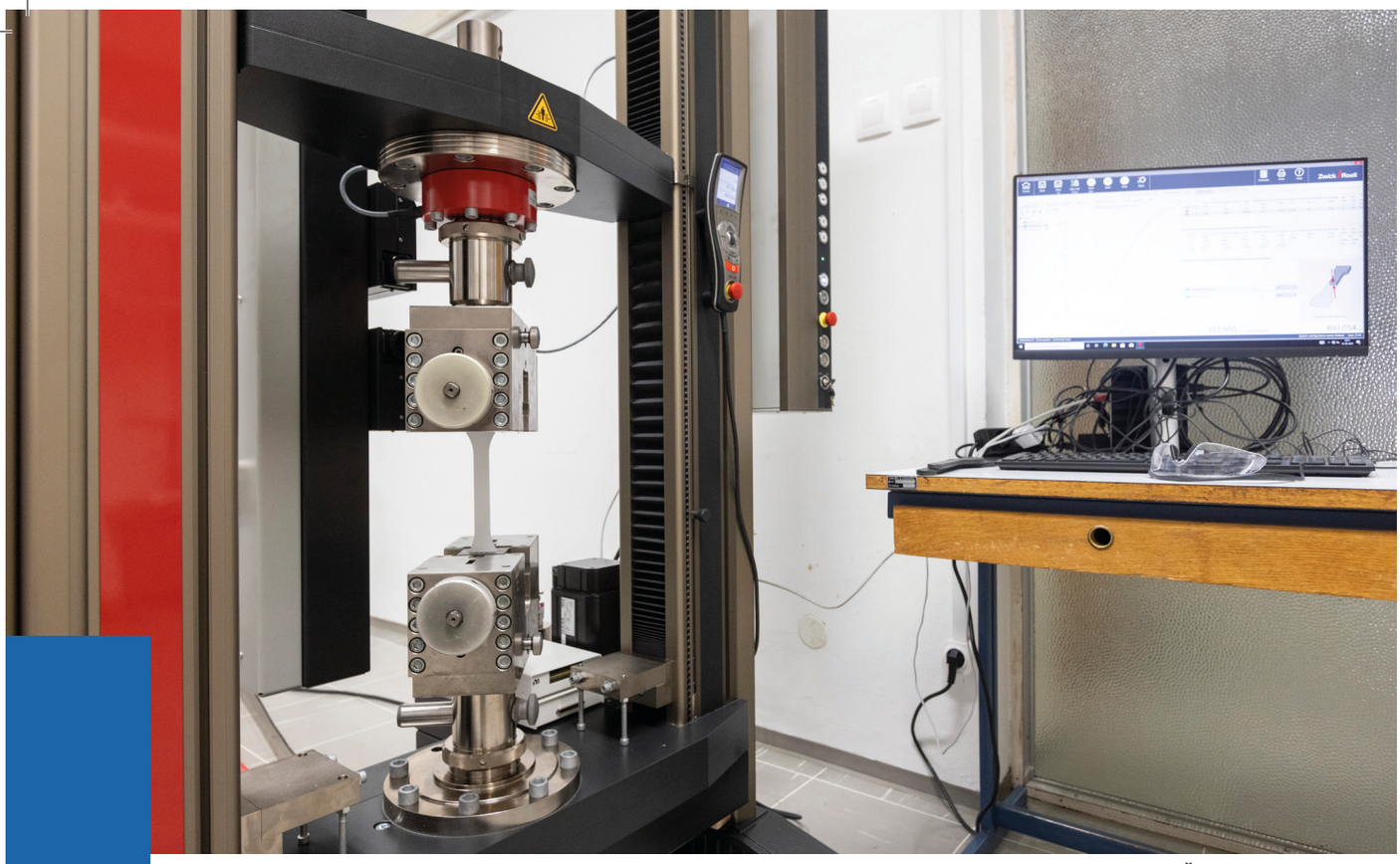

Photo: Željko Stevanić, IFP d.o.o

Laboratory for Non-Linear Mechanics LANEM

RESEARCH AREAS

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

DEPARTMENT HEAD Assist. Prof. dr. Miha Brojan

DEPARTMENT MEMBERS Assist. Jan Zavodnik, Assist. Jonas Trojer, Assist. Tomaž Brzin, Assist. Enej Istenič, Assist. dr. Damjan Lolić, Assist. David Rožamn, dr. Tomaž Videnič, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

ZAVODNIK, Jan, KOŠMRLJ, Andrej, BROJAN, Miha. Rate-dependent evolution of wrinkling films due to growth on semi-infinite planar viscoelastic substrates. Journal of the Mechanics and Physics of Solids. ISSN 1873-4782, Apr. 2023, vol. 173, str. 1-18

ISTENIČ, Enej, BROJAN, Miha. Fluid flow during phase transition : from viscous fluid to viscoelastic solid via variable-order calculus. Physics of fluids. ISSN 1070-6631, Dec. 2023, vol. 35, iss. 12, str. 1-21

RAHMANI, Ramin, KARIMI, Javad, KAMBOJ, Nikhil, KUMAR, Rahul, BROJAN, Miha, TCHÓRZ, Adam, SKRABALAK, Grzegorz, LOPES, Sérgio Ivan. Fabrication of localized diamond-filled copper structures via selective laser melting and spark plasma sintering. Diamond and related materials. ISSN 0925-9635, Jun. 2023, vol. 136, str. 1-12.

Photo: UL FME Archive

PROJECTS

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

Slovenian Research and Innovation Agency. Morphing soft kirigami composite system for the design of flexible deployables and soft-robots. Miha Brojan. 1.10.2022 - 30.9.2025

Erasmus+. LiDeSuM. Lightweight Design for Sustainable Mobility. Miha Brojan. 1.10.2022 - 31.12.2023

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Miha Brojan. 1.1.2024 – 30.6.2026

Photo: Željko Stevanić, IFP d.o.o

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. dr. Miroslav Halilovič

DEPARTMENT MEMBERS Assoc. Prof. dr. Nikolaj Mole, Assist. Prof. dr. Pino Koc, Assist. dr. Kristjan Krebelj, Assist. dr. Primož Rus, Assist. Prof. dr. Bojan Starman, Assist. Prof. dr. Janez Urevc, Assist. Štefan Obid, Assist. Tomaž Kastelic, Assist. Dejan Kovšca, Assist. Rok Markežič, Assist. dr. Maček Andraž, Bergauer Andrej, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

SALON, Adam, VLADIC, Nikola, SCHIMD-ZALAUDEK, Karin, STEUBER, Bianca, HAWLICZEK, Anna, UREVC, Janez, BERGAUER, Andrej, PIVEC, Vid, SHANKHWAR, Vishwajeet, GOSWAMI, Nandu. Sex variations in retinal microcirculation response to lower body negative pressure. Biology. ISSN 2079-7737, Sep. 2023, vol. 12, iss. 9, str. 1-9

KOVŠCA, Dejan, STARMAN, Bojan, KLOBČAR, Damjan, HALILOVIČ, Miroslav, MOLE,Nikolaj. Towards an automated framework for the finite element computational modelling of directed energy deposition. Finite elements in analysis and design. ISSN 0168-874X, Sept. 2023, vol. 221, str. 1-12

SHANKHWAR, Vishwajeet, UREVC, Janez, STEUBER, Bianca, SCHIMD-ZALAUDEK, Karin, BERGAUER, Andrej, ALSUWAIDI, Hanan, DU PLESSIS, Stefan, ALSHEIKH-ALI, Alawi, KELLETT, Catherine, BAYOUMI, Riad, BLABER, Andrew Phillip, GOSWAMI, Nandu. Association of gender with cardiovascular and autonomic responses to central hypovolemia. Frontiers in cardiovascular medicine. ISSN 2297-055X, Aug. 2023, vol. 10, str. 1-8

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HALILOVIČ, Miroslav, MAČEK, Andraž, MOLE, Nikolaj, KOC, Pino, PLEŠNIK, Filip, RUS, Primož, ŽNIDARŠIČ, Matjaž, KRAL], Aleš. Accurate determination of the static equilibrium in insulating glass units under climatic loading. Journal of building engineering. ISSN 2352-7102, Dec. 2023, vol. 80, str. 1-18

PATENT

MAČEK, Andraž, UREVC, Janez, HALILOVIČ, Miroslav. Arrangement of detachable and optionally sealed interconnection between a male and female construction part : European patent specification EP 3 884 194 B1, 2023-06-28 = Anordnung zur Lösbaren und Gegebenenfalls Abgedichteten Verbindung zwischen einem Steker- und einem Buchsenbauteil = Agencement d'interconnexion amovible et éventuellement étanche entre une pièce de construction mâle et une pièce de construction femmelle. Munich: European Patent Office, 2023.

PROJECTS

Slovenian Research and Innovation Agency. Development of technical guidelines for quadruple glazing. Miroslav Halilovič. 1. 10. 2021 – 30. 9. 2024

NEK d.o.o. Izdelava neodvisnih analiz in strokovnega mnenja na poročila vezano na puščanje SI-53 cevovoda. Miroslav Halilovič. 19.12.2023 - 30.6.2024

Hella Saturnus. Vedenje in simulacija ortotropnih materialov in struktur. Miroslav Halilovič. 17.11.2023 - 30.9.2024

Hella Saturnus. Vedenje in simulacija reodiktičnih materialov s kompleksno termo- mehansko zgodovino. Miroslav Halilovič. 17.11.2023 - 30.9.2024

Gorenje d.o.o. Karakterizacija emajlirane pločevine. Miroslav Halilovič. 1.10.2023 - 15.5.2024

Photo: Željko Stevanić, IFP d.o.o

Laboratory for aeronautics AEROL

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. dr. Franci Pušavec
DEPARTMENT MEMBERS Assist. dr. Igor Petrović, Assist. Peter Pipp, Branimir Filovski, 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.

Photo: Željko Stevanić, IFP d.o.o

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. dr. Lidija Slemenik Perše,

DEPARTMENT MEMBERS Res. assoc. dr. Mohor Mihelčič, Assist. Prof. dr. Alen Oseli, Assist. dr. Urška Gradišar Centa, Assist. dr. Sadaf Mahrukh, Matic Šobak, Jr. Res Serafimoski Stefan, Jasna Gornik

ORIGINAL SCIENTIFIC ARTICLES

OSELI, Alen, TOMKOVIĆ, Tanja, HATZIKIRIAKOS, Savvas G., VESEL, Alenka, ARZENŠEK, Matija, ROJAC, Tadej, MIHELČIČ, Mohor, SLEMENIK PERŠE, Lidija. Carbon nanotube network formation and configuration/morphology on reinforcing and conductive performance of polymer-based nanocomposites. Composites science and technology. ISSN 1879-1050, May 2023, vol. 237, str. 1-9

STERNIŠA, Meta, GRADIŠAR CENTA, Urška, DRNOVŠEK, Aljaž, REMŠKAR, Maja, SMOLE MOŽINA, Sonja. Pseudomonas fragi biofilm on stainless steel (at low temperatures) affects the survival of Campylobacter jejuni and Listeria monocytogenes and their control by a polymer molybdenum oxide nanocomposite coating. International journal of food microbiology. ISSN 0168-1605, Jun. 2023, vol. 394, str. 1-11

PODMILJŠAK, Benjamin, KOBE, Spomenka, TOMŠE, Tomaž, BEK, Marko, KOTNIK, Tomaž, SLEMENIK PERŠE, Lidija, ŽAGAR, Ema, SAJE, Boris, ŽUŽEK ROŽMAN, Kristina, ŠTURM, Sašo. Additive-manufactured anisotropic magnets for harsh environments. Journal of Magnetism and Magnetic Materials. ISSN 0304-8853, Nov. 2023, vol. 586, str. 1-9

VUKŠIĆ, Milan, BEK, Marko, SLEMENIK PERŠE, Lidija, MAČEK, Marjeta, KOCJAN, Andraž, IVEKOVIĆ, Aljaž. The role of paraffin wax on the properties and printability of ethylene vinyl acetate-based feedstocks for alumina fused filament fabrication. Open ceramics. ISSN 2666-5395, Dec. 2023, vol. 16, str. 1-9

ŽIGON, Jure, GRADIŠAR CENTA, Urška, REMŠKAR, Maja, HUMAR, Miha. Application and characterization of a novel PVDF-HFP/PVP polymer composite with MoO3 nanowires as a protective coating for wood. Scientific reports. ISSN 2045-2322, 2023, vol. 13, str. 1-15

PROJECTS

Slovenian Research and Innovation Agency. Sustainable polymer materials and technologies. Lidija Slemenik Perše. 1.1.2020 - 31.12.2025

Slovenian Research and Innovation Agency. Sustainable use of polymers in home appliances - Prediction of long-term viscoelastic behavior. Lidija Slemenik Perše. 1.10.2021 - 30.9.2024

Horizon Europe. aProMag. Anisotropic fast PROtotyping of MAGnetic materials. Lidija Slemenik Perše. 1.1.2023 – 29.12.2023

Hella Saturnus. Vedenje in simulacija ortotropnih materialov in struktur. Lidija Slemenik Perše. 17.11.2023 - 30.9.2024

Hella Saturnus. Vedenje in simulacija reodiktičnih materialov s kompleksno termo- mehansko zgodovino. Lidija Slemenik Perše. 17.11.2023 - 30.9.2024

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.

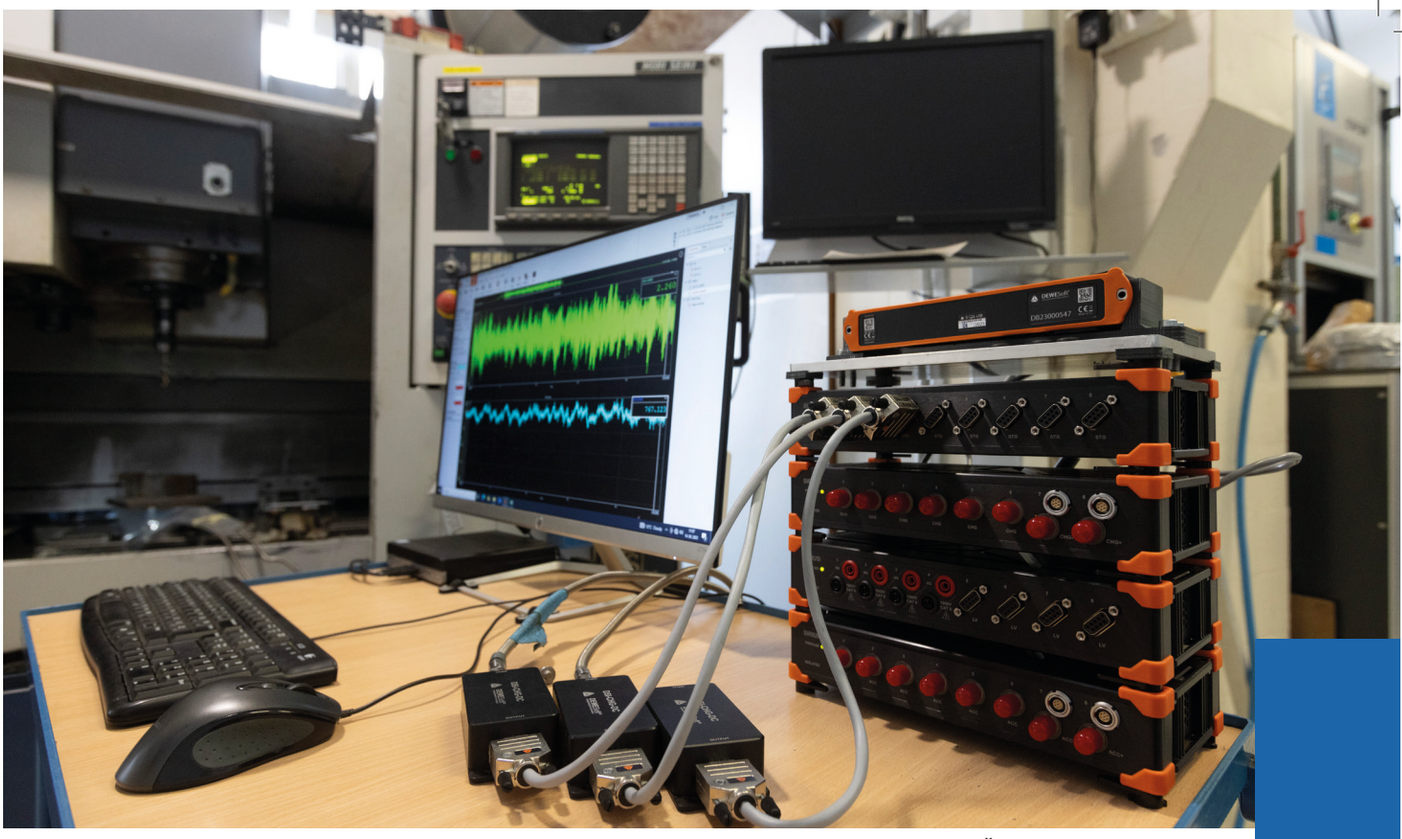

Photo: Željko Stevanić, IFP d.o.o

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. dr. Franci Pušavec

DEPARTMENT MEMBERS Assoc. Prof. dr. Peter Krajnik, Res. Assoc. dr. Radovan Dražumerič, Assist. dr. Awais Ikram, Assist. Jaka Dugar, Assist. Matjaž Kern, Vinko Rotar, Assist. Luka Sterle, Assist. Deepa Kareepadath Santhos, Rodriguez Bogajo Iñigo, Assist. dr. Damir Grguraš, Assist. Luka Kastelic, Assist. Vid Gostiša, Marija Jeretin

ORIGINAL SCIENTIFIC ARTICLES

RODRIGUEZ, Iñigo, ARRAZOLA, Pedro J., CUESTA, Mikel, STERLE, Luka, PUŠAVEC, Franci. Improving surface integrity when drilling CFRPs and Ti-6Al-4V using sustainable lubricated liquid carbon dioxide. Chinese journal of aeronautics. ISSN 1000-9361, Jul. 2023, vol. 36, iss. 7, str. 129-146

BADGER, Jeffrey A., HOIER, Philipp, VINDEMMIO, Stefano, NIGRO, Francesco, DRAŽUMERIČ, Radovan, KRAJNIK, Peter. On mechanics and monitoring of plunge-roll rotary dressing of grinding wheels. CIRP annals. ISSN 0007-8506, 2023, vol. 72, iss. 1, str. 277-280

LIKAR, Borut, HAFNER, Ana, ROPRET, Marko, FATUR, Peter, MARKIČ, Mirko, PUŠAVEC, Franci. Smart innovation management for better business performance. Journal of East European management studies. ISSN 0949-6181, 2023, vol. 28, iss. 3, str. 533-556

KERN, Matjaž, DRAŽUMERIČ, Radovan, PUŠAVEC, Franci. Analytical study on critical load and deformation of chip in high-pressure jet assisted machining. Journal of materials processing technology. ISSN 0924-0136, Jul. 2023, vol. 316, str. 1-12

CICA, Djordje, KRAMAR, Davorin. Machinability investigation and sustainability analysis of high-pressure coolant assisted turning of the nickel-based superalloy Inconel 718. Proceedings of the Institution of Mechanical Engineers. Part B, Journal of engineering manufacture. ISSN 0954-4054, 2023, vol. 237, iss. 1/2, str. 43–54

KAREEPADATH SANTHOS, Deepa, PUŠAVEC, Franci, KRAJNIK, Peter. Grinding of cemented carbide using a vitrified diamond pin and lubricated liquid carbon dioxide. Strojniški vestnik. ISSN 0039-2480, Nov.-Dec. 2023, vol. 69, no. 11/12, str. 435-443

PATENT

PUŠAVEC, Franci, STERLE, Luka, GRGURAŠ, Damir. A device for mixing a coolant and a lubricant : European patent specification EP 3 744 422 B1, 2023-07-19 = Vorrichtung zum Vermischen eines Kühlmittels mit einem Schmiermittel = Dispositif pour mélanger un réfrigérant et un lubrifiant. Munich: European Patent Office, 2023.

PROJECTS

Slovenian Research and Innovation Agency. Research and development of innovative manufacturing technologies for hydrogen fuel cell production for green mobility. Damir Grguraš. 01.10.2022 - 30.09.2024

Erasmus+ (Erasmus Mundus). META4.0. Manufacturing 4.0 by intElligent and susTAinable technologies. Franci Pušavec. 1.11.2022 - 31.12.2028

Horizon Europe. CRYO-MQL. Transitioning to a waste-free production – international cryogenic+MQL machining activity. Franci Pušavec. 1.1.2023 - 31.12.2023

Slovenian Research and Innovation Agency. Research on near dry cryogenic machining for transition to cleaner and waste free production in mass automotive industry. Franci Pušavec. 1.10.2023 - 30.9.2026

Norway Grant. Combined learning model for vocational education in the field of mechanical engineering and development of competencies of students and teachers for digital education. Franci Pušavec. 1.6.2022 – 30.4.2024

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Franci Pušavec. 1.1.2024 – 30.6.2026

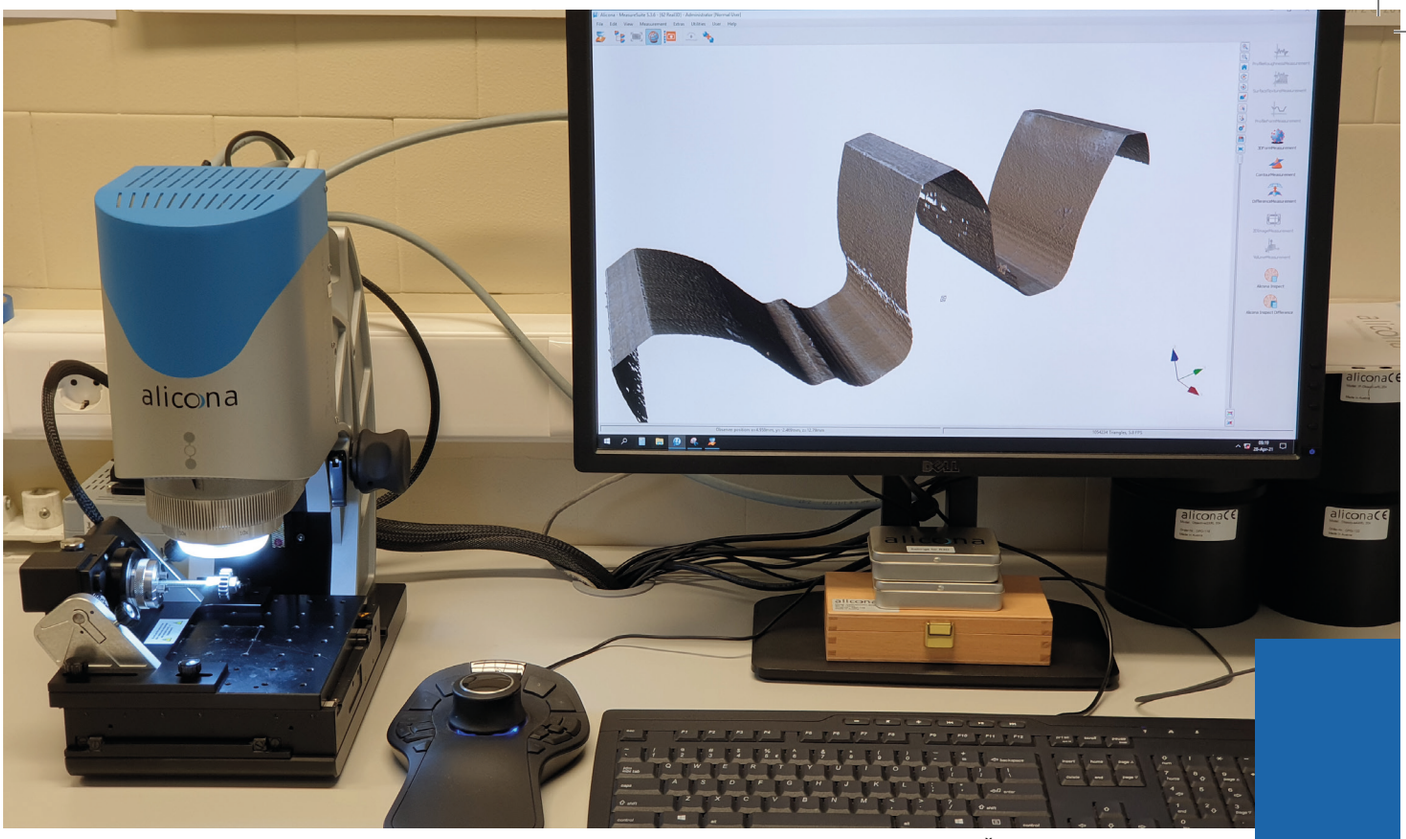

Photo: Željko Stevanić, IFP d.o.o

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. dr. Davorin Kramar
DEPARTMENT MEMBERS Assist. Mark Porenta, Nina Dečman

ORIGINAL SCIENTIFIC ARTICLES

CICA, Djordje, KRAMAR, Davorin. Analysis and optimization of the process parameters on surface roughness in ball burnishing of AISI O2 hardened steel. International journal of advanced manufacturing technology. ISSN 0268-3768, 2023, vol. 128, iss. 1/2, str. 345– 356

CICA, Djordje, KRAMAR, Davorin. Machinability investigation and sustainability analysis of high-pressure coolant assisted turning of the nickel-based superalloy Inconel 718. Proceedings of the Institution of Mechanical Engineers. Part B, Journal of engineering manufacture. ISSN 0954-4054, 023, vol. 237, iss. 1/2, str. 43–54

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.

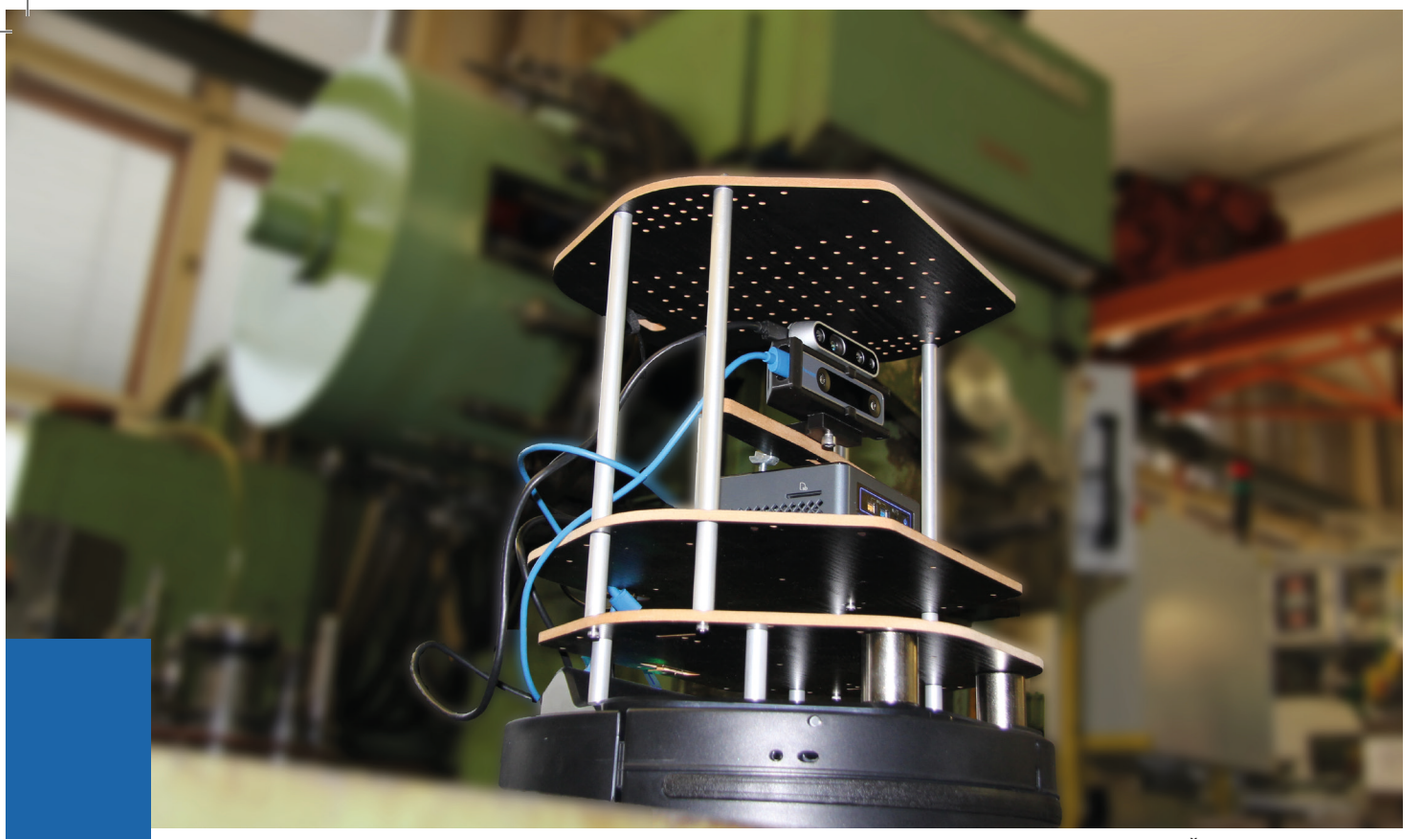

Photo: Željko Stevanić, IFP d.o.o

Laboratory for Mechatronics, Production 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. dr. Podržaj Primož

DEPARTMENT MEMBERS Assist. Prof. dr. Berlec Tomaž, Assist. Prof. dr. Bračun Drago, Assist. dr. Corn Marko, Assist. Prof. dr. Jenko Marjan, Assist. prof. dr. Kozjek Dominik, Juriševič Anja, Kavčič Tadeja, Kelvišar Matic, Assist. Kozamernik Nejc, Assist. Malus Andreja, Assist. Pleterski Jan, Assist. dr. Požrl Tomaž, Assist. Puc Jernej, Assist. Prof. dr. Rihar Lidija, Assist. dr. Ravnikar Dunja, Assist. dr. Rožman Nejc, Rupert Dominik, Assist. dr. Selak Luka, Assist. prof. dr. Škulj Gašper, Assist. Prof. dr. Vrabič Rok, Assist. dr. Žužek Tena, Assist. Jure Dvoršak, Assist. Benko Loknar Martina, Jasna Gornik

ORIGINAL SCIENTIFIC ARTICLES

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BENKO LOKNAR, Martina, BLAŽIČ, Sašo, KLANČAR, Gregor. Minimum-time velocity profile planning for planar motion considering velocity, acceleration and jerk constraints. International journal of control. ISSN 0020-7179, 2023, vol. 96, no. 1, str. 251–265

KOZJEK, Dominik, CARTER, Fred M., PORTER, Conor, MOGONYE, Jon-Erik, EHMANN, Kornel F., CAO, Jian. Data-driven prediction of geometry- and toolpath sequence- dependent intra-layer process conditions variations in laser powder bed fusion. Journal of manufacturing processes. ISSN 1526-6125, Aug. 2023, vol. 100, str. 34-46

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PROJECTS

Erasmus+. TET. The Evolving Textbook. Primož Podržaj. 1.9.2022 - 31.8.2025

Erasmus+. BLISS. Blended Learning Implementation for reSilient, acceSsible and efficient higher education. Primož Podržaj. 1.2.2022 - 31.1.2025

Erasmus+. DERHE. Digital Education Readiness in the field of Higher Education. Tomaž Berlec. 1.12.2023 - 30.11.2026

Erasmus+. FabLab. Developing competences on the Internet of Things through digital fabrication labolatories. Tomaž Berlec. 1.9.2022 - 31.8.2025

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Rok Vrabič. 1.1.2024 – 30.6.2026

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

DOCTORAL DISSERTATIONS

ROŽMAN, Nejc. Framework for control of Mechatronic Devices Based on Blockchain Technology : doctoral thesis. Mentor Janez Diaci

BENKO LOKNAR, Martina. Path planning for autonomous mobile systems with time optimization and jerk restrictions : doctoral thesis. Mentor Sašo Blažič

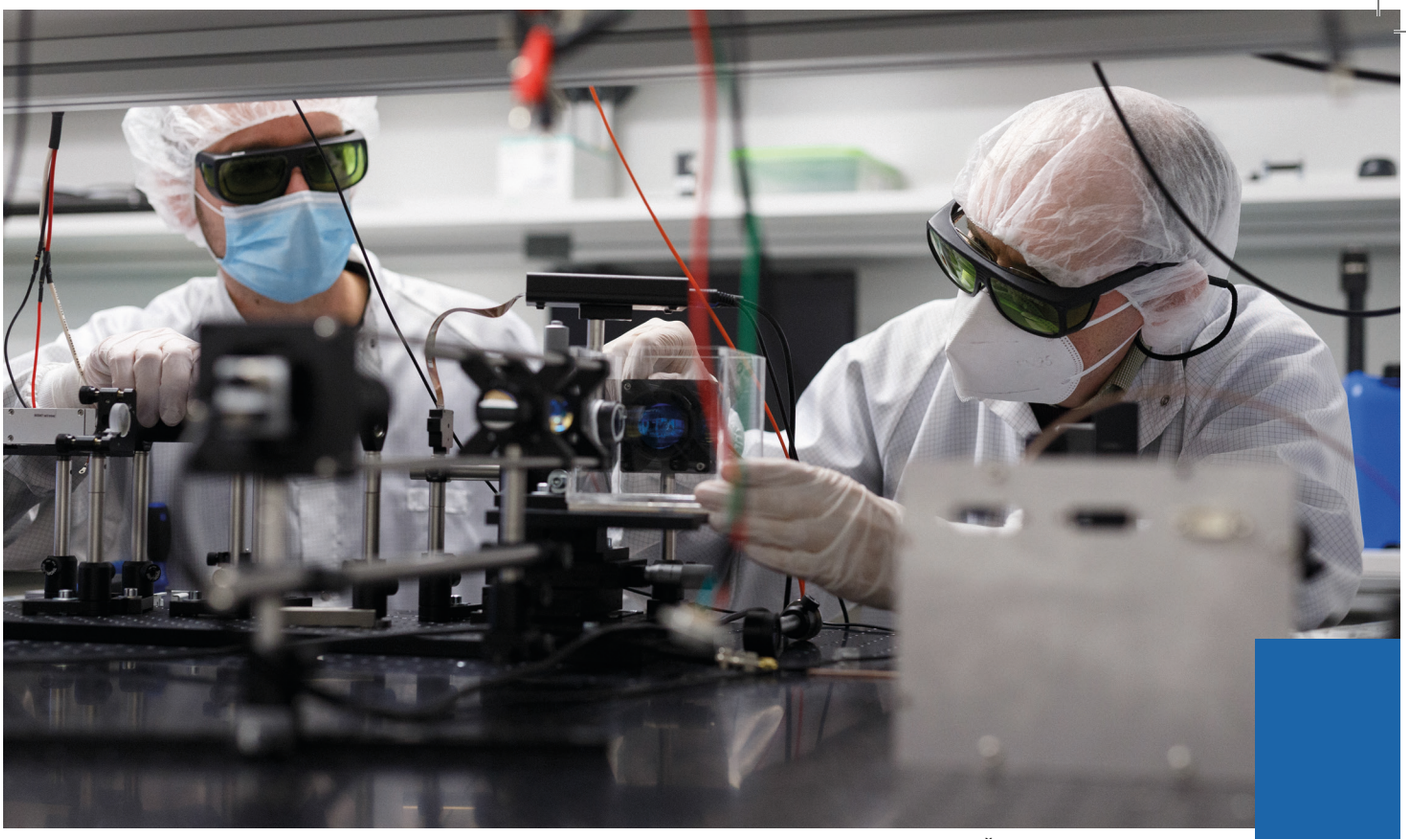

Photo: Željko Stevanić, IFP d.o.o

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. dr. Rok Petkovšek

DEPARTMENT MEMBERS Assist. Prof. dr. Vid Agrež, Assist. dr. Darja Horvat, Assist. dr. Žiga Lokar, Assist. Prof. dr. Jaka Mur, Assist. dr. Jaka Petelin, Assist. dr. Uroš Orthaber, Assist. dr. Luka Černe, Assist. Jernej Jan Kočica, Assist. Matevž Marš, Assist. Miha Jelenčič, Assist. Janko Tuta, Assist. Gašper Hribar, Jasna Gornik

ORIGINAL SCIENTIFIC ARTICLES

KOČICA, Jernej Jan, MUR, Jaka, DIDIERJEAN, Julien, GUILLOSSOU, Arnaud, SABY, Julien, PETELIN, Jaka, MINCUZZI, Girolamo, PETKOVŠEK, Rok. Pulse-on-demand operation for precise high-speed UV laser microstructuring. Micromachines. ISSN 2072-666X, 2023, vol. 14, iss. 4, str. 1-11

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LOKAR, Žiga, HORVAT, Darja, PETELIN, Jaka, PETKOVŠEK, Rok. Ultrafast measurement of laser-induced shock waves. Photoacoustics. ISSN 2213-59794, Apr. 2023, vol. 30, str. 1-6

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PROJECTS

Horizon Europe. ENLIGHTEN. European Non-Line-of-Sight Optical Imaging. Rok Petkovšek. 1.12.2022 - 30.11.2026

Slovenian Research and Innovation Agency. Generation of ultra-short laser pulses for very high speed and highly adaptable parallel microprocessing. Rok Petkovšek. 1.10.2021 – 30.9.2024

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Rok Petkovšek. 1.1.2024 – 30.6.2026

AWARDS AND ACHIEVEMENTS

Assist. Prof. dr. Jaka Mur and assist. Miha Jelenčič received an Award from the Faculty of Mechanical Engineering to colleagues under the age of 35 for outstanding research achievements.

PATENTS

VREČKO, Andrej, POŽAR, Tomaž, PETKOVŠEK, Rok, ORTHABER, Uroš. An acoustic diverter for improved safety during ophthalmic laser treatments = Déflecteur acoustique pour une sécurité améliorée pendant des traitements ophtalmiques au laser = Akustischer Ablenker für verbesserte Sicherheit bei ophthalmischen Laserbehandlungen : European patent specification EP 3 810 050 B1, 2023-03-29. Paris: Europäisches Patentamt: = European Patent Office: = Office européen des brevets, 2023.

SUSIČ, Egon, SAVŠEK, Pavel, POŽAR, Tomaž, PETKOVŠEK, Rok. Cavitation sensing unit for providing a cavitation sensing signal and being adapted to be connected to a control valve of a hydrodynamic system = Kavitationsabtsteinheit zur Erzeugung enes Kavitationsabtastsignals, die an ein Steuerventil eines hydrodynamischen Systems angeschlossen werden kann = Unité de détection de cavitation pour fournir un signal de détection de cavitation et conçue pour être reliée à une soupape de commande d un systéme hydrodinamique : European patent specification EP 3 832 272 B1, 2023-06-28. Munich: European Patent Office, 2023.

Photo: UL FME Archive

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. dr. Roman Šturm

DEPARTMENT MEMBERS Assist. Prof. dr. Zoran Bergant, Assist. Prof. dr. Tomaž Kek, Assist. Prof. dr. Sebastjan Žagar, Assist. dr. Bor Mojškerc, Assist. dr. Dunja Ravnikar, Vane Kralj, Assist. Jan Šmalc, Anja Senegačnik, Dušanka Grubor Železnik

ORIGINAL SCIENTIFIC ARTICLES

RAVNIKAR, Dunja, ŠTURM, Roman, ŽAGAR, Sebastjan. Effect of shot peening on the strength and corrosion properties of 6082-T651 aluminium alloy. Materials. ISSN 1996-1944, 2023, vol. 16, iss. 14, str. 1-15

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Photo: UL FME Archive

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. dr. Damjan Klobčar

DEPARTMENT MEMBERS Assist. Prof. dr. Uroš Trdan, Assist. Mirza Imširović, Prof. dr. Kosec Borut, Jaka Lavrih, Assist. dr. Aljaž Ščetinec, Assist. dr. Matej Pleterski

ORIGINAL SCIENTIFIC ARTICLES

SIMIĆ, Sanja, MILOŠEVIĆ, Mijodrag, KOSEC, Borut, BOŽIĆ, Dejan, LUKIC, Dejan. Application of the multicriteria decision-making for selecting optimal maintenance strategy. Advanced Engineering Letters. ISSN 2812-9709, 2023, vol. 2, no. 4, str. 151-160

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VRSALOVIĆ, Ladislav, GUDIĆ, Senka, PERČIĆ, Nika, GOJIĆ, Mirko, IVANIĆ, Ivana, KOŽUH, Stjepan, NAGODE, Aleš, KOSEC, Borut. Electrochemical behaviour of CuAlMn alloy in the presence of chloride

and sulphate ions. Applied surface science advances. ISSN 2666-5239, 2023, vol. 13, str. 1-12

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KERN, Katarina, KOVAČ, Janez, KLANJŠEK GUNDE, Marta, NAGODE, Aleš, BIZJAK, Milan, ZORC, Matija, KOSEC, Borut, KARPE, Blaž. Effect of a scandium addition on anodizing AlMg alloys = Vpliv dodatka skandija na anodiziranje zlitin AlMg. Materiali in tehnologije. ISSN 1580-2949, mar.-apr. 2023, letn. 57, št. 2, str. 155-161

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ZORC, Matija, NAGODE, Aleš, BURJA, Jaka, KOSEC, Borut, BIZJAK, Milan, ZORC, Borut. Preliminary study of new low-temperature hard abrasion resistant Fe-P and Fe-P-X (X = C or/and B) casting alloys. Materials. ISSN 1996-1944, 2023, vol. 16, iss. 10, str. 1-18

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PROJECTS

Q Techna. Raziskave in razvoj sistemov in metod za zagotavljanje kakovosti procesa varjenja in končne kontrole kakovosti izdelkov. Damjan Klobčar. 4.9.2023 - 30.11.2023

Erasmus+. ANGIE. Academic Network for Green and Innovative Europe. Damjan Klobčar. 1.9.2023 - 28.2.2026

BAM-ING d.o.o. Development of FSW tools. Damjan Klobčar. 6.6.2023 - 1.10.2023

Topomatika d.o.o. Research and developement of methods for improved quality control of welded joints and additively manufactured parts using CT scanning, D scanning and DIC systems. Damjan Klobčar. 20.3.2023 - 30.11.2023

Kolektor Mobility d.o.o. Raziskovalno in razvojno delo na področju spajanja bakra in bakrenih zlitin. Damjan Klobčar. 9.2.2023 - 30.11.2026

Erasmus+. DIGIGREEN. Improved workforce to set transition from manufacturing to digital green fabrication. Damjan Klobčar. 1.1.2022 - 31.12.2023

COST. Euro-MIC. New paths for science, sustainability and standards. Uroš Trdan. 26.10.2021 – 25.10.2025

COST. CERTBOND. Reliable roadmap for certification of bonded primary structures. Uroš Trdan. 04.04.2019 - 03.04.2023 COST. CERTBOND. Reliable roadmap for certification of bonded primary structures. Damjan Klobčar. 04.04.2019 - 03.04.2023

DOCTORAL DISSERTATIONS

ŠČETINEC, Aljaž. Wire arc additive manufacturing and post-processing for achieving near net shape deposit with selected material properties: doctoral thesis. Mentor: Damjan Klobčar

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.

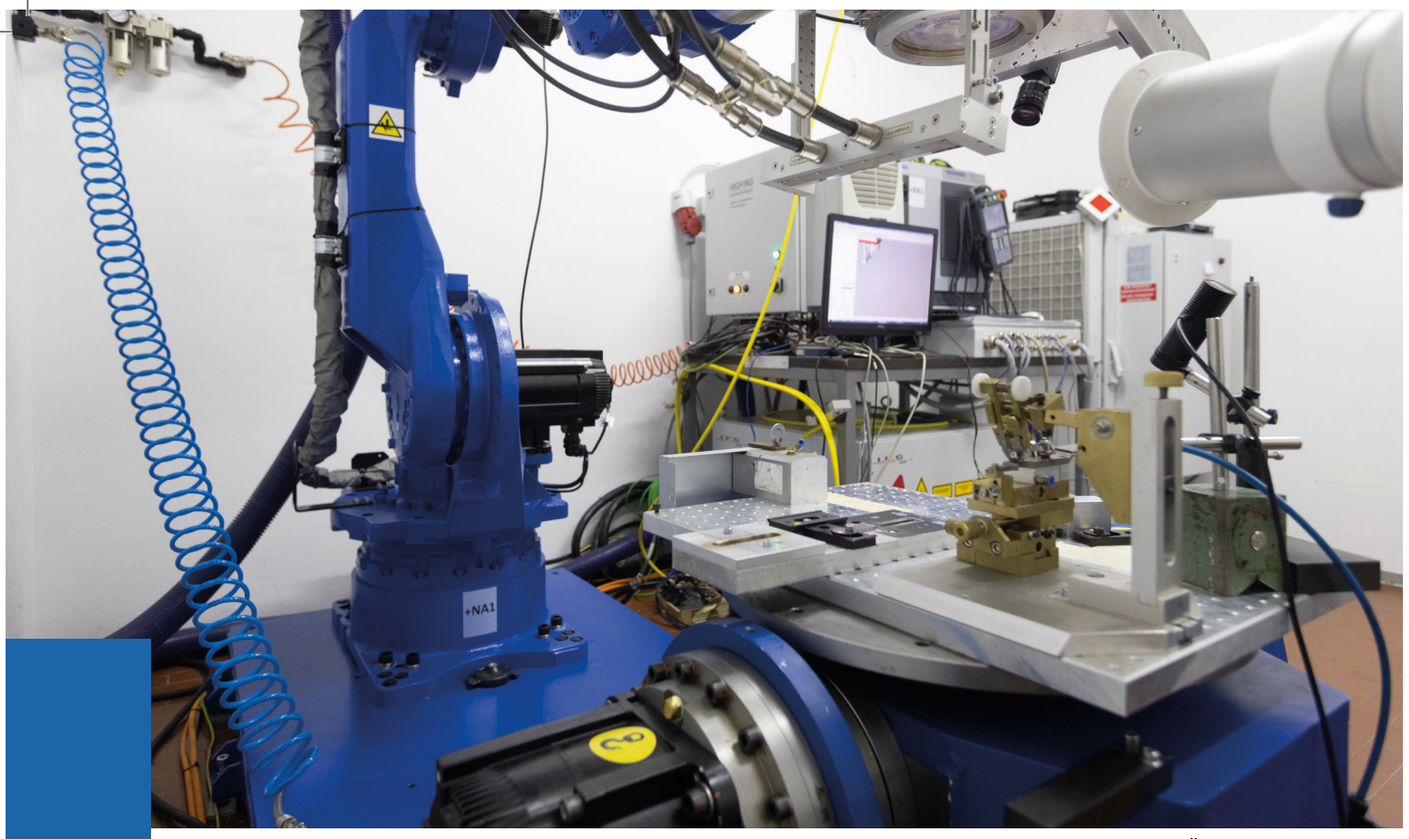

Photo: Željko Stevanić, IFP d.o.o

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 Prof. dr. Matija Jezeršek

DEPARTMENT MEMBERS Assoc. Prof. dr. Peter Gregorčič, Assist. dr. Aleš Babnik, Assist. dr. Urban Pavlovčič, Assist. dr. Ladislav Grad, Assist. dr. Nejc Lukač, Assist. Luka Hribar, Assist. dr. Daniele Vella, Assist. dr. Matjaž Kos, Assist. Gaia Kravanja, Assist. Tine Brežan, Assist. Rida Ahmed, Assist. dr. Eva Kranjc, Assist. Dominik Šavli, Assist. dr. Jure Košir, Jasna Gornik

ORIGINAL SCIENTIFIC ARTICLES

KRAVANJA, Gaia, KRIEGL, Raphael, HRIBAR, Luka, GLAVAN, Gašper, DREVENŠEK OLENIK, Irena, SHAMONIN, Mikhail, JEZERŠEK, Matija. Magnetically actuated surface microstructures for efficient transport and tunable separation of droplets and solids. Advanced engineering materials. ISSN 1438-1656, Nov. 2023, vol. 25, iss. 22, str. 1-11

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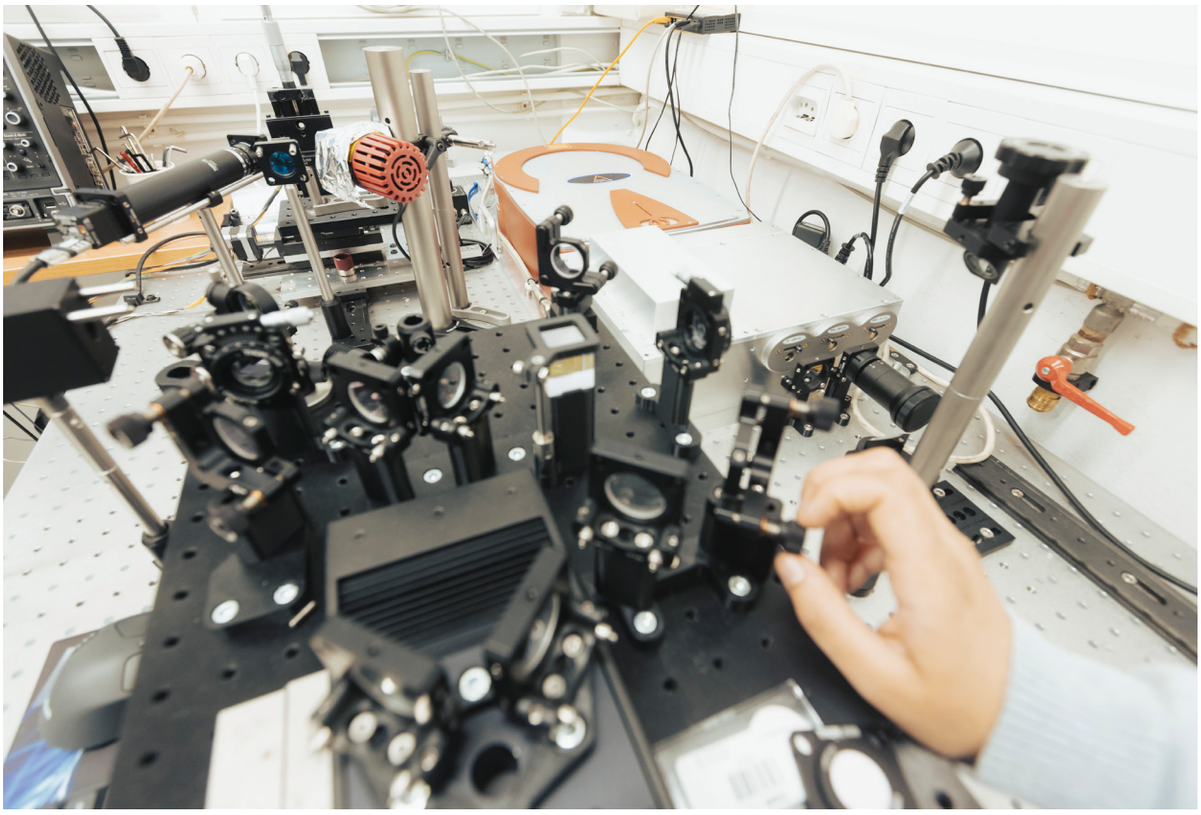

Photo: Željko Stevanić, IFP d.o.o

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JEZERŠEK, Matija, MOLAN, Katja, TERLEP, Saša, LEVIČNIK HOEFFERLE, Špela, GAŠPIRC, Boris, LUKAČ, Matjaž, STOPAR, David. The evolution of cavitation in narrow soft-solid wedge geometry mimicking periodontal and peri-implant pockets. Ultrasonics Sonochemistry. ISSN 1350-4177, Mar. 2023, vol. 94, str. 1-12

PROJECTS

Slovenian Research and Innovation 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

Fotona d.o.o. Raziskave in razvoj naprednih medicinskih laserskih sistemov. Matija Jezeršek. 1.1.2022 - 31.12.2025

Slovenian Research and Innovation Agency. GREENTECH. Hybrid Technologies for Green Factories of the Future. Matija Jezeršek. 1.1.2024 – 30.6.2026

Slovenian Research and Innovation Agency. Two-dimensional materials-based piezophotonic composites for tailor-made ultrasounds stimulation in biological systems (2D-UltraS). Daniele Vella. 1.10.2023 – 30.9.2026

DOCTORAL DISSERTATION

KOS, Matjaž. Adaptive remote laser welding system with triangulation feedback: doctoral thesis. Mentor Matija Jezeršek

HRIBAR, Luka. The influence of processing parameters on macroscopic removal of material by laser ablation at high repetition rates: doctoral thesis. Mentor Peter Gregorčič

AWARDS AND ACHIEVEMENTS

Prof. dr. Matija Jezeršek received an award of the Faculty of Mechanical Engineering for excellence in teaching.

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: Žan Rutar

Unit for supplementary division EDZ

MEMBERS Žiga Bratuž, Iztok Novak, Aleš Lavrič

ACTIVITIES

- Organization of indoor sports activities for students (basketball, volleyball, futsal, fitness, dancing...)
- Hiking trips for students
- One day alpine skiing trips for students
- Cooper's physical fitness testing for students
- Physical education chart fitness testing for students
- Participation in various competitions of University of Ljubljana or Slovenian university sports association (basketball league, volleyball league, futsal league)

THE BEST PERFORMANCES OF FME STUDENTS IN 2022 COMPETITONS

3rd place – Volleyball team (league)
3rd place – Futsal team (tournament)
3rd place Orienteering (employees category) Robert Kunc
4th place – Basketball team (league)
Quarterfinal - Futsal team (league)

Photo: UL FME Archive

Mathematics Research Team RSMAT

DEPARTMENT HEAD Prof. dr. Janez Žerovnik

DEPARTMENT MEMBERS Assoc. Prof. dr. Aljoša Peperko, Assist. Prof. dr. Boštjan Gabrovšek, Assist. Prof. dr. Darja Rupnik Poklukar, Assist. dr. Helena Zakrajšek, Assist. dr. Brezovnik Simon, Teja Pirnat

ORIGINAL SCIENTIFIC ARTICLES

BREZOVNIK, Simon, DEHMER, Matthias, TRATNIK, Niko, ŽIGERT PLETERŠEK, Petra. Szeged and Mostar root-indices of graphs. Applied mathematics and computation. ISSN 0096-3003, Apr. 2023, vol. 442, 11 str.

GABROVŠEK, Boštjan, PEPERKO, Aljoša, ŽEROVNIK, Janez. On the 2-rainbow independent domination numbers of some graphs. Central European journal of operations research. ISSN 1435-246X, Sept. 2023, vol. 31, iss. 3, str. 817-831

GABROVŠEK, Boštjan, MOLICA BISCI, Giovanni, REPOVŠ, Dušan. On nonlocal Dirichlet problems with oscillating term. Discrete and continuous dynamical systems. Series S. ISSN 1937-1632, June 2023, vol. 16, no. 6, str. 1401-1413

REDŽEPOVIĆ, Izudin, ĐORĐEVIĆ, Slađana, BREZOVNIK, Simon, TRATNIK, Niko, ŽIGERT PLETERŠEK, Petra, FURTULA, Boris, RADENKOVIĆ, Slavko. Partition of topological indices of benzenoid hydrocarbons into ring contributions. International journal of quantum chemistry. ISSN 1097-461X, 2023, vol. 123, iss. 12, 10 str.

BOGDANOVIĆ, Katarina, PEPERKO, Aljoša. Inequalities and equalities on the joint and generalized spectral and essential spectral radius of the Hadamard geometric mean of bounded sets of positive kernel operators. Linear and Multilinear Algebra. ISSN 0308-1087, 2023, vol. 71, iss. 17, str. 2839-2857

BREZOVNIK, Simon, TRATNIK, Niko. Generalized cut method for computing Szeged-like polynomials with applications to polyphenyls and carbon nanocones. Match : communications in mathematical and in computer chemistry. ISSN 0340-6253, 2023, vol. 90, no. 2, str. 401-427

BREZOVNIK, Simon, TRATNIK, Niko, ŽIGERT PLETERŠEK, Petra. Resonance graphs and a binary coding of perfect matchings of outerplane bipartite graphs. Match : communications in mathematical and in computer chemistry. ISSN 0340-6253, 2023, vol. 90, no. 2, str. 453-468

RUPNIK POKLUKAR, Darja, ŽEROVNIK, Janez. Double Roman domination : a survey. Mathematics. ISSN 2227-7390, Jan. 2023, vol. 11, iss. 2, str. 1-20

BREZOVNIK, Simon, RUPNIK POKLUKAR, Darja, ŽEROVNIK, Janez. On 2-Rainbow Domination of Generalized Petersen Graphs P(ck,k). Mathematics. ISSN 2227-7390, 2023, vol. 11, iss. 10, 16 str.

GABROVŠEK, Boštjan, GÜGÜMCÜ, Neslihan. Invariants of Multi-linkoids. Mediterranean journal of mathematics. ISSN 1660-5446, June 2023, vol. 20, iss. 3, art. 165, str. 1-22

PROJECTS

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

Slovenian Research and Innovation Agency. A computational library for knotted structures and applications. Boštjan Gabrovšek. 1.10.2022 - 30.9.2025

UNIVERSITY, HIGER EDUCATION OR SHORT-TERM HIGER EDUCATION TEXTBOOKS WITH REVIEW

ŽEROVNIK, Janez, GABROVŠEK, Boštjan, RUPNIK POKLUKAR, Darja. Analiza in navadne diferencialne enačbe. 1. ponatis 1. izd. Ljubljana: Fakulteta za strojništvo, 2023

CENCEL], Matija, GABROVŠEK, Boštjan. Matematika v umetnosti. 1. izd. Ljubljana: Pedagoška fakulteta, 2023

RUPNIK POKLUKAR, Darja, PEPERKO, Aljoša, ŽEROVNIK, Janez. Parcialne diferencialne enačbe, kompleksna analiza in optimizacija. 1. izd. Ljubljana: Fakulteta za strojništvo, 2023

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.

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.

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 2022, we organized it for the 9th consecutive year, which indicates that it is becoming a tradition. We had a record attendance of a whopping 91 participants, almost 10 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.

Photo: Željko Stevanić, IFP d.o.o

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 2022 18 papers arrived and 10 were presented.

Photo: UL FME Archive

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.

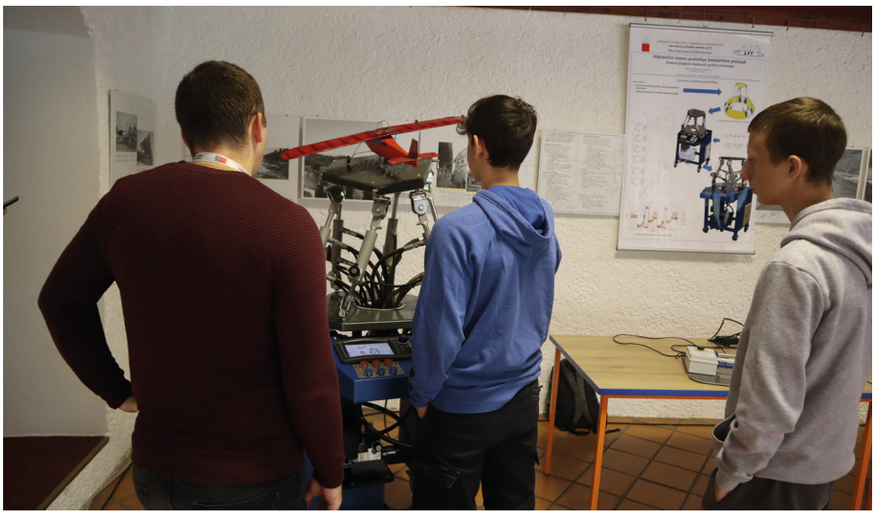

Photo: UL FME Archive

OPEN FACULTY

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.

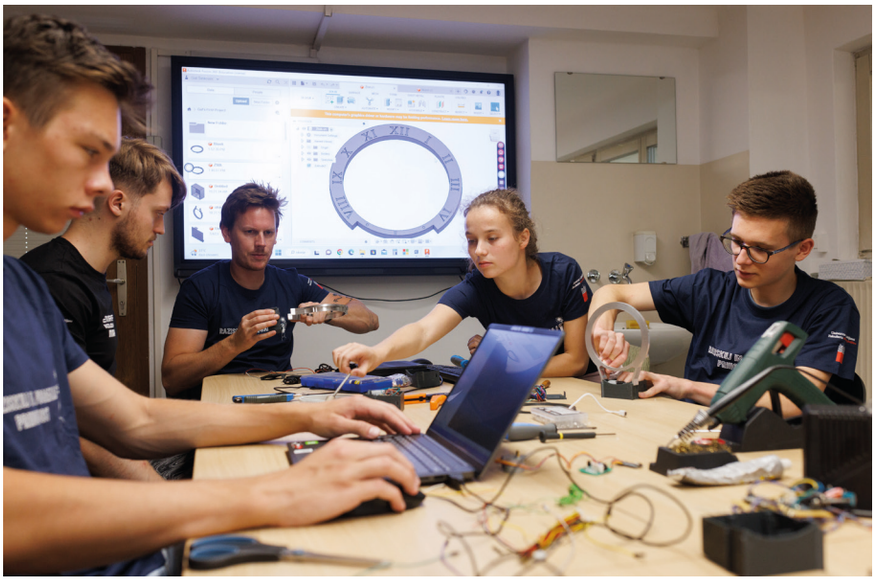

Photo: Željko Stevanovič, IFP d.o.o.

OPEN LABORATORY – PESKOVNIK

One of the greatest assets for students in 2022 is certainly the Open Laboratory - Peskovnik. Peskovnik launched its activities in the summer of 2022. The mission of Peskovnik is to become the central community for student engineering engagement and innovation at the Faculty of Mechanical Engineering, University of Ljubljana. We try to build an engineering community by organising workshops, facilitating student projects, and connecting students from different disciplines.

Peskovnik's vision is encapsulated in the Membership Pledge, which commits the user to: solve any problems that arise; keep the space safe, clean and tidy; and maintain the open, friendly and educational nature of the Open Laboratory. He/she will also ensure the equality of all members.

Photo: Željko Stevanič, IFP d.o.o.

Photo: Željko Stevanič, IFP d.o.o.

The project is co-funded by the Republic of Slovenia, the Ministry of Education, Science and Sport and the European Union - NextGeneration EU.

SUMMER RESEARCH CAMP “EXPLORE AND PROPEL THE FUTURE"

At UL Faculty of Mechanical Engineering, we are aware of the importance of early career orientation. For this reason, we organized the first summer research camp for students "Research and drive the future". Under the mentorship of their colleagues in the Faculty of Mechanical Engineering, the students conducted a range of individual research projects, ranging from analysing the aerodynamic qualities of aeroplanes to creating 3D printed smart devices. Apart from providing mentorship, the research camp also included selected interesting lectures by internationally recognized experts.

Photo: Željko Stevanič, IFP d.o.o.