

Univerza v Ljubljani
Fakulteta za strojništvo



Annual Report

2018

Univerza v Ljubljani
Fakulteta *za strojništvo*



University of Ljubljana

Faculty of Mechanical Engineering

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UNIVERSITY OF LJUBLJANA FACULTY OF MECHANICAL ENGINEERING

FACULTY MANAGEMENT



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1st Cycle

Assoc. Prof.
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PhD



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2nd and 3rd Cycles

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Pika Škraba, Roman Putrih

INTRODUCTION

UNIVERSITY OF LJUBLJANA

The University of Ljubljana is the oldest and largest higher education and scientific research institution in Slovenia. Since its foundation in 1919 it has been an important pillar of the Slovene society and the development of the Slovene scientific terminology. The university is striving to deliver the highest quality of knowledge and to fulfil its ethical standards in all areas of science and art, which is proven by its 370th place in the CWUR rankings among the 18,000 universities in the world.

Today, the University of Ljubljana is the central and largest educational institution, with more than 40,000 students, employing more than 5,800 higher education teachers, researchers, assistants, and administrative staff at 23 faculties and 3 art academies. The students can choose among several hundred study programmes, which are structured in accordance with the Bologna Declaration guidelines. The number of joint programmes is also on the rise, which aim to increase internationalisation and closer cooperation with foreign educational institutions. This encourages interdisciplinary study and facilitates mobility of lecturers and students in the international university environment.

The University of Ljubljana is listed amongst the top 500 universities in the world according to the ARWU Shanghai, Times THES-QS and WEBOMETRICS rankings.

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).

It also actively encourages the strengthening of the academic community of teachers, researchers and students, who are striving to use their knowledge and achievements in Slovenia and abroad. Its research, educational, professional and public activities are founded on the following values of:

- Academic excellence, namely ensuring the highest quality,
- Academic freedom of faculty and students, especially creative freedom,
- Autonomy from the state, political parties, corporations and religions,
- Humanities and human rights, including equal opportunities, and solidarity,
- Ethical and responsible relationship to the world.



FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY OF LJUBLJANA

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



Foundation

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

Today

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

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

Scientific research work at the Faculty of Mechanical Engineering is carried out in the fields of power and process engineering, design, mechanics and maintenance of machines, production engineering, mechatronics, micromechanic systems and automatisations. 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 OPTODYNAMICS AND LASER APPLICATIONS

Laboratory for photonics and
laser systems **FOLAS**

Laboratory for laser
techniques **LASTEH**

10

CHAIR OF TRIBOLOGY AND MAINTENANCE SYSTEMS

Laboratory for tribology and
interface nanotechnology
TINT

Laboratory for Fluid Power
and Controls **LFT**

11

CHAIR OF FLUID DYNAMICS AND THERMODYNAMICS

Laboratory for Fluid Dynamics
and Thermodynamics **LFDT**

12

CHAIR OF CYBERNETICS, MECHATRONIC AND PRODUCTION ENGINEERING

Laboratory for Control and
Manufacturing Systems
LAKOS

Laboratory for Digital Systems
and Electrical Engineering
LDSE

Laboratory for Process
Automation **LPA**

Laboratory for Manufacturing
Systems and Production
Process Planning **LAPS**

Laboratory for Manufacturing
Cybernetics and
Experimentation **MCE**

4

CHAIR OF MANUFACTURING TECHNOLOGIES AND SYSTEMS

Laboratory for Forming **LAP**

Laboratory for Alternative
Technologies **LAT**

Laboratory for Handling,
Assembly and Pneumatics
LASIM

5

CHAIR OF MATERIALS, SCIENCE AND TECHNOLOGY

Laboratory for heat treatment
and materials testing **LATOP**

Laboratory for Welding
LAVAR

6

CHAIR OF THERMAL AND ENVIRONMENTAL ENGINEERING

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

Laboratory for Refrigeration
and District Energy **LAHDE**

Laboratory for Sustainable
Technologies in Buildings
LOTZ

13

CHAIR OF MACHINING TECHNOLOGY MANAGEMENT

Laboratory for Cutting
LABOD

Laboratory of Quality
Assurance **LAZAK**

14

CHAIR OF ENGINEERING DESIGN AND TRANSPORTATION SYSTEMS

Laboratory for Engineering
Design **LECAD**

Laboratory for Material
Handling and Machine
Structures **LASOK**

15

CHAIR OF MODELLING IN ENGINEERING SCIENCES AND MEDICINE

Laboratory for Modelling
Machine Elements and
Structures **LAMEK**

16

AVIATION DIVISION

Laboratory for aeronautics

17

UNIT FOR SUPPLEMENTARY DIVISION

Mathematics Research Team
RSMAT

Unit for Supplementary
Division **EDZ**

18

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.

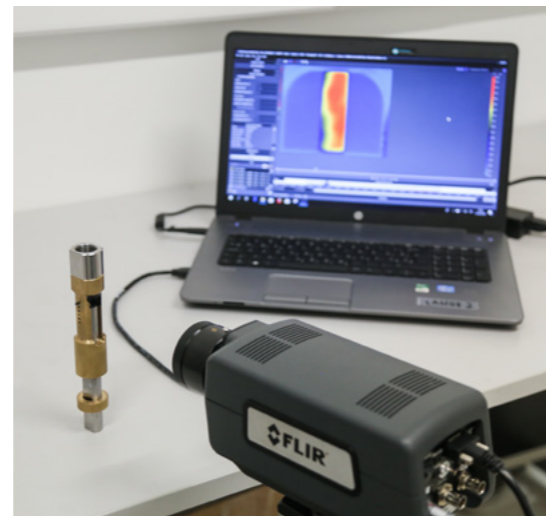
In 2018, 37 laboratories and a Unit for Supplementary Division operated within the scope of 16 chairs.

IN FOCUS

University of Ljubljana's Faculty of Mechanical Engineering Wins Second ERC Project

With its breakthrough ideas, the University of Ljubljana's Faculty of Mechanical Engineering convinced the **European Research Council (ERC)** to award it a grant for the second time; this time, amounting to nearly €1.4m, the grant is for the project with the acronym **SUPERCOOL: Superelastic Porous Structures for Efficient Elastocaloric Cooling**.

The project's final goal is the development of an elastocaloric cooling device, which may be the first major breakthrough in cooling in over a century, with increased efficiency and reduced environmental pollution. Once successfully developed, the proposed cooling concept will be of great utility for different areas of cooling technology, from miniature to large cooling systems and heat pumps.

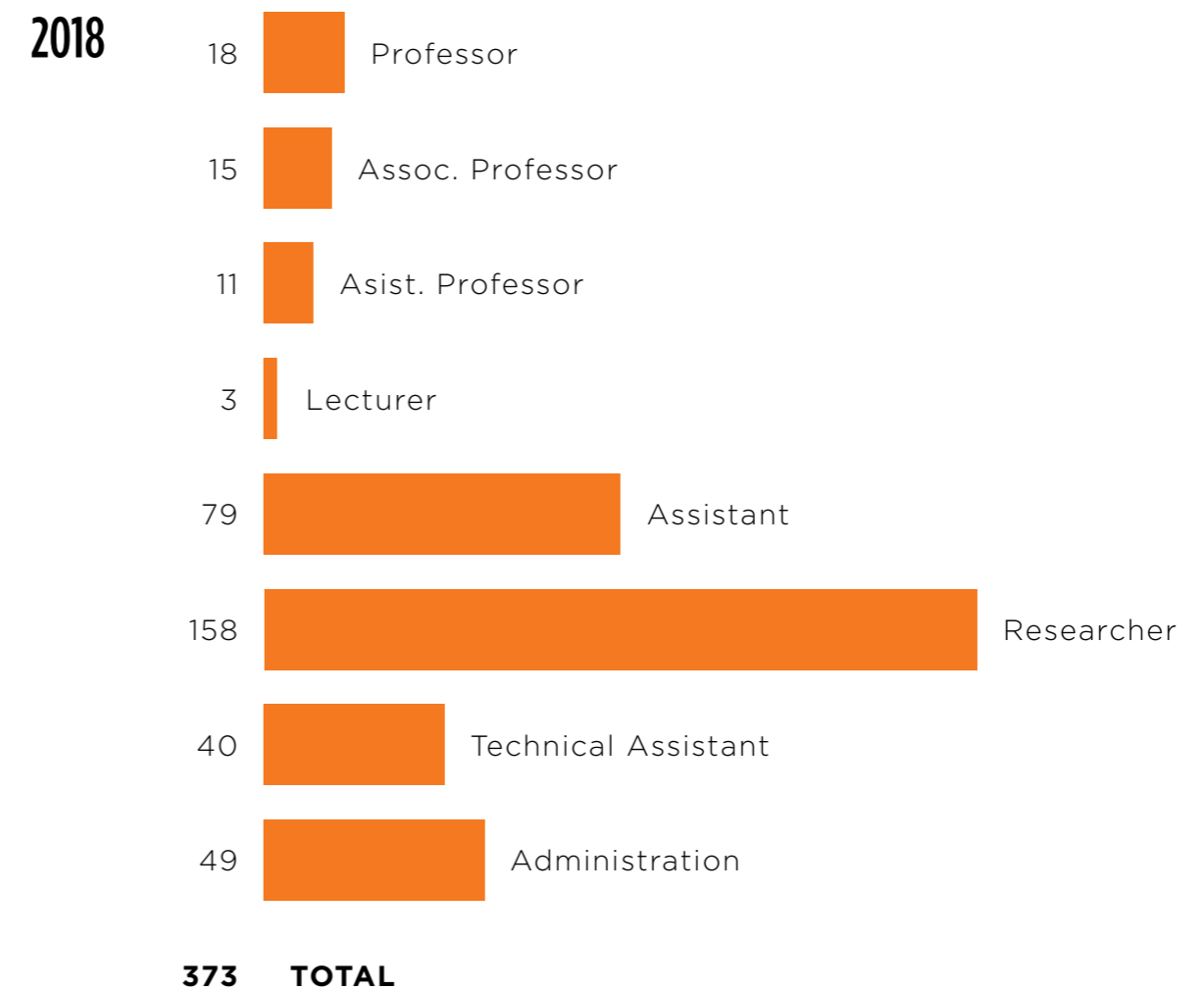


Assistant Professor Jaka Tušek PhD is Slovenia's first and only successful applicant for Horizon 2020 Programme's ERC Starting Grant, which he will use to establish his first independent research team of six researchers for the next five years. With this grant, he became the Faculty of Mechanical Engineering second researcher, in addition to Professor Matevž Dular PhD, to receive funding from the European Research Council. As part of the project, he will analyse the key elements of elastocaloric cooling technology, which, according to many estimates, evidences the highest potential as an alternative to today's widely applicable vapour-compression cooling technology, which, even though it has been further developed in the more than 100 years since its inception, is still relatively energy inefficient and its utilisation ecologically debatable.

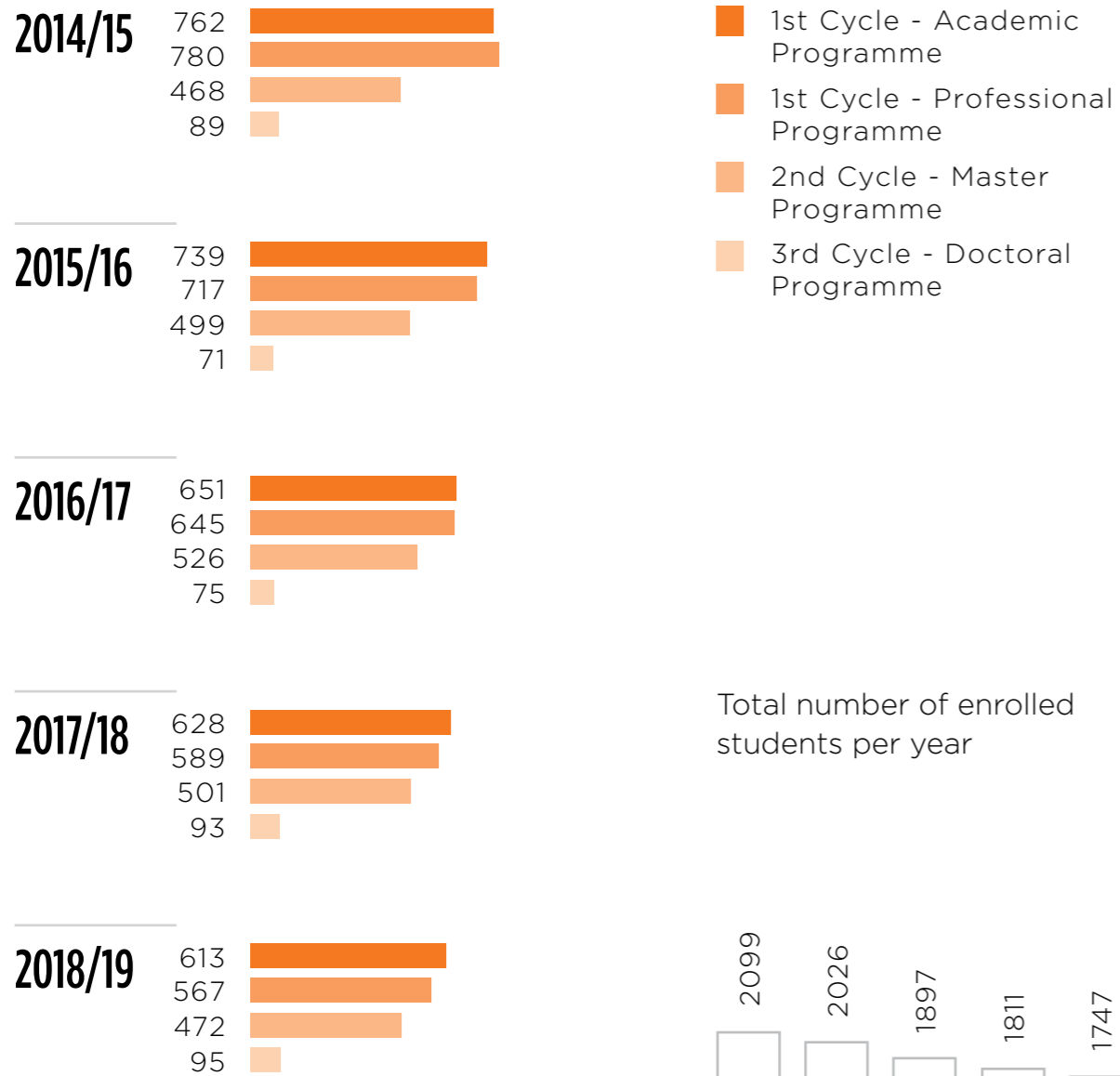
The responsible person for the project, Assistant Professor Jaka Tušek PhD said: "In addition to elastocaloric cooling technology, the findings of the SUPERCOOL Project will also impact numerous other, also wider fields, especially medicine, civil, and mechanical engineering, where shape-memory materials have been applied widely, however their potential and limitations are not yet known well enough."

THE FACULTY OF MECHANICAL ENGINEERING IN NUMBERS

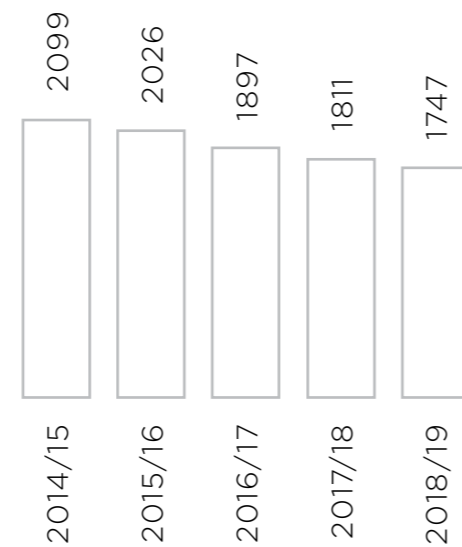
EMPLOYEE STRUCTURE



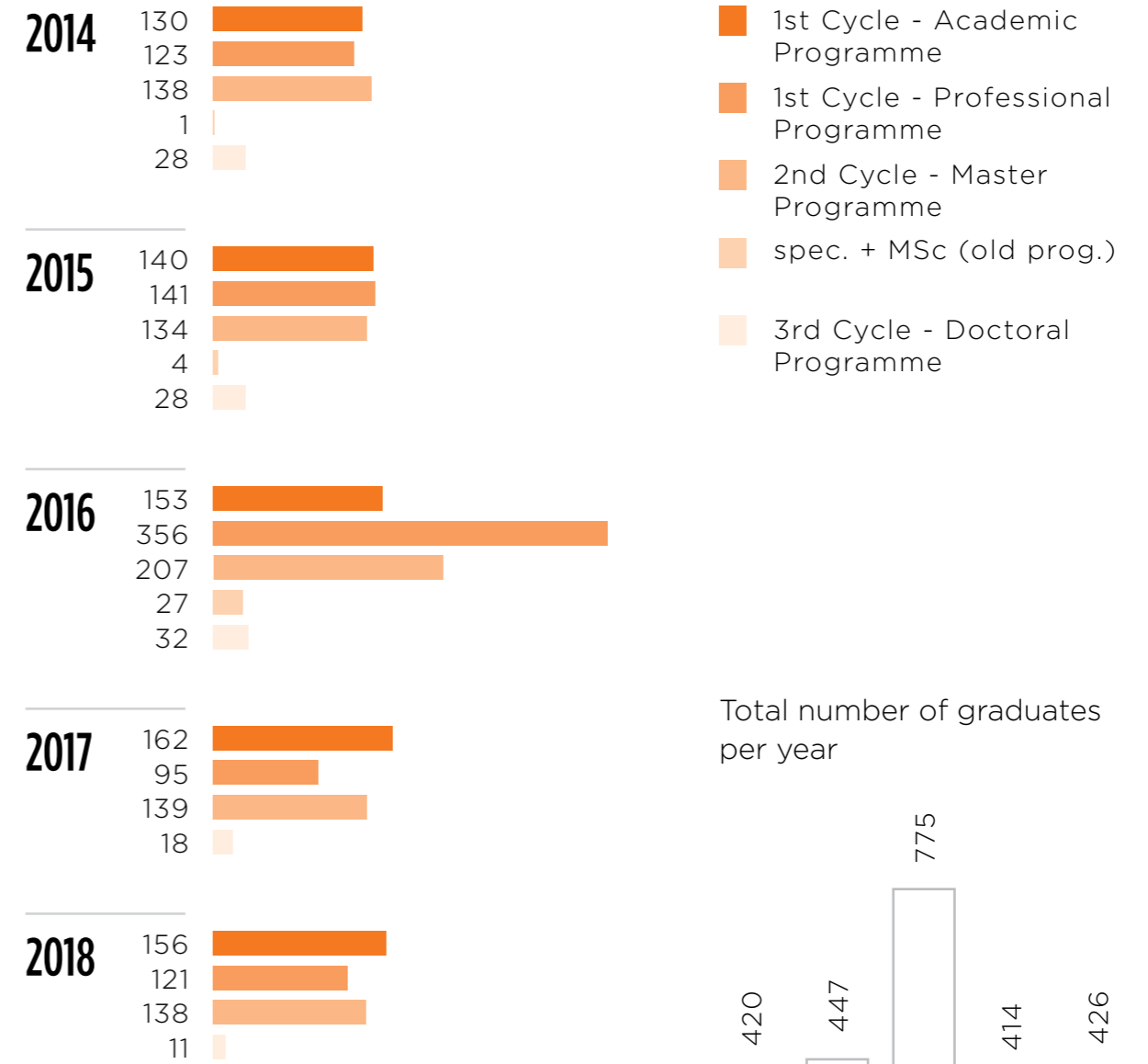
NUMBER OF ENROLLED STUDENTS



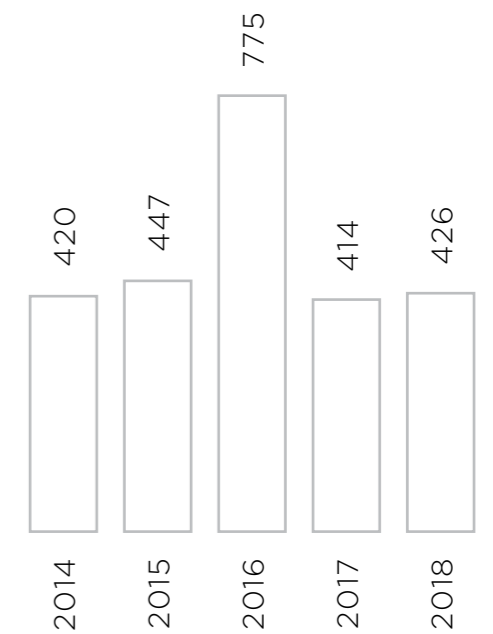
Total number of enrolled students per year



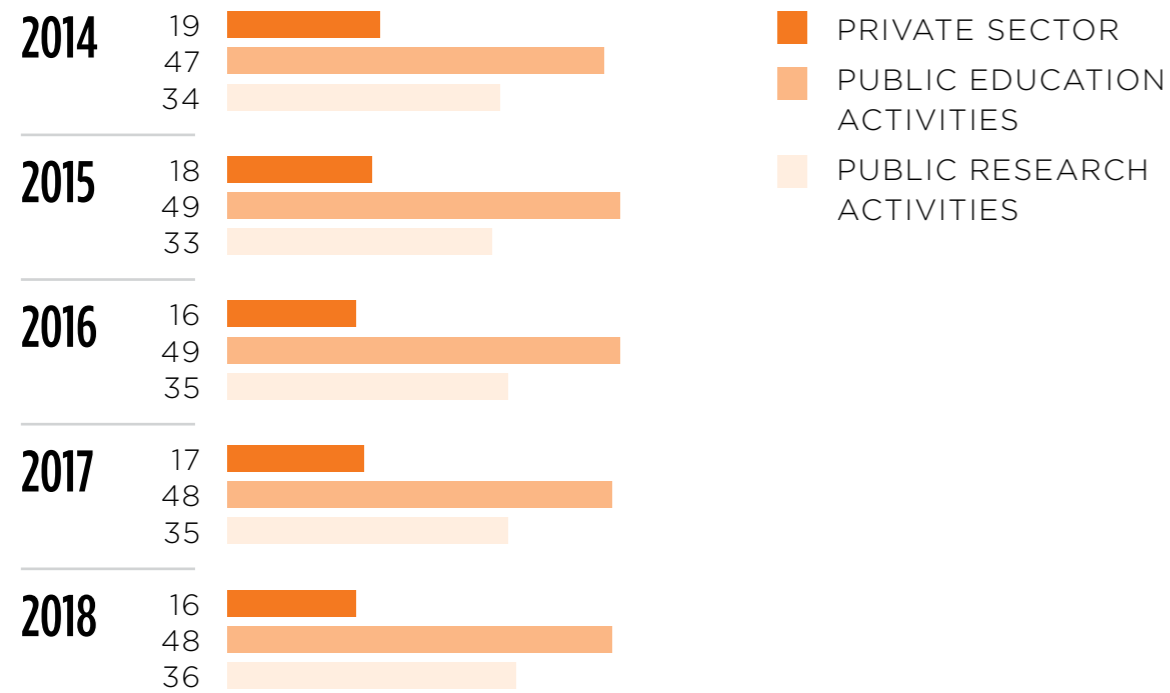
NUMBER OF GRADUATES



Total number of graduates per year



FINANCING STRUCTURE IN %



NUMBER OF MARKET-ORIENTED PROJECTS WITH THE INDUSTRY



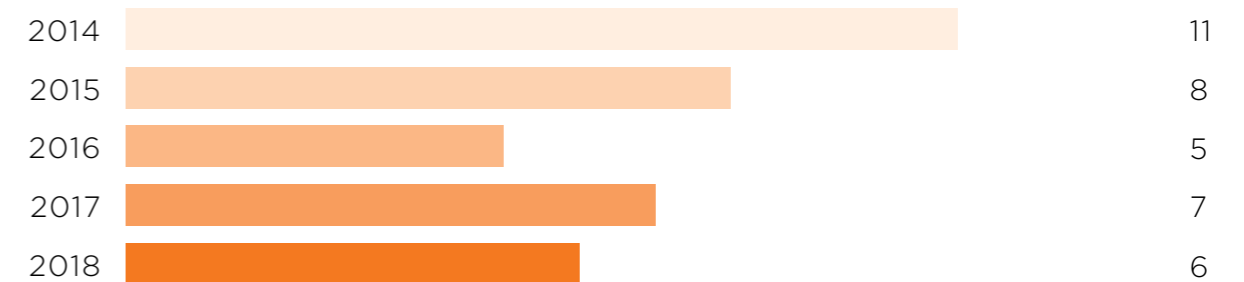
NUMBER OF ORIGINAL SCIENTIFIC ARTICLE



NUMBER OF INTERNATIONAL RESEARCH PROJECTS

| Programm | 2014 | 2015 | 2016 | 2017 | 2018 |
|--|-----------|-----------|-----------|-----------|-----------|
| Horizon 2020 | 1 | 3 | 5 | 7 | 11 |
| ERDF - European regional development fond | 1 | 0 | 6 | 7 | 9 |
| ERA NET M-era.Net | 1 | 0 | 0 | 1 | 1 |
| Life+ | 0 | 0 | 1 | 1 | 1 |
| Erasmus + | 2 | 2 | 3 | 5 | 6 |
| ESA - European space agency | 1 | 1 | 1 | 2 | 1 |
| Eureka | 3 | 2 | 0 | 1 | 1 |
| COST - European Cooperation in science and technology | 4 | 4 | 6 | 8 | 8 |
| Other: LLP lifelong learning programme - Erasmus Mundus, ITER, FGG - The Austrian Research and Promotion Agency, COMET - Competence Centers for Excellent Technologies | 2 | 4 | 6 | 8 | 5 |
| EIT - European Institute of Innovation & Technology | 0 | 0 | 0 | 0 | 2 |
| TOTAL | 15 | 16 | 28 | 40 | 45 |

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

The Faculty of Mechanical Engineering has been publishing two periodicals: the scientific publication *Strojniški vestnik* (Journal of Mechanical Engineering) and the scientific and expert journal *Ventil* (The Valve).

Strojniški vestnik - Journal of Mechanical Engineering



The scientific publication Strojniški vestnik – Journal of Mechanical Engineering publishes theoretical and practice oriented articles, dealing with problems of modern technology (power and process engineering, structural and machine design, production engineering, mechanism and materials etc.). It deals with activities like project engineering, construction, operation, environment protection etc. in the field of mechanical engineering and other closely related branches. The Journal is indexed in the WoS Thomson Reuters and Scopus databases. In the Scopus database it is positioned in the second quarter. The growth of the Journal is evident in the constant increase in the number of citations in WoS. It has been published since 1955. The publishers are the Faculty of the 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 – Metal Processing Association.

The Journal is freely available at <https://www.sv-jme.eu/issues/volume-64-2018/>

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, automation 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, automation, and mechatronics, especially among the young people, while it also cultivates the scientific terminology in these fields.

REVIJA ZA FLUIDNO TEHNIKO, AVTOMATIZACIJO IN MEHATRONIKO

VENTIL

ISSN 1318 - 7279 Letnik 25 / 2019 / 4 / Avgust

| | | | |
|------------------|----------------------|----------------------|---------------------|
| Procesna tehnika | Okoljsko vrednotenje | Hidravlika skozi čas | Iz prakse za prakso |
|------------------|----------------------|----------------------|---------------------|

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 - nadzor spodsavanja
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 - zaznavalo tlaka
- ZAZNAVALO HITROSTI
- SPREMINJANJE HITROSTI
- PROTIZDRSNI VENTIL
- MOTOR
- TANDEM ČRPALKA z SA krmiljem
 - krmiljenje iztisnine
 - potenciometer povratne zveze
 - zaznavalo hitrosti
 - zaznavalo omejevalnika moči
- PROTIZDRSNI VENTIL
- POCLAIN hydraulics
- www.poclain-hydraulics.com

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FESTO POCLAIN Hydraulics OPL S3C Parker

IMI Precision Engineering MIEL omron omron omron PPT commerce

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 1,500 copies each. The technical quality conforms to the international standards, valid in Slovenia. It is also included in the COBBIS, INSPEC and university and library databases (RWTH Aachen - IFAS, TU - Wien, University in Hannover and The British Library). Under its present title Ventil the journal has been published since 1995.

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

STUDY PROGRAMMES

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



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

1ST CYCLE

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

| 1 st year | 2 nd year – directions | 3 rd year – sub-directions |
|----------------------|--|--|
| Common curriculum | Power, Process and Environmental Engineering – EPO | Power Engineering, Household and Sanitary technology, Process Engineering |
| | Engineering Design, Machine Operation and Maintenance – SOV | Material Handling and Self-propelled Machines, Vehicle Engineering, Maintenance Management |
| | Production Engineering – PRS | Production Technologies, Production Management, Welding Technologies |
| | Mechatronics – MEH | Mechatronics |
| | Aviation – LET | Airplane pilot/Helicopter pilot, Aircraft Design and Maintenance |

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 4 basic and 7 interdisciplinary directions. Graduates acquire the degree of Master of Engineering.

| Basic directions | Interdisciplinary directions |
|---|--|
| Machine Design and Mechanics: Mechanics of Materials, Systems and Processes, Engineering Design and Product Development | Traffic Safety Systems, Engineering rheology, Environmental Engineering, Welding, Terotechnology, Engineering pedagogy, Engineering Safety |
| Power and Process Engineering: Thermal and Process Engineering, Power Engineering | |
| Production Engineering: Production Technologies and Systems, Industrial 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 3 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 3 years and combines the scientific fields of 13 faculties. Graduates acquire the degree of Doctor of Science.

Interdisciplinary Doctoral Study Programme Biosciences lasts 3 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,
- Automatisations.

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

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

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

Program groups

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

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

PRESENTATION OF PROGRAMME GROUPS AND ACTIVITIES OF LABORATORIES



01

MODELLING IN TECHNICS AND MEDICINE

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

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

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



Laboratory for Modelling Machine Elements and Structures **LAMEK**

RESEARCH AREAS

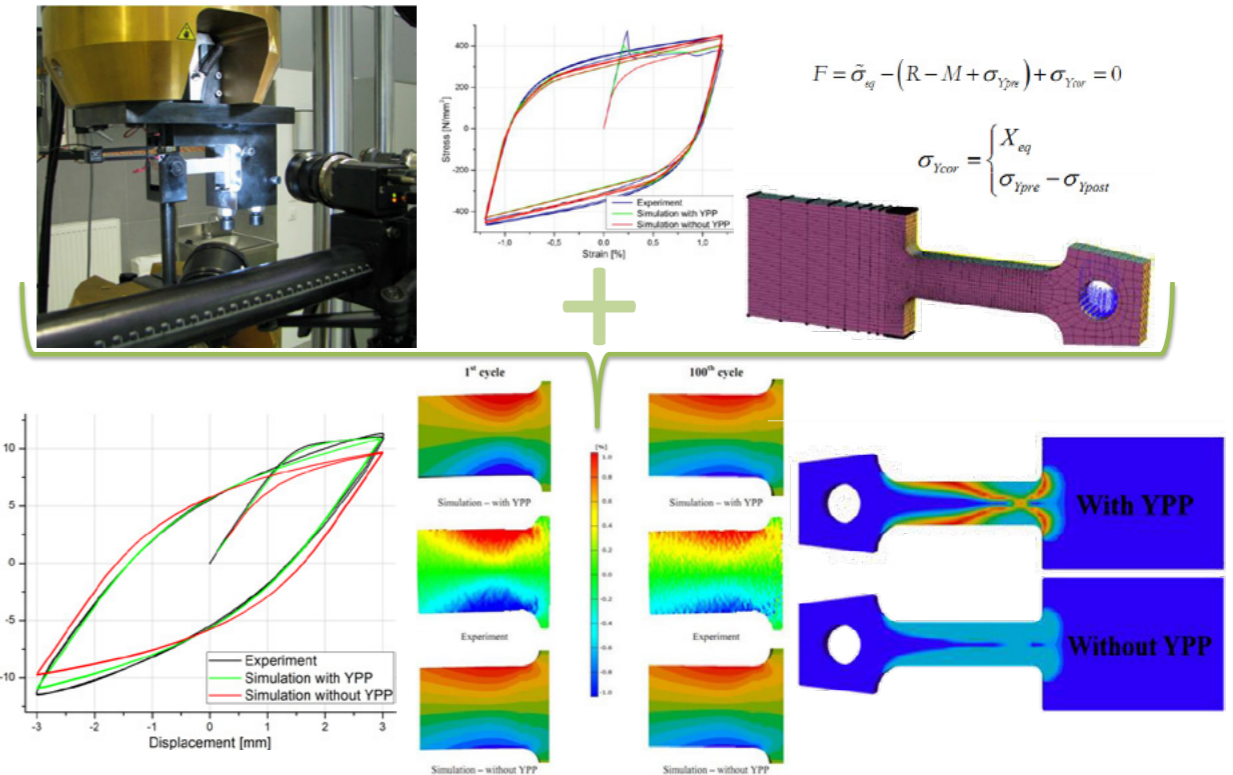
- Mechanical engineering • Special constructions know-how • Large size bearings • Rolling rotational connections • Combustion processes in internal combustion engines • Vehicles • Traffic accidents
- Machine design • Mechanics of structures and machines • Geometric dimensioning and tolerancing • Expert systems • Tolerance analysis
 - Transportation research • Biomechanics • Vehicle engineering
 - Measurement in traffic • Traffic accident analysis

DEPARTMENT HEAD Assist. Prof. Samo Zupan, PhD

DEPARTMENT MEMBERS Assoc. Prof. Robert Kunc, PhD, Assist. Prof. Miha Ambrož, PhD, Assist. Prof. Andrej Žerovnik, PhD, Assist. Simon Krašna, PhD, Assist. Ana Trajkovski, PhD, Assist. Assist. Jovan Trajkovski, PhD, Assist. Matej Žvokelj, PhD, Assist. Matej Kranjec, Assist. Aleksander Novak, Slobodanka Ivanjić Kostrešević, Jernej Korinšek, Silva Brenčič

ORIGINAL SCIENTIFIC ARTICLE

TRAJKOVSKI, Jovan, AMBROŽ, Miha, KUNC, Robert. The importance of friction coefficient between vehicle tyres and concrete safety barrier to vehicle rollover : FE analysis study. Journal of Mechanical Engineering, 2018, vol. 64, no. 12, p. 753-762.



TRAJKOVSKI, Jovan, PERENDA, Jasenko, KUNC, Robert. Blast response of light armoured vehicles (LAVs) with flat and V-hull floor. Thin-walled structures, Oct. 2018, vol. 131, p. 238-244.

PROJECTS

- H2020 - Horizon 2020 - Open access virtual testing protocols for enhanced road users safety - VIRTUAL. Simon Krašna. 2018-2022.
- Company SMM - Assistance in education, consultation, implementation and project management. Samo Zupan.

02 TRANSIENT TWO-PHASE FLOWS

Key long-term research activities of the programme group Transient two-phase flows are focussed on the following areas:

1. Two-phase flows (gas-liquid, solid-gas) where we want to include also more complex systems with different types of boundaries, moving surfaces (such as stirred vessels, trickle bed reactors and fluidization of solid particles in Wurster chamber) which are frequently used in industry.
2. Investigation of unsteady friction effects on the magnitude and timing of pressure pulses during column separation events in industrial applications.
3. Medical modelling and simulation in fluid-structure interaction studies, for example, for analysing partial upper airway collapse or air stream coupling with soft tissue vibration. The only reasonable methodology leading to a successful scientific development involves a coherent and tight integration of theory, modelling and simulation (TMS) with experiment (E) and the data obtained.
4. Validation of CFD codes where the specific problems are going to be chosen in searching for generic principles of complex fluid dynamics simulation with the aim to range commercial codes of applicability to selected industrial problems.



Laboratory for Fluid Dynamics and Thermodynamics **LFDT**

RESEARCH AREAS

Two-phase flow • Phase transitions • Medical modelling and simulation
• Intelligent systems • Thermoeconomics

DEPARTMENT HEAD Prof. Božidar Šarler, PhD

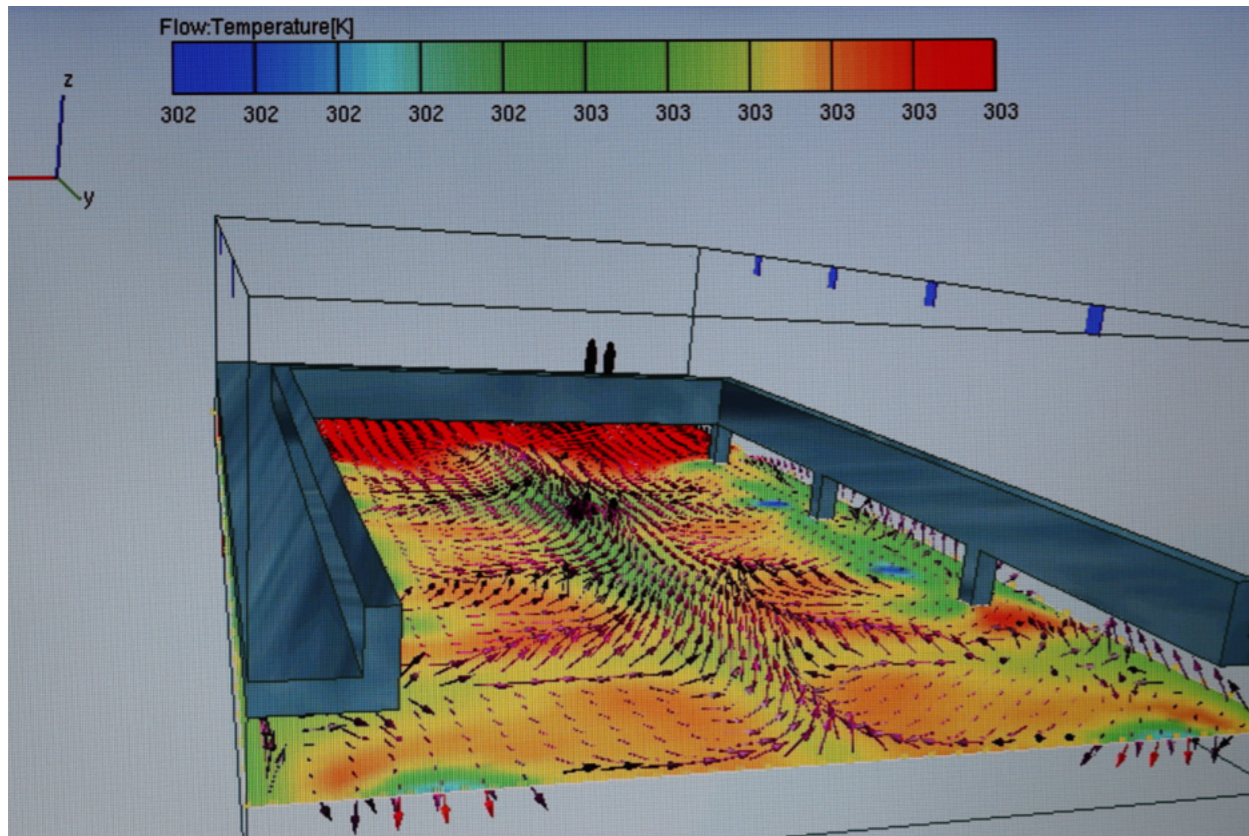
DEPARTMENT MEMBERS Assoc. Prof. Anton Bergant, PhD, Assist. Prof. Andrej Bombač, PhD, Assist. Prof. Matjaž Perpar, PhD, Assist. Jurij Gregorc, PhD, Assist. Zahoor Rizwan, PhD, Zlatko Rek, PhD, Umut Hanoglu, PhD, Katarina Mramor, PhD, Boštjan Mavrič, PhD, Qingguo Liu, PhD, Matic Cotič, Zdenka Rupič

ORIGINAL SCIENTIFIC ARTICLE

HANOGLU, Umut, ŠARLER, Božidar. Multi-pass hot-rolling simulation using a meshless method. *Computers & Structures*, Jan. 2018, vol. 194, p. 1-14.

TALAT, Nazia, MAVRIČ, Boštjan, HATIČ, Vanja, BAJT, Saša, ŠARLER, Božidar. Phase field simulation of Rayleigh-Taylor instability with a meshless method. *Engineering analysis with boundary elements*, Feb. 2018, vol. 87, p. 78-89.

LIU, Qingguo, ŠARLER, Božidar. Non-singular method of fundamental solutions for elasticity problems in three-dimensions. *Engineering analysis with boundary elements*, Nov. 2018, vol. 96, p. 23-35.



TALAT, Nazia, MAVRIČ, Boštjan, BELŠAK, Grega, HATIČ, Vanja, BAJT, Saša, ŠARLER, Božidar. Development of meshless phase field method for two-phase flow. *International Journal of Multiphase Flow*, 2018, vol. 108, p. 169-180.

ZAHOOR, Rizwan, BAJT, Saša, ŠARLER, Božidar. Influence of gas dynamic virtual nozzle geometry on micro-jet characteristics. *International journal of multiphase flow*, 2018, vol. 104, p. 152-165.

HATIČ, Vanja, MAVRIČ, Boštjan, ŠARLER, Božidar. Simulation of a macrosegregation benchmark with a meshless diffuse approximate method. *International journal of numerical methods for heat & fluid flow*, 2018, vol. 28, iss. 2, p. 361-380.

KARADŽIĆ, Uroš, BERGANT, Anton. Experimental investigations of pipeline filling and emptying in a small-scale apparatus = Eksperimentalne raziskave polnjenja in praznjenja cevovoda malih izmer. *Journal of energy technology*, Sept. 2018, vol. 11, iss. 2, p. 11-22.

ZHOU, Ling, WANG, Huan, BERGANT, Anton, TIJSSELING, Arris S., LIU, Deyou, GUO, Su. Godunov-type solutions with discrete gas cavity model for transient cavitating pipe flow. *Journal of hydraulic engineering*, May 2018, vol. 144, iss. 5, p. 1-9.

VILHENA, Luís Miguel Silva, SEDLAČEK, Marko, PODGORNIK, Bojan, REK, Zlatko, ŽUN, Iztok. CFD modeling of the effect of different surface texturing geometries on the frictional behavior. *Lubricants*, 2018, vol. 6, iss. 1, p. 1-25.

ZAHOOR, Rizwan, BELŠAK, Grega, BAJT, Saša, ŠARLER, Božidar. Simulation of liquid micro-jet in free expanding high-speed co-flowing gas streams. *Microfluidics and nanofluidics*, Aug. 2018, vol. 22, p. 1-20.

LUŠTRIK, Matevž, DREU, Rok, PERPAR, Matjaž. Influence of perforated draft tube air intake on a pellet coating process. *Powder technology*, 2018, vol. 330, p. 114-124.

BERGANT, Anton, TIJSSELING, Arris S., KIM, Young-il, KARADŽIĆ, Uroš, ZHOU, Ling, LAMBERT, Martin, SIMPSON, Angus R. Unsteady pressures influenced by trapped air pockets in water-filled pipelines. *Journal of Mechanical Engineering*, 2018, vol. 64, no. 9, p. 501-512.

BOMBAČ, Andrej. Asymmetric blade disc turbine for high aeration rates. *Journal of Mechanical Engineering*, Sept. 2018, vol. 64, no. 9, p. 513-524.

KARADŽIĆ, Uroš, JANKOVIČ, Marko, STRUNJAŠ, Filip, BERGANT, Anton. Water hammer and column separation induced by simultaneous and delayed closure of two valves. *Journal of Mechanical Engineering*, 2018, vol. 64, no. 9, p. 525-535.

PROJECTS

Eureka Cluster - Metallurgy Europe. Božidar Šarler. 1/1/2012 - 31/12/2022

Slovenian Research Agency - Multiphysics and multiscale numerical modelling for competitive continuous casting. Božidar Šarler. 1/7/2018 - 30/6/2021

Company DESY - Innovative methods for imaging with the use of x-ray Free Electron Laser and synchrotron sources. Božidar Šarler. 13/4/2018 - 13/4/2022

AWARDS AND ACHIEVEMENTS

Boštjan Mavrič received an award of the Faculty of Mechanical Engineering for high quality publications

Rizwan Zahoor received an award of the Faculty of Mechanical Engineering for high quality publications

03 ENERGY ENGINEERING

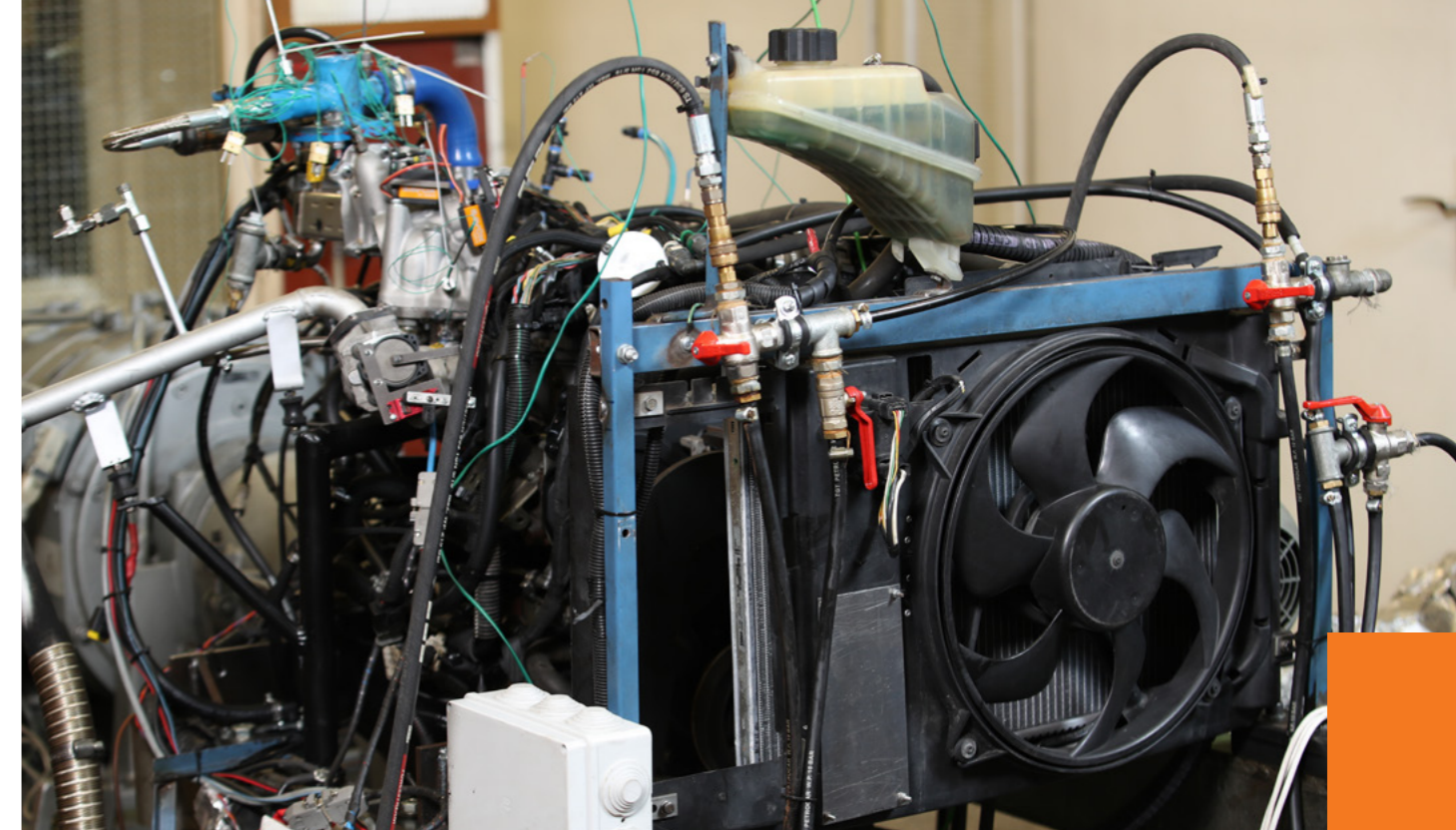
The Energy Engineering research programme is engaged in a wide range of activities:

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

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

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

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



Laboratory for Internal Combustion Engines and Electromobility LICeM

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. Tomaž Katrašnik, PhD

DEPARTMENT MEMBERS Assist. Prof. Tine Seljak, PhD, Assist. Ambrož Kregar, PhD, Assist. Samuel Rodman Oprešnik, PhD, Assist. Gregor Tavčar, PhD, Assist. Rok Vihar, PhD, Assist. Anton Žnidarčič, PhD, Klemen Zelič PhD, Assist. Urban Žvar Baškovič, Igor Mele, Andraž Kravos, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLE

BUFFI, Marco, SELJAK, Tine, CAPPELLETTI, Alessandro, BETTUCCI, Lorenzo, VALERA-MEDINA, Augustin, KATRAŠNIK, Tomaž, CHIARAMONTI, David. Performance and emissions of liquefied wood as fuel for a small scale gas turbine. Applied energy, Nov. 2018, vol. 230, p. 1193-1204.

RODMAN OPREŠNIK, Samuel, VIHAR, Rok, SELJAK, Tine, VIHAR, Rok, GERBEC, Marko, KATRAŠNIK, Tomaž. Real-World fuel consumption, fuel cost and exhaust emissions of different bus powertrain technologies. Energies, 2018, vol. 11, iss. 8, p. 1-20.

RAMŠAK, Anton, ČADEŽ, Tilen, KREGAR, Ambrož, ULČAKAR, Lara. Exact spin-orbit qubit manipulation. The European physical journal, Special topics, 2018, vol. 227, iss. 3/4, p. 353-363.

SELJAK, Tine, PAVALEC, Klemen, BUFFI, Marco, VALERA-MEDINA, Augustin, CHIARAMONTI, David, KATRAŠNIK, Tomaž. Challenges and solutions for utilization of bioliquids in microturbines. Journal of engineering for gas turbines and power, Oct. 2018, vol 141, iss. 3, p. 1-9.

ZELIČ, Klemen, GODEC, Matjaž. A modified mean-linear-intercept method for distinguishing lamellar and globular eutectic carbides in metallographic samples. Materials and technology, 2018, vol. 52, no. 1, p. 83-87.

ZELIČ, Klemen, GODEC, Matjaž. Nucleation and growth of eutectic carbides in AISI D2 tool steel modified by rare earth elements: experimental and modelling approaches. Materials and technology, 2018, vol. 52, no. 5, p. 515-520.

VIHAR, Rok, ŽVAR BAŠKOVIČ, Urban, KATRAŠNIK, Tomaž. Real time capable virtual NOx sensor for diesel engines based on a two-zone thermodynamic model. Oil & gas science and technology, Apr. 2018, vol. 73, p. 1-17.

ZELIČ, Klemen, BURJA, Jaka, MCGUINNESS, Paul J., GODEC, Matjaž. Effect of rare earth elements on the morphology of eutectic carbides in AISI D2 tool steels : experimental and modelling approaches. Scientific reports, 2018, vol. 8, p. 1-8.

ŽVAR BAŠKOVIČ, Urban, VIHAR, Rok, RODMAN OPREŠNIK, Samuel, KATRAŠNIK, Tomaž. Simultaneous particulate matter and nitrogen oxide emission reduction through enhanced charge homogenization in diesel engines. Thermal science, 2018, vol. 22, no. 5, p. 2039-2052.

PROJECTS

Slovenian Research Agency - Next-generation electrochemical LiFePO4 battery model. Tomaž Katrašnik. 1/5/2017 - 30/4/2020

H2020 - Horizon 2020 - Optimization of scalable realtime models and functional testing for e-drive Concepts (OBELICS). Tomaž Katrašnik. 01/10/2017 - 30/9/2020

ERDF - European regional development fond SPS - Environmentally Safe Green Mobility Car (EVA4green). Tomaž Katrašnik. 01/9/2016 - 28/2/2019

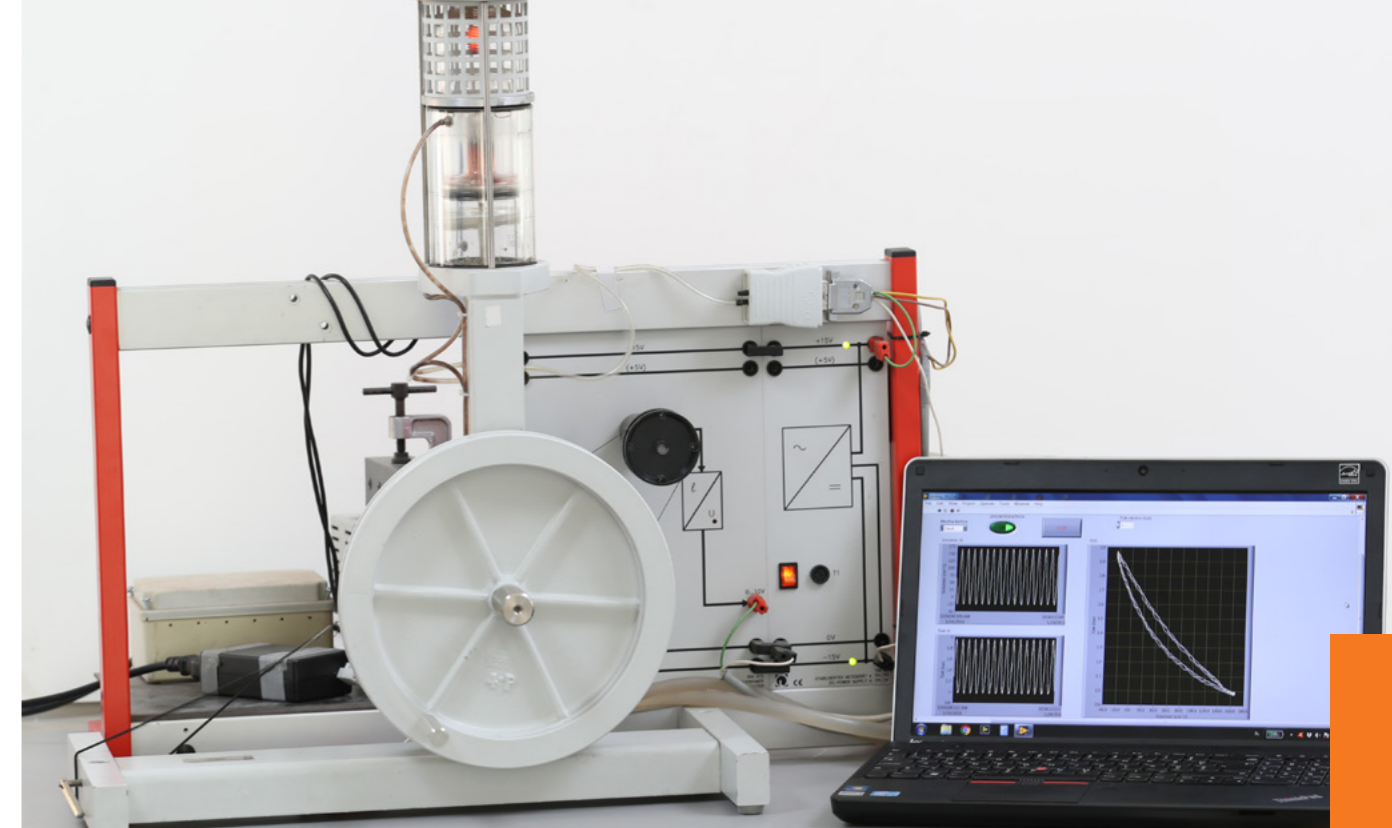
ERDF - European regional development fond SPS - Exploring biomass potential for development of advanced materials and bio-based products (AMP). Tomaž Katrašnik. 1/9/2016 - 30/6/2020

FFG - State of Health Überwachung für PEM Brennstoffzellenstapel (SOH4PEM). Tomaž Katrašnik. 1/10/2016 - 31/3/2019

FFG - Resource-saving composite materials for stationary PEM fuel cells with increased power density and long-term stability (MEA Power). Tomaž Katrašnik. 1/3/2015 - 28/2/2018

COMET - K2 Funding Program - K2 Digital Mobility - Context-Embedded Vehicle Technologies (K2 Mobility). Tomaž Katrašnik. 1/1/2018 - 31/12/2021

Company AVL - Development of advanced mechanistically based simulation models for Internal Combustion Engines and Fuel Cells. Tomaž Katrašnik.



Laboratory for Heat and Power LTE

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. Mihael Sekavčnik, PhD

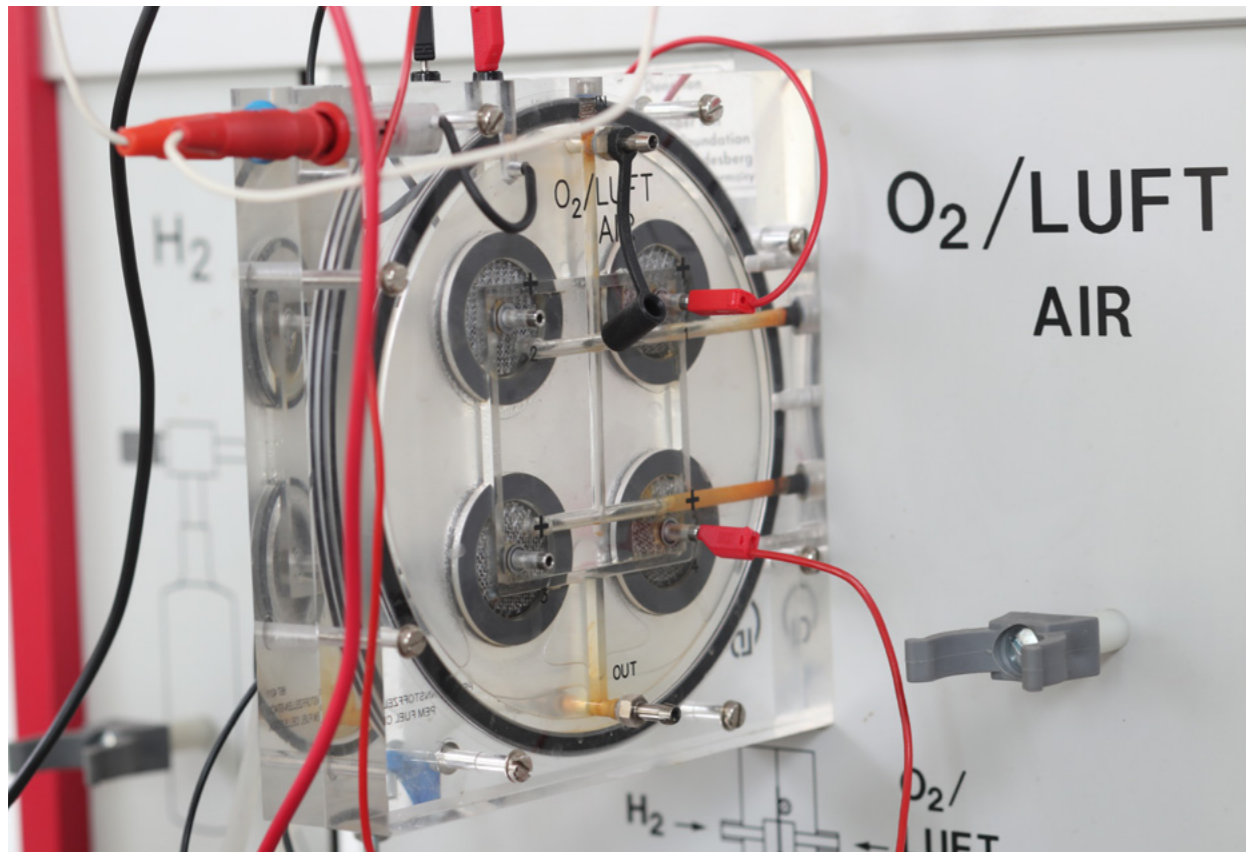
DEPARTMENT MEMBERS Assoc. Prof. Andrej Senegačnik, PhD, Assist. Prof. Boštjan Drobnič, PhD, Assist. Prof. Mitja Mori, PhD, Igor Kuštrin, PhD, Assist. Andrej Lotrič, PhD, Assist. Rok Stropnik, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLE

STROPNIK, Rok, SEKAVČNIK, Mihael, FERRIZ, Ana María, MORI, Mitja. Reducing environmental impacts of the ups system based on PEM fuel cell with circular economy. Energy, 2018, vol. 165, part B, p. 824-835.

MELE, Jernej, SENEGAČNIK, Andrej. Design of a fast internal circulating fluidized-bed gasifier with a conical bed angle. Thermal science, 2018, p. 1-13.

FÉRRIZ, Ana María, BERNAD, Alfonso, MORI, Mitja, FIOROT, Sabina. End-of-life of fuel cell and hydrogen products : a state of the art. International journal of hydrogen energy, 2018, p. 1-8.



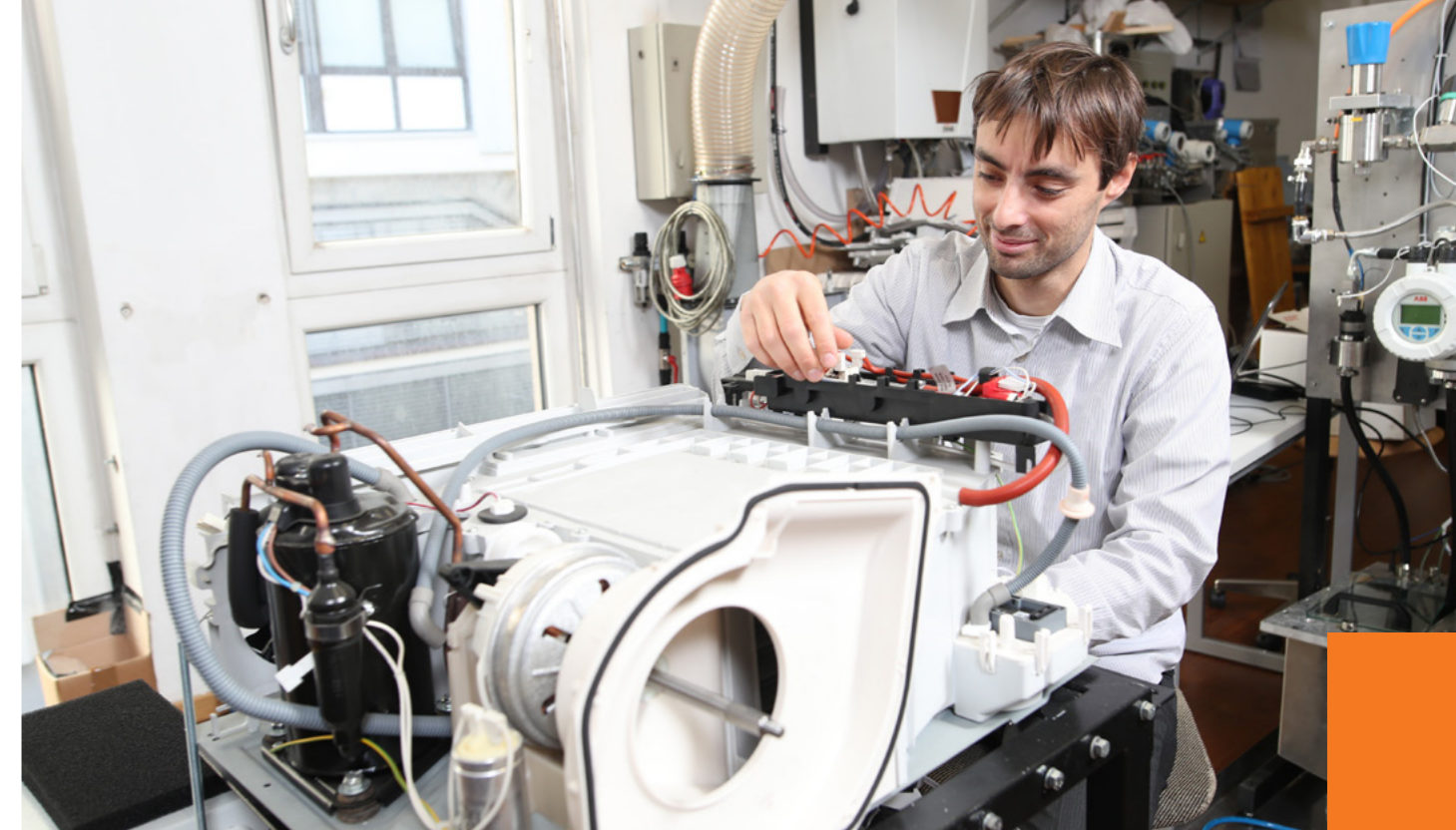
PROJECTS

H2020 - Horizon 2020 - New technologies and strategies for fuel cells and hydrogen technologies in the phase of recycling and dismantling (HYTECHCYCLING). Mihael Sekavčnik. 01/5/2016 - 30/4/2019

LIFE - Sustainable Mountain huts in Europe (SUSTAINHUTS). Mihael Sekavčnik. 1/5/2016 - 30/4/2019

COST - European Cooperation in science and technology - Performance and Reliability of Photovoltaic Systems: Evaluations of Large-Scale Monitoring Data; CA COST Action CA16235. Mitja Mori. 5/10/2017-4/10/2021

COST - European Cooperation in science and technology. Performance and Reliability of Photovoltaic Systems: Evaluations of Large-Scale Monitoring Data. Mitja Mori. 5/10/2017-4/10/2021



Laboratory for Hydraulic Machines **LVTS**

RESEARCH AREAS

Fluid mechanics • Turbine machines • Computer aided visualisation

DEPARTMENT HEAD Prof. Marko Hočevar, PhD

DEPARTMENT MEMBERS Prof. Matevž Dular, PhD, Prof. Branko Širok, PhD, Assist. Prof. Benjamin Bizjan, PhD, Assist. Prof. Martin Petkovšek, PhD, Assist. Lovrenc Novak, PhD, Assist. Janez Vrtovšek, PhD, Assist. Mojca Zupanc, PhD, Tadej Stepišnik Perdih, PhD, Assist. Jurij Gostiša, Assist. Jure Zevnik, M.sc. Tone Godeša, Aleš Malneršič, Matej Sečnik, Peter Pipp, Žiga Pandur, Pero Gatarić, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLE

MODIČ, Špela, ŽIGON, Primož, KOLMANIČ, Aleš, GODEŠA, Tone, RAZINGER, Jaka. Effectiveness of different control measures against western corn rootworm larvae *Diabrotica virgifera virgifera* LeConte, 1868. *Acta agriculturae Slovenica*, 2018, letn. 111, št. 1, p. 161-167.

BIZJAN, Benjamin, ŠIROK, Brane, CHEN, Jinpeng. Optical measurement of high-temperature melt flow rate. *Applied optics*, May 2018, vol. 57, iss. 15, p. 4202-4210.

DŽEMIĆ, Zijad, ŠIROK, Brane, BIZJAN, Benjamin. Turbine flowmeter response to transitional flow regimes. *Flow measurement and instrumentation*, 2018, vol. 59, p. 18-22.

LEŠNIK, Luka, KEGL, Breda, BOMBEK, Gorazd, HOČEVAR, Marko, BILUŠ, Ignacijo. The influence of in-nozzle cavitation on flow characteristics and spray break-up. *Fuel*, Jun. 2018, vol. 222, p. 550-56.

WANG, Jian, WANG, Yong, LIU, Houlin, SI, Qiaorui, DULAR, Matevž. Rotating corrected-based cavitation model for a centrifugal pump. *Journal of fluids engineering : Transactions of the ASME*, Nov. 2018, vol. 140, iss. 11, p. 1-8.

RAK, Gašper, HOČEVAR, Marko, STEINMAN, Franci. Construction of water surface topography using LIDAR data. *Journal of Mechanical Engineering*, 2018, letn. 64, št. 9, p. 555-565.

ŠARC, Andrej, KOSEL, Janez, STOPAR, David, ODER, Martina, DULAR, Matevž. Removal of bacteria *Legionella pneumophila*, *Escherichia coli*, and *Bacillus subtilis* by (super)cavitation. *Ultrasonics Sonochemistry*, Apr. 2018, vol. 42, p. 228-236.

DULAR, Matevž, PETKOVŠEK, Martin. Cavitation erosion in liquid nitrogen. *Wear*, 2018, vol. 400/401, p. 111-118.

DOCTORAL DISSERTATIONS

Peternelj Marko. Kinematics of mineral wool fibers in air flow. Mentor Branko Širok

Stepišnik Perdih Tadej. The application of hydrodynamic cavitation in the washing machine. Mentor Branko Širok, Co-mentor Matevž Dular

PROJECTS

Slovenian Research Agency – Scale effects in acoustic cavitation in various liquids with dimensionless number definition. Martin Petkovšek. 01/5/2016 - 30/4/2019

Slovenian Research Agency – Improved treatment and monitoring of Water Framework Directive priority pollutants. Marko Hočevar (operator: IJS). 01/9/2016 - 28/2/2019

Slovenian Research Agency - Development of new, environment-friendly approaches for plant and human virus inactivation in waters. Matevž Dular. 1/7/2018 - 30/6/2021

Slovenian Research Agency - The physics of ultrasonic production of (nano) emulsions. Matevž Dular. 1/1/2018 - 31/12/2019

EIT - European Institute of Innovation & Technology - Cooling Tower Profiler - Performance Evaluation of Cooling Towers (CTProfiler). Marko Hočevar. 1/4/2017 - 30/9/2019

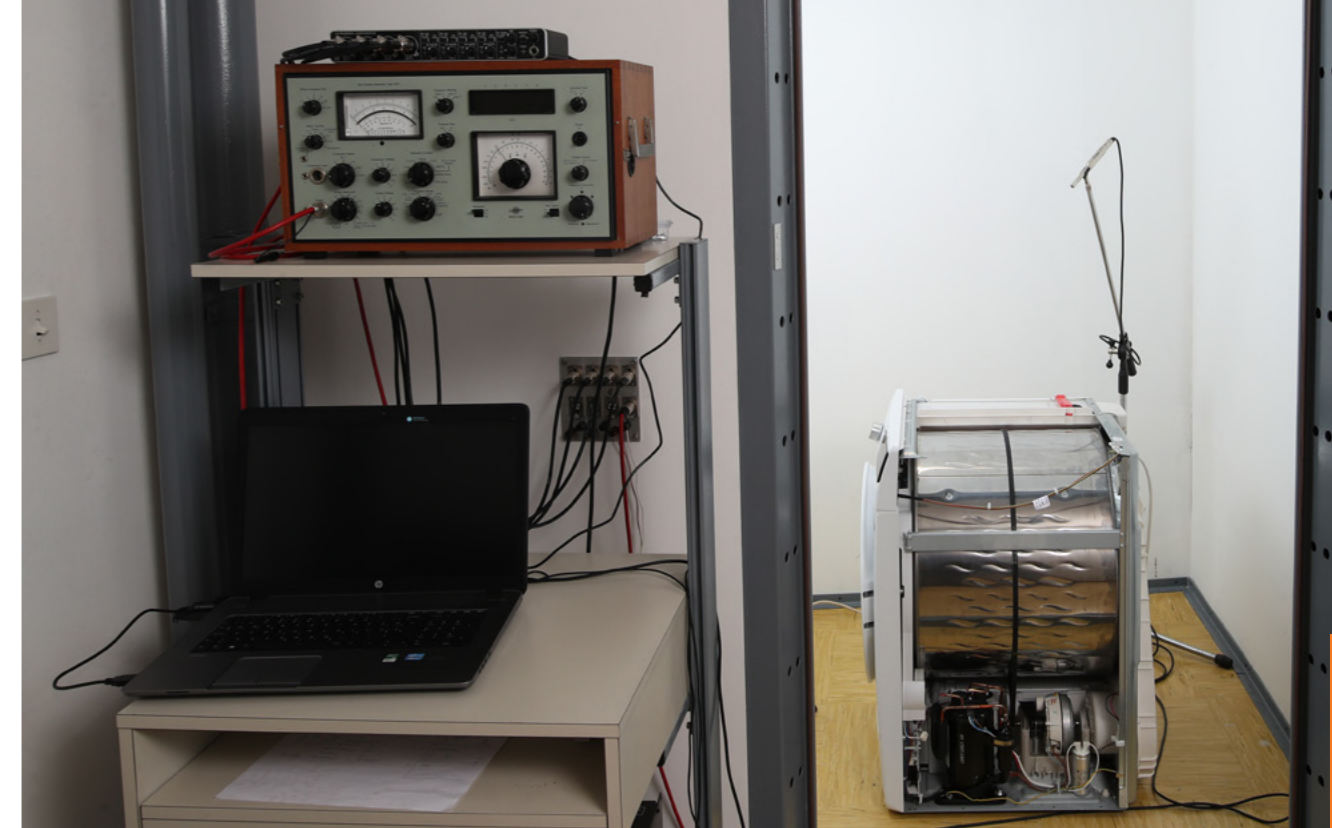
H2020 Horizon 2020 - ERC - An Investigation of the Mechanisms at the Interaction Between Cavitation Bubbles and Cotaminants (CABUM). Matevž Dular. 1/6/2018 - 31/5/2023

ERDF - European regional development fund - SPS - Intelligent home of the new generation designed on smart appliances and wood (IQ HOME). Marko Hočevar. 1/9/2016 - 28/2/2019

ERDF - European regional development fund - SPS - Potential of biomass for development of advanced materials and bio-based products (NMP). Marko Hočevar. 1/9/2016 - 30/6/2020

ERDF - European regional development fund - SPS - Exploring biomass potential for development of advanced materials and bio-based products (AMP). Marko Hočevar. 1/9/2016 - 30/6/2020

Company Gorenje - Development of a fan and independent control of the heat pump tumble dryer fan and drum. Marko Hočevar. 1/12/2018 - 31/5/2020



Laboratory for Pumps, Compressors and Technical Acoustics LEDSTA

RESEARCH AREAS

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

DEPARTMENT HEAD Assoc. Prof. Jurij Prezelj, PhD

DEPARTMENT MEMBERS Assist. Luka Čurović, Jure Murovec, Tadej Novaković, Zdenka Rupič

ORIGINAL SCIENTIFIC ARTICLE

PREZELJ, Jurij, NOVAKOVIĆ, Tadej. Centrifugal fan with inclined blades for vacuum cleaner motor. *Applied acoustics*, Nov. 2018, vol. 140, p. 13-23.

MUROVEC, Jure, PREZELJ, Jurij, ČUROVIĆ, Luka, NOVAKOVIĆ, Tadej. Microphone array based automated environmental noise measurement system. *Applied acoustics*, 2018, vol. 141, p. 106-114.

CONFERENCE

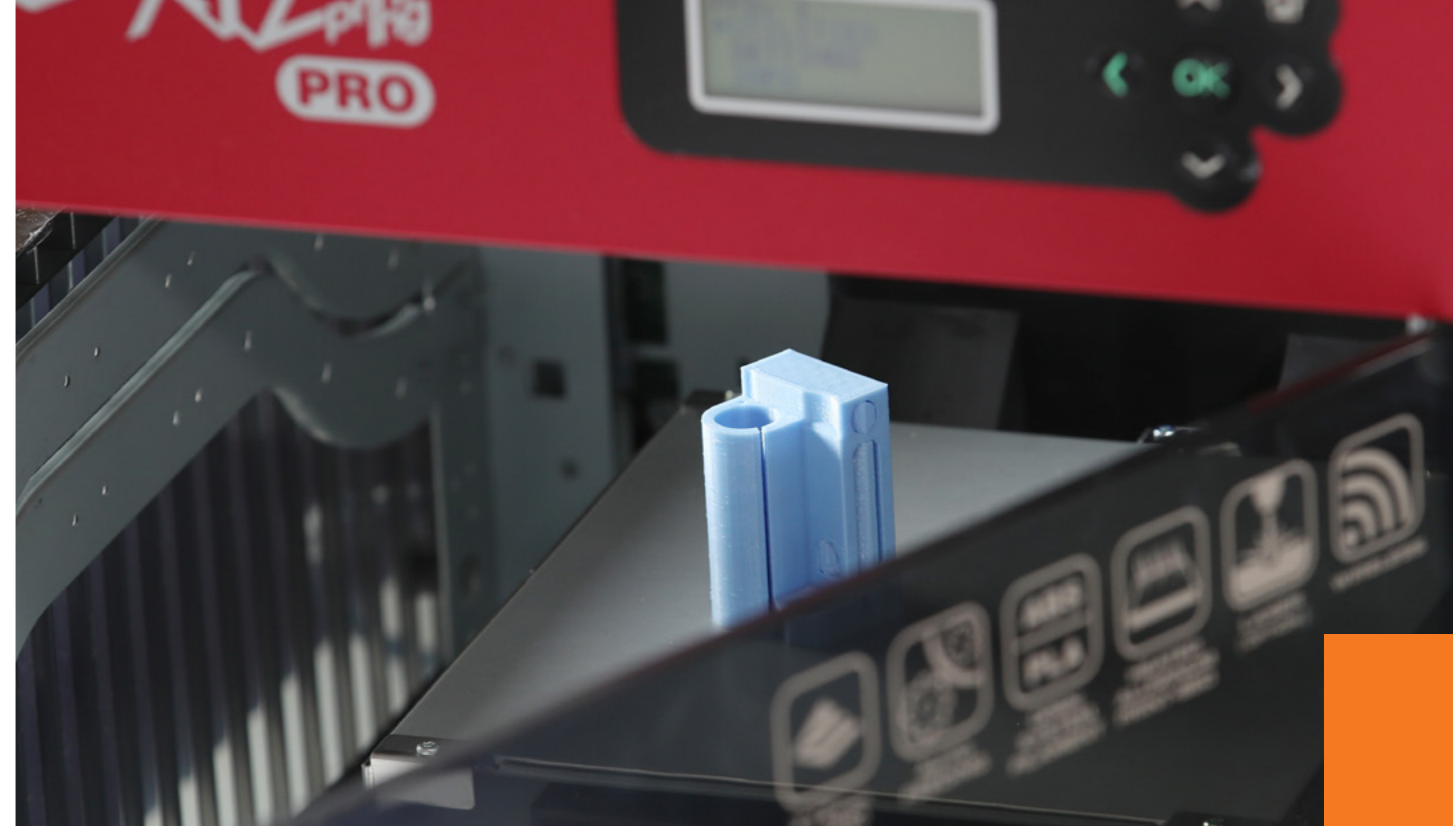
8th CONFERENCE of Alps Adria Acoustic Association, 20-21 September, Zagreb, Croatia

04 DEVELOPMENT EVALUATION

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

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

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



Laboratory for Machine Elements **LASEM**

RESEARCH AREAS

Machine element • Operational strength • Development evaluations

DEPARTMENT HEAD Prof. Marko Nagode, PhD

DEPARTMENT MEMBERS Assist. Prof. Simon Oman PhD, Assist. Aleš Gosar, PhD, Assist. Ivan Okorn, PhD, Assist. Tadej Kocjan, Assist. Branislav Panič, Assist. Urša Šolinc, Miran Nerat, Silva Brenčič

ORIGINAL SCIENTIFIC ARTICLE

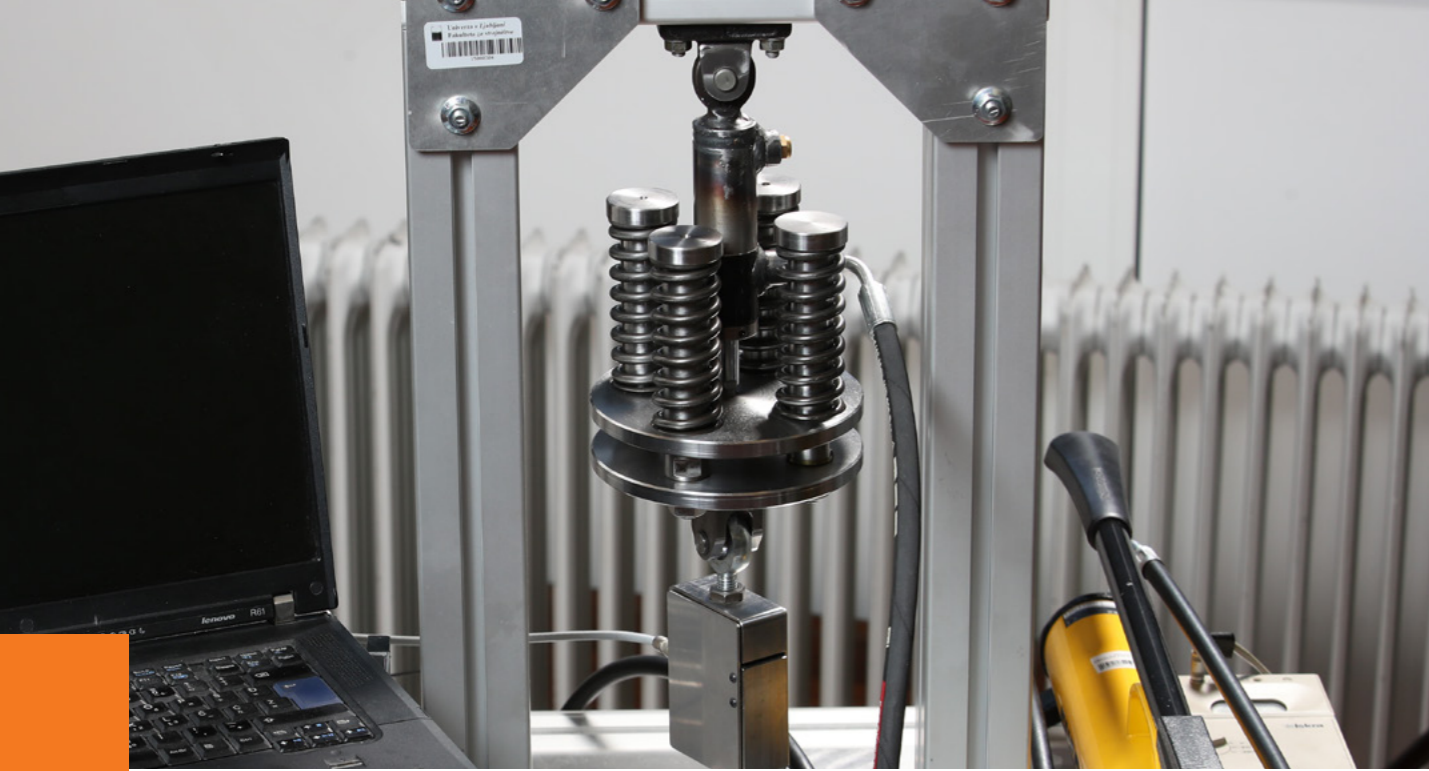
OMAN, Simon, NAGODE, Marko. The influence of piston shape on air-spring fatigue life. Fatigue & fracture of engineering materials & structures, 2018, vol. 41, iss. 5, p. 1019-1031.

OKORN, Ivan, NAGODE, Marko, KLEMENC, Jernej. Analysis on damage to rolling bearings at small turning angles. Journal of Mechanical Engineering, Apr. 2018, vol. 64, no. 4, p. 209-215.

PROJECTS

Slovenian Research Agency – Development of multifunctional auxetic cellular structures. Marko Nagode (operator: UM – Matej Vesenjajk). 1/5/2017 - 30/4/2020

ERDF - European regional development fond SPS - Ecological Safe Vehicle for green mobility (EVA4green). Marko Nagode. 1/9/2016 - 28/2/2019



05 HEAT AND MASS TRANSFER

Laboratory for Structure Evaluation **LAVEK**

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. Jernej Klemenc, PhD

DEPARTMENT MEMBERS Assist. Prof. Domen Šeruga, PhD, Assist. Andrej Škrlec, PhD, Assist. Dejan Tomažinčič, Assist. Peter Zobec, M. Sc. Tomaž Bešter, Silva Brenčič

ORIGINAL SCIENTIFIC ARTICLE

MORAL PORTALÉS, Rubén, BOCHONS SANIA, María del Mar, KLEMENC, Jernej. Theoretical framework for estimating a product's reliability using a variable-amplitude loading spectrum and a stress-based approach. *Fatigue & fracture of engineering materials & structures*, Aug. 2018, vol. 41, iss. 8, p. 1662-1673.

PROJECTS

ERDF - European regional development fond SPS - Ecological Safe Vehicle for green mobility (EVA4green). Jernej Klemenc. 1/9/2016 - 28/2/2019

Slovenian Research Agency - Development of multifunctional auxetic cellular structures. Marko Nagode (operator: UM - Matej Vesenjok). 1/5/2017 - 30/4/2020

AWARDS AND ACHIEVEMENTS

Jernej Klemenc received an award of the Faculty of Mechanical Engineering for excellence in teaching

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

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

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



Laboratory for Measurements in Process Engineering **LMPS**

RESEARCH AREAS

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

DEPARTMENT HEAD Assoc. Prof. Jože Kutin, PhD

DEPARTMENT MEMBERS Assist. Prof. Gregor Bobovnik, PhD, Assist. Andrej Svete, PhD, Assist. Metka Štefe, Marjan Pohl, Peter Sambol, Zdenka Rupič

ORIGINAL SCIENTIFIC ARTICLE

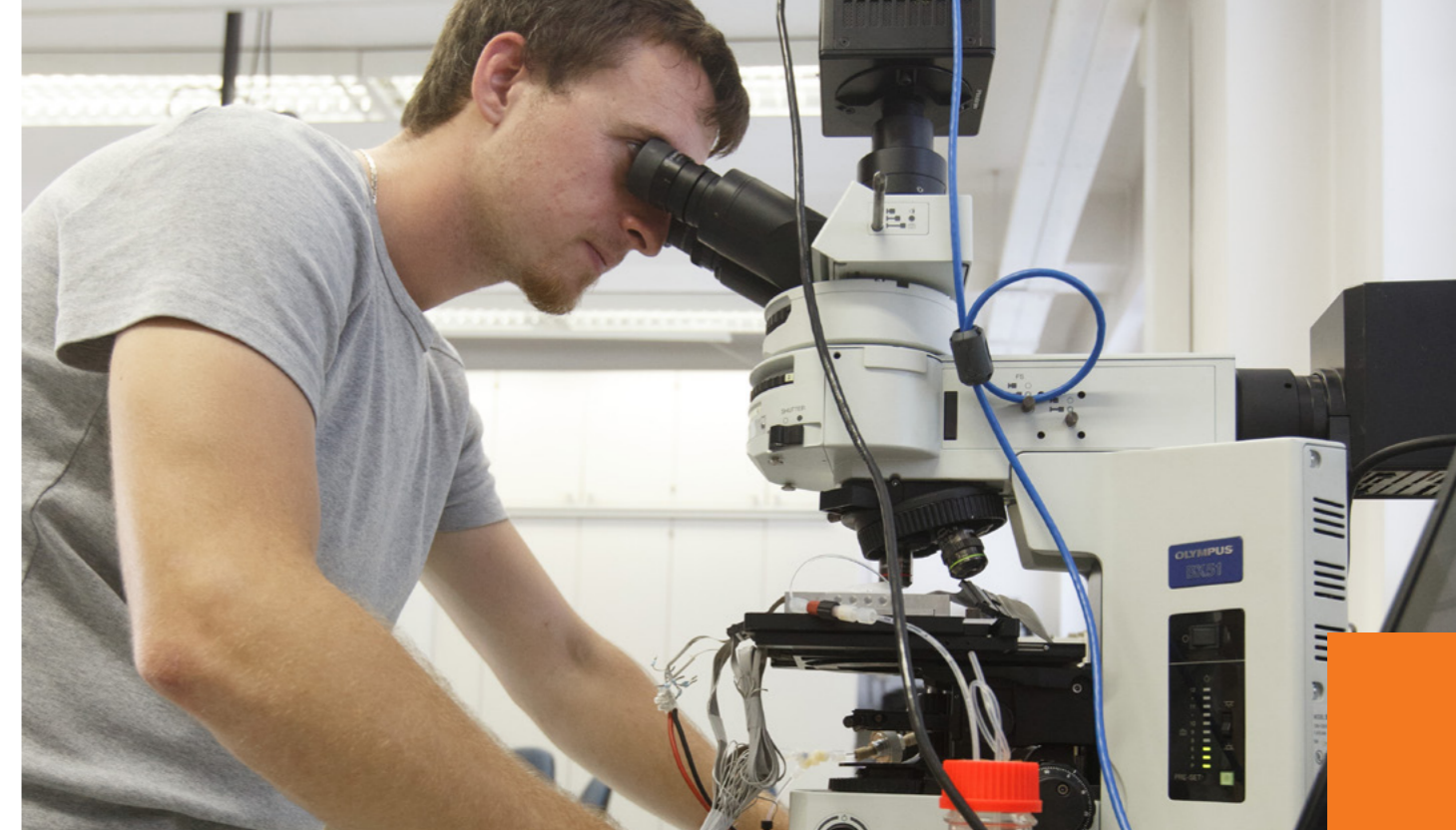
RUPNIK, Klemen, BAJSIČ, Ivan, KUTIN, Jože. Modelling of a thermal dispersion mass flow meter. *Flow measurement and instrumentation*, 2018, vol. 59, p. 37-44.

BOBOVNIK, Gregor, KUTIN, Jože. Numerical study of the fluid-dynamic loading on pipes conveying fluid with a laminar velocity profile. *Journal of fluids and structures*, 2018, vol. 80, p. 441-450.

ŠTEFE, Metka, SVETE, Andrej, KUTIN, Jože. Development of a dynamic pressure generator based on a loudspeaker with improved frequency characteristics. *Measurement : journal of the International Measurement Confederation*, Jul. 2018, vol. 122, p. 212-219.

KUTIN, Jože, SVETE, Andrej. On the theory of the frequency response of gas and liquid pressure measurement systems with connecting tubes. *Measurement science & technology*, 2018, vol. 29, no. 12, p. 1-11.

SVETE, Andrej, BAJSIČ, Ivan, KUTIN, Jože. Investigation of polytropic corrections for the piston-in-cylinder primary standard used in dynamic calibrations of pressure sensors. *Sensors and actuators. A, Physical*, May 2018, vol. 274, p. 262-271.



Laboratory for Heating Technology **LTT**

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. Iztok Golobič, PhD

DEPARTMENT MEMBERS Assist. Prof. Matevž Zupančič, PhD, Assist. Anže Sitar, PhD, Assist. Jure Voglar, Assist. Matic Može, Ivan Sedmak, Zdenka Rupič

ORIGINAL SCIENTIFIC ARTICLE

SITAR, Anže, LEBAR, Andrej, CRIVELLARI, Michele, BAGOLINI, Alvis, GOLOBIČ, Iztok. Oscillations during flow boiling in single microchannels. *Acta chimica slovenica*, 2018, vol. 65, no. 4, p. 980-988.

VOGLAR, Jure, GREGORČIČ, Peter, ZUPANČIČ, Matevž, GOLOBIČ, Iztok. Boiling performance on surfaces with capillary-length-spaced one- and two-dimensional laser-textured patterns. *International journal of heat and mass transfer*, Dec. 2018, vol. 127, part A, p. 1188-1196.

RAVNIK, Jure, GOLOBIČ, Iztok, SITAR, Anže, AVANZO, M., IRMAN, Špela, KOČEVAR, K., CEGNAR, Mateja, ZADRAVEC, Matej, RAMŠAK, Matjaž, HRIBERŠEK, Matjaž. Lyophilization model of mannitol water solution in a laboratory scale lyophilizer. *Journal of drug delivery science and technology*, June 2018, vol. 45, p. 28-38.



INDEPENDENT SCIENTIFIC COMPONENT PART OR A CHAPTER IN A MONOGRAPH

SEDMAK, Ivan, URBANČIČ, Iztok, ŠTRANCAR, Janez, MORTIER, Michel, GOLOBIČ, Iztok. High-Resolution thermal imaging based on the fluorescence of Erbium/Ytterbium co-doped ceramic : chapter 13. V: YURISH, Sergey Y. (ur.). Physical sensors, sensor networks and remote sensing, (Advances in sensors: Reviews, Vol. 5). [S. l.]: IFSA. 2018, p. 325-338, ilup. http://www.sensorsportal.com/HTML/BOOKSTORE/Advances_in_Sensors_Reviews_Vol_5.pdf.

DOCTORAL DISSERTATIONS

Petkovšek Jure. Nucleate Boiling Heat Transfer and Critical Heat Flux on Thin Heaters. Mentor Iztok Golobič

PROJECTS

ESA – European space agency - Microgravity Applications Program (MAP project). Iztok Golobič. 1/1/2016 - 30/6/2019

Company Melamin - Making of the study on the development of a membrane process system for nano-filtration of PAE resins. Iztok Golobič. 17/2/2017 – 17/2/2018

Company Melamin - Execution of an ultrafiltration system for the preparation of process water for filling up the cooling system. Iztok Golobič. 27/11/2018 - 27/5/2019



Laboratory for Refrigeration and District Energy LAHDE

RESEARCH AREAS

Refrigeration • Heat pumps • Heat and mass transfer • Micro Thermal devices • Caloric technologies • Applied Energy Materials

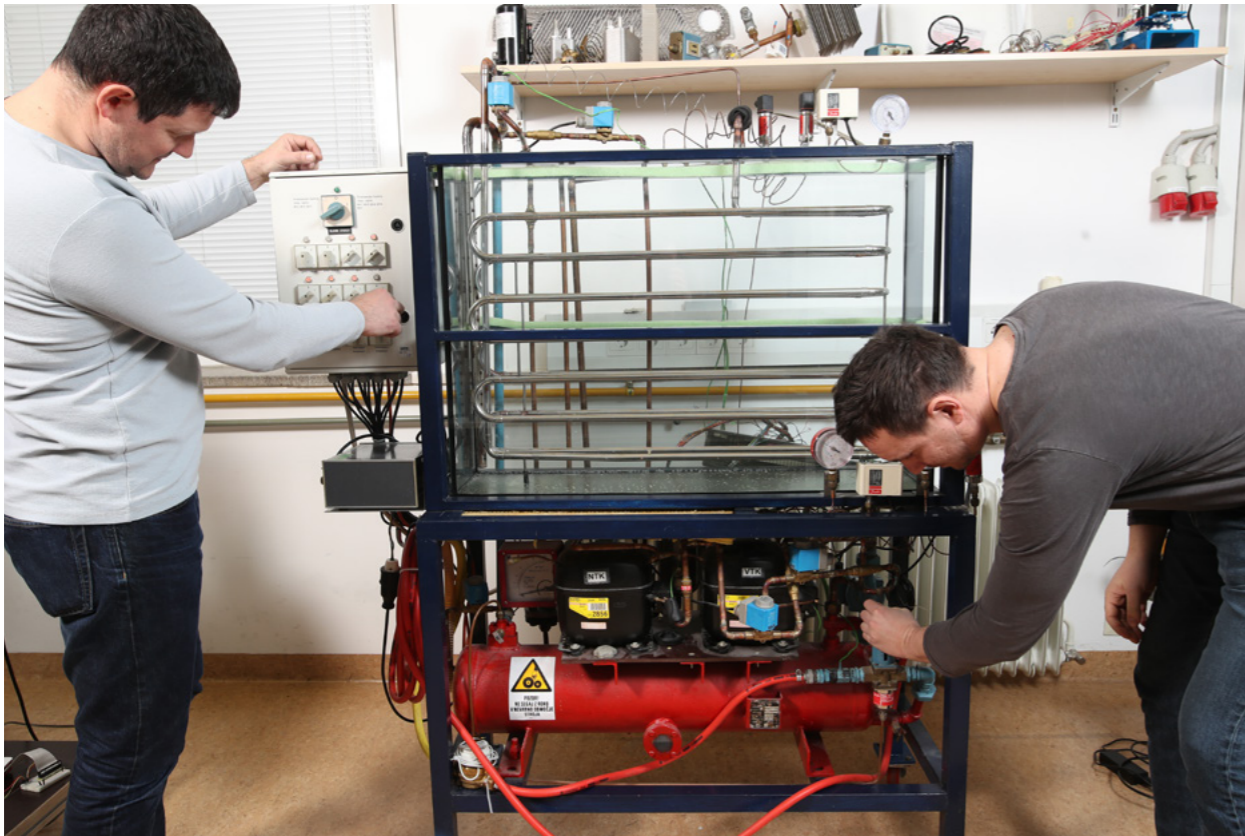
DEPARTMENT HEAD Prof. Andrej Kitanovski, PhD / Prof. Alojz Poredoš, PhD

DEPARTMENT MEMBERS Assist. Prof. Jure Mencinger, PhD, Assist. Prof. Jaka Tušek, PhD, Assist. Andrej Ljubenko, PhD, Assist. Primož Poredoš, PhD, Assist. Urban Tomc, PhD, Assist. Boris Vidrih, PhD, Assist. Uroš Plaznik, PhD, Assist. Katja Klinar, Assist. Luka Lorbek, Assist. Nada Petelin, Simon Nosan, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLE

TUŠEK, Jaka, ŽEROVNIK, Andrej, ČEBRON, Matjaž, BROJAN, Miha, ŽUŽEK, Borut, ENGELBRECHT, Kurt, CADELLI, Andrea. Elastocaloric effect vs fatigue life : exploring the durability limits of Ni-Ti plates under pre-strain conditions for elastocaloric cooling. Acta materialia, May 2018, vol. 150, p. 295-307.

POREDOŠ, Primož, VIDRIH, Boris, KITANOVSKI, Andrej, POREDOŠ, Alojz. A thermo-economic and emissions analysis of different sanitary-water heating units embedded within fourth-generation district-heating systems. Journal of energy resources technology : Transactions of the ASME, 2018, vol. 140, iss. 12, p. 122003-1-122003-8.



LORBEK, Luka, POREDOŠ, Primož, KITANOVSKI, Andrej, POREDOŠ, Alojz. Analytical modeling and numerical simulation of heat transfer in a skin evaporator. *International journal of refrigeration*, 2018, p. 1-19.

PATENT

MALIČ, Barbara, URŠIČ, Hana, KOSEC, Marija, DRNOVŠEK, Silvo, CILENŠEK, Jena, KUTNJAK, Zdravko, ROŽIČ, Brigita, FLISAR, Uroš, KITANOVSKI, Andrej, OŽBOLT, Marko, PLAZNIK, Uroš, POREDOŠ, Alojz, TOMC, Urban, TUŠEK, Jaka. Method for electrocaloric energy conversion : United States Patent US9915446 (B2), 2018-03-13. [S. I.]: Unated States Patent and Trademark Office, 2018. [16] p., patent family: US2016187034 (A1).

PROJECTS

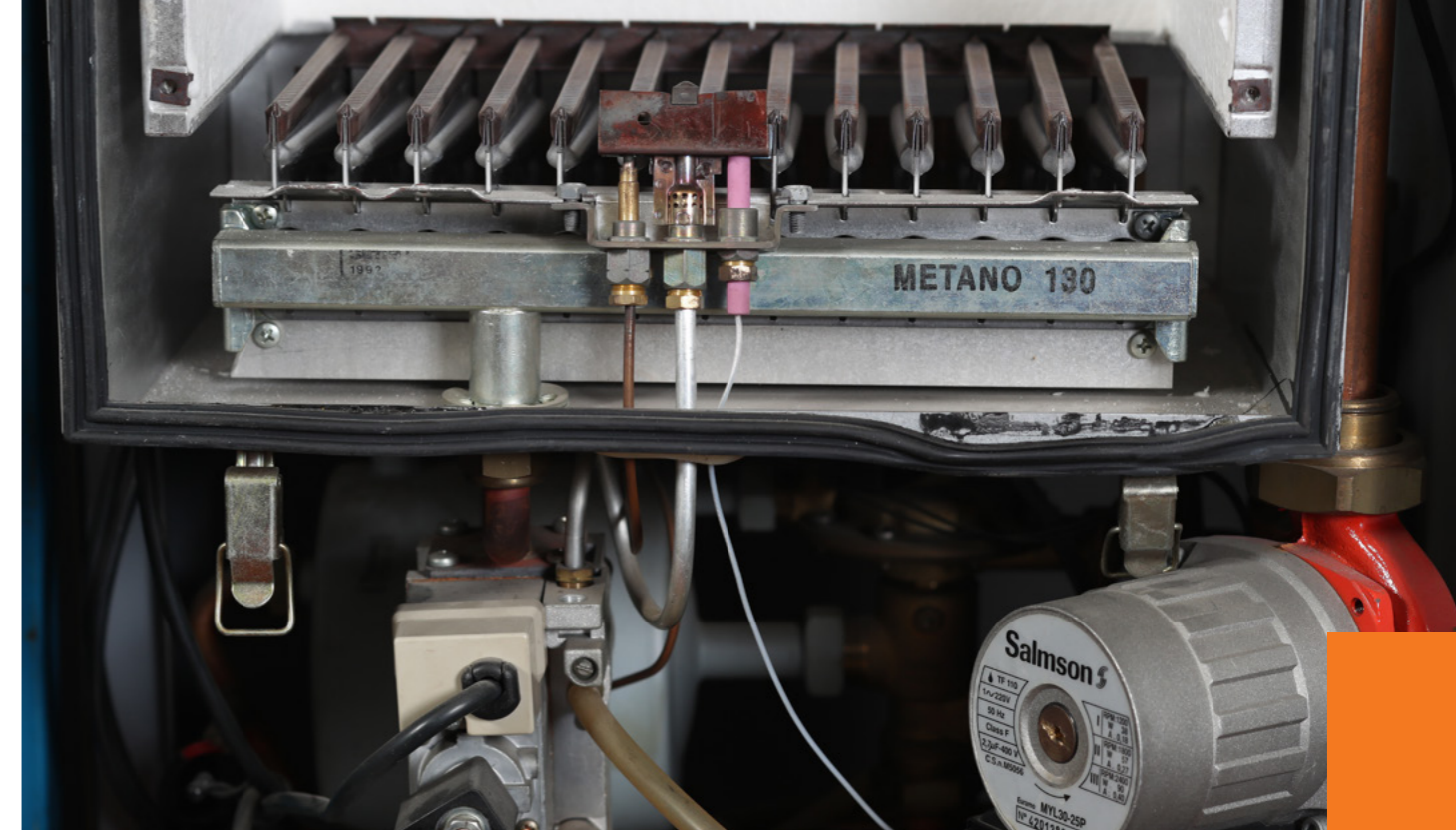
Slovenian Research Agency - From the elastocaloric effect to the efficient cooling device. Jaka Tušek. 1/1/2016 - 30/1/2018

Slovenian Research Agency - Digital microfluidics in magnetocaloric refrigeration. Urban Tomc. 1/7/2018 - 30/6/2020

Slovenian Research Agency - Multicaloric cooling. Andrej Kitanovski. 1/7/2018 - 30/6/2021

Slovenian Research Agency - Advanced electrocaloric energy conversion. Prof. dr. Andrej Kitanovski Andrej. 1/3/2016 - 2/2/2019

ERDF - European regional development fond SPS - Intelligent home of the new generation designed on smart appliances and wood (IQ HOME). Alojz Poredoš, 1/9/2016 - 28/2/2019



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

RESEARCH AREAS

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

DEPARTMENT HEAD Assoc. Prof. Uroš Stritih, PhD

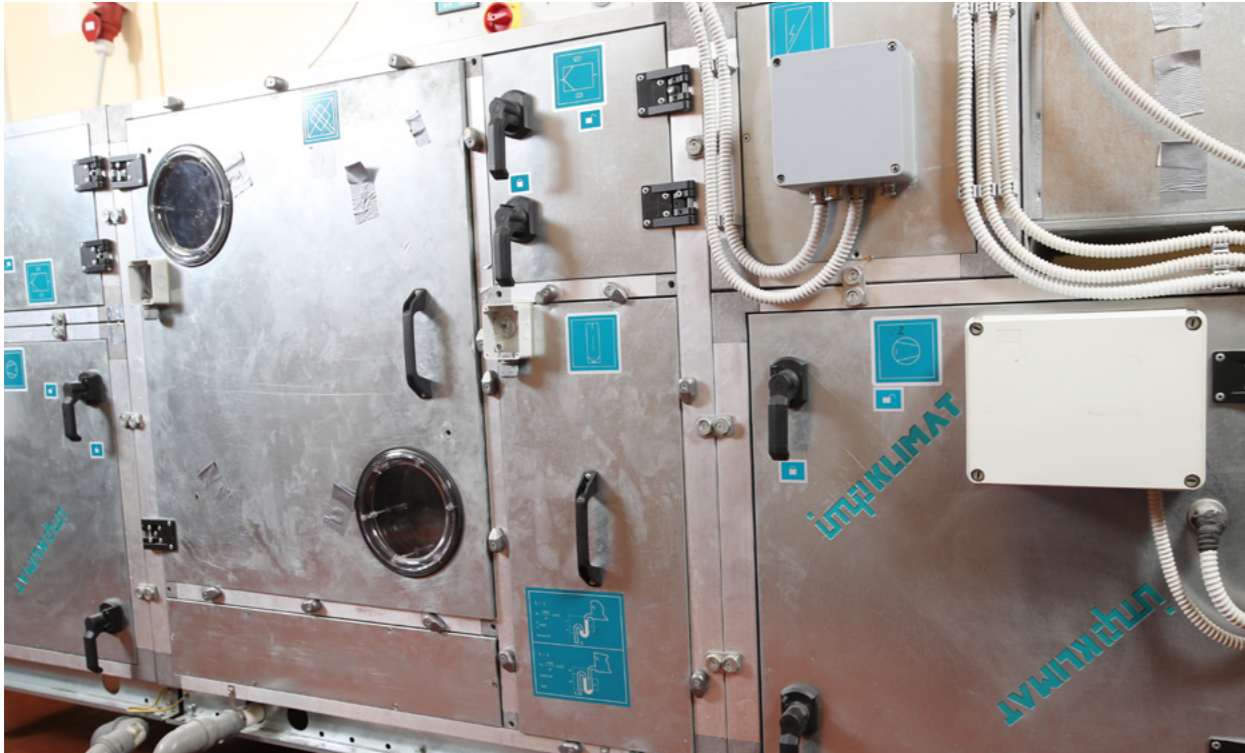
DEPARTMENT MEMBERS Assist. Prof. Matjaž Prek, PhD, Assist. Eneja Osterman, PhD, Assist. Rok Koželj, Žiga Lampret, Eva Zavrl, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLE

KRESE, Gorazd, KOŽELJ, Rok, BUTALA, Vincenc, STRITIH, Uroš. Thermochemical seasonal solar energy storage for heating and cooling of buildings. *Energy and buildings*, Apr. 2018, vol. 164, p. 239-253.

LAMPRET, Žiga, KRESE, Gorazd, BUTALA, Vincenc, PREK, Matjaž. Impact of airflow temperature fluctuations on the perception of draught. *Energy and buildings*, Nov. 2018, vol. 179, p. 112-120.

KRESE, Gorazd, LAMPRET, Žiga, BUTALA, Vincenc, PREK, Matjaž. Determination of a building's balance point temperature as an energy characteristic. *Energy*, Dec. 2018, vol. 165, Part B, p. 1034-1049.



PREK, Matjaž, KRESE, Gorazd. Experimental analysis of an improved regulation concept for multi-panel heating radiators : proof-of-concept. *Energy*, Oct. 2018, vol. 161, p. 52-59.

OSTERMAN, Eneja, BUTALA, Vincenc, STRITIH, Uroš. Parametric analysis of PCM thermal storage system in an annual period. *Journal of Mechanical Engineering*, 2018, vol. 64, no. 5, p. 283-289.

STRITIH, Uroš, CHARVÁT, Pavel, KOŽELJ, Rok, KLIMEŠ, Lubomír, OSTERMAN, Eneja, OSTRÝ, Milan, BUTALA, Vincenc. PCM thermal energy storage in solar heating of ventilation air : experimental and numerical investigations. *Sustainable cities and society*, Feb. 2018, vol. 37, p. 104-115.

STRITIH, Uroš, TYAGI, V. V., STROPNIK, Rok, PAKSOY, Halime, HAGHIGHAT, Fariborz, JOYBARI, Mahmood Mastani. Integration of passive PCM technologies for net-zero energy buildings. *Sustainable cities and society*, Aug. 2018, vol. 41, p. 286-295.

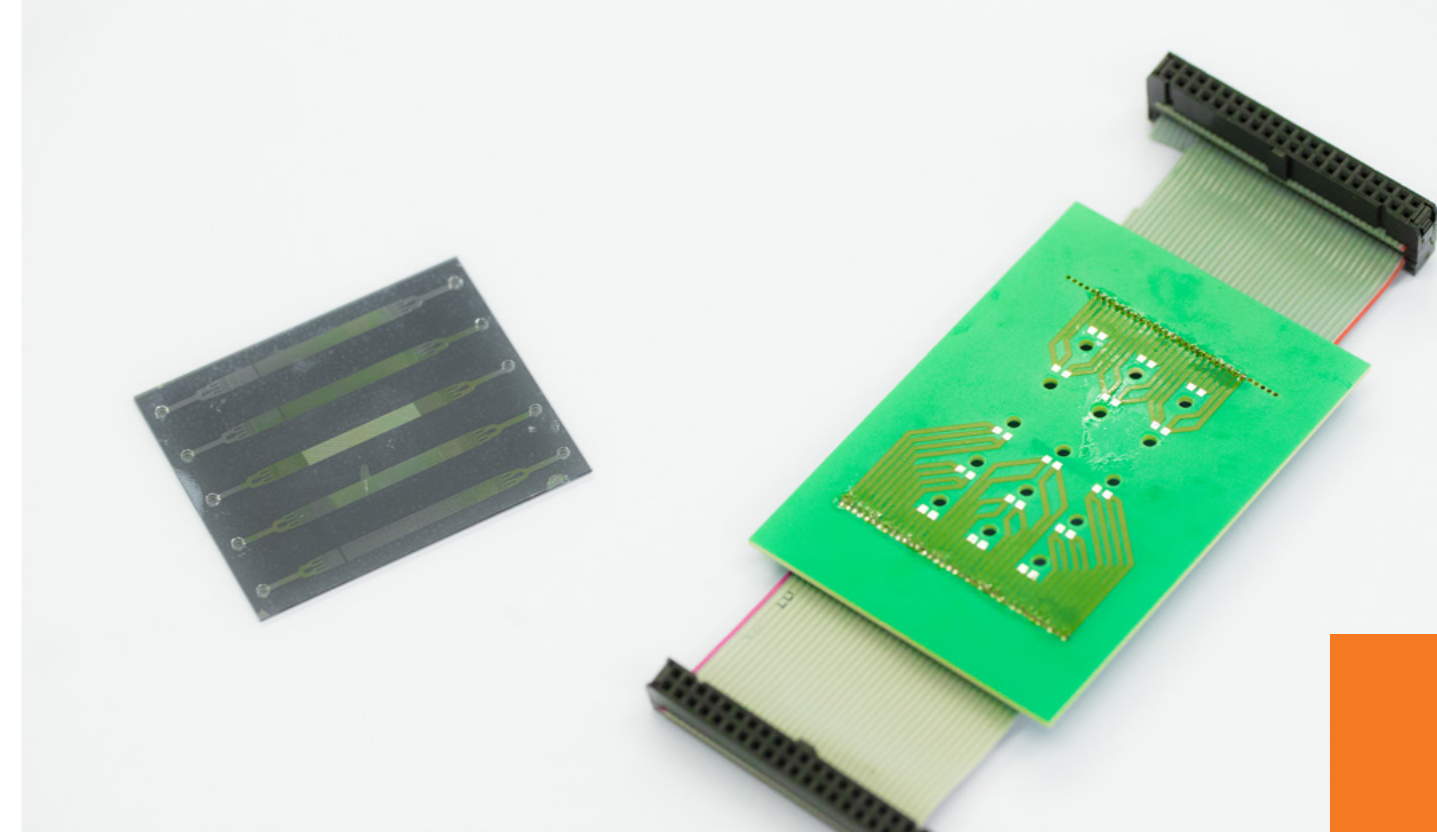
INDEPENDENT SCIENTIFIC COMPONENT PART OR A CHAPTER IN A MONOGRAPH

STRITIH, Uroš, MLAKAR, Urška. Technologies for seasonal solar energy storage in buildings. V: CAO, Wenping (ur.). *Advancements in energy storage technologies*. Rijeka: InTech. 2018, p. 51-75.

PROJECTS

Slovenian Research Agency – Advanced heat storage materials for integrated storage solutions. Uroš Stritih. (operator: National Institute of Chemistry). 01/9/2016 - 28/2/2019

H2020 - Horizon 2020 - Holistic Energy and Architectural Retrofit Toolkit (HEART). Prof. Uroš Stritih. 01.10.2017 - 30.9.2021



Laboratory for Sustainable Technologies in Buildings **LOTZ**

RESEARCH AREAS

Engineering sciences • Energy engineering • Renewable sources and technologies

DEPARTMENT HEAD Prof. Sašo Medved, PhD

DEPARTMENT MEMBERS Assoc. Prof. Ciril Arkar, PhD, Assist. Tomaž Šuklje, PhD, Assist. M. Sc. Suzana Domjan, Assist. Žiga Begelj, Darja Jeločnik

ORIGINAL SCIENTIFIC ARTICLE

ARKAR, Ciril, DOMJAN, Suzana, MEDVED, Sašo. Heat transfer in a lightweight extensive green roof under water-freezing conditions. *Energy and buildings*, 2018, vol. 167, p. 187-199.

ARKAR, Ciril, DOMJAN, Suzana, MEDVED, Sašo. Lightweight composite timber façade wall with improved thermal response. *Sustainable cities and society*, Apr. 2018, vol. 38, p. 325-332.

PROJECTS

COST – European Cooperation in science and technology - Adaptive Facades Network. Ciril Arkar. 28/10/2014 - 27/10/2018

ERDF - European regional development fond SPS - Sustainable and innovative construction of smart buildings (TIGR4smart). Sašo Medved. 1/9/2016 - 28/2/2019

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, tribochemistry and adhesion processes, and power-control hydraulic design.

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



Laboratory for tribology and interface nanotechnology **TINT**

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. Mitjan Kalin, PhD

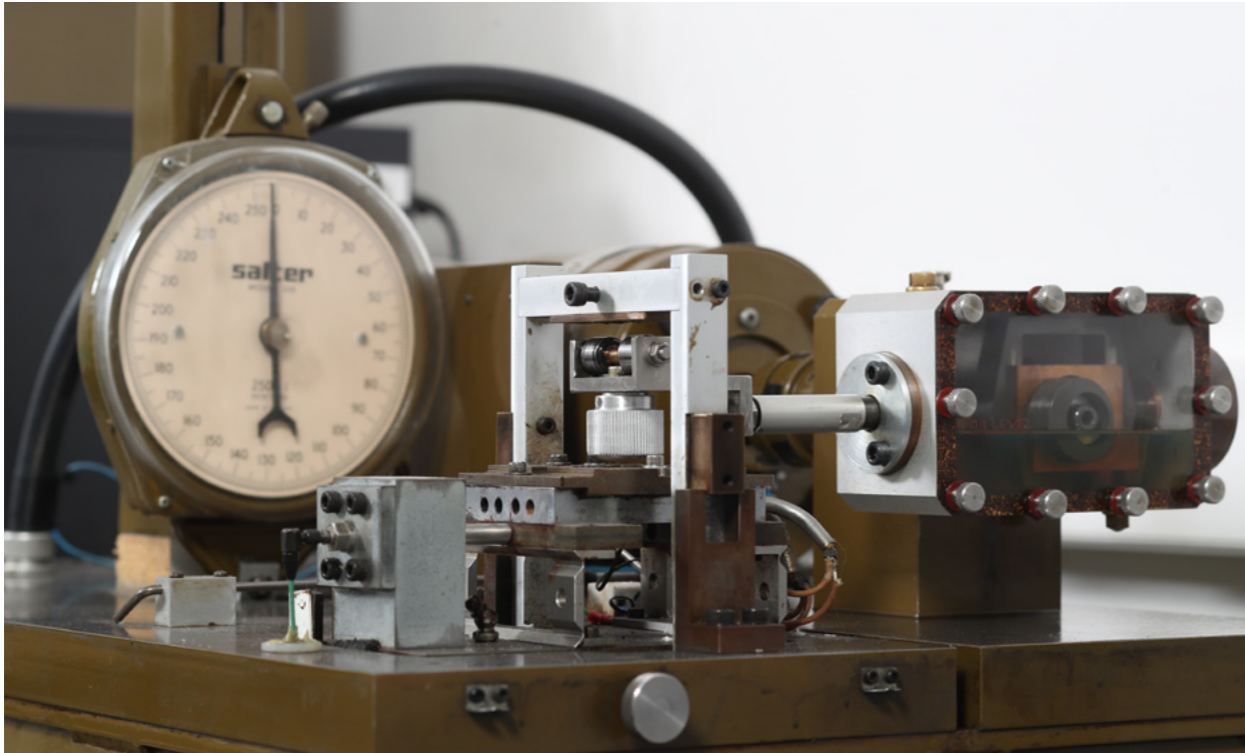
DEPARTMENT MEMBERS Assist. Prof. Marko Polajnar, PhD, Assist. Prof. Janez Kogovšek, PhD, Assist. Boris Kržan, PhD, Assist. Akbari Somayeh PhD, Assist. Arshad Muhammad Shahid, PhD, Assist. Blaž Brodnik Žugelj, PhD, Assist. Sharma Sandan Kumar, PhD, Assist. Lucija Čoga, PhD, Assist. Jure Jerina, PhD, Assist. Maja Kus, Assist. Vadivel Hari Shankar, Hamouda Karim, Sebastjan Matkovič, Siddiqui Muhammad Shoaib Naseem, Franc Kopač, Jožica Sterle.

ORIGINAL SCIENTIFIC ARTICLE

KITANO, Houichi, DOHDA, Kuniaki, KALIN, Mitjan, EHMANN, Kornel F. Galling growth analysis in metal forming. Manufacturing letters, Apr. 2018, vol. 16, p. 32-35.

MARCINAUSKAS, Liutauras, MATHEW, Jacob Shiby, MILIEŠKA, Mindaugas, THANIGACHALAM, Balakumaran, KUPEC, Alja, ČESNAVIČIUS, Ramunas, KEŽELIS, Romualdas, KALIN, Mitjan. Microstructure and tribological properties of plasma sprayed alumina and alumina-graphite coatings. Surface & coatings technology, Sep. 2018, vol. 350, p. 401-409.

BRODNIK ŽUGELJ, Blaž, KALIN, Mitjan. Submicron-scale experimental analyses of multi-asperity contacts with different roughnesses. Tribology international, Mar. 2018, vol. 119, p. 667-671.



KALIN, Mitjan, POLJANEC, Dejan. Influence of the contact parameters and several graphite materials on the tribological behaviour of graphite/copper two-disc electrical contacts. *Tribology international*, Oct. 2018, vol. 126, p. 192-205.

POLJANEC, Dejan, KALIN, Mitjan, KUMAR, Ludvik. Influence of contact parameters on the tribological behaviour of various graphite/graphite sliding electrical contacts. *Wear*, Jul. 2018, vol. 406-407, p. 75-83.

INDEPENDENT SCIENTIFIC COMPONENT PART OR A CHAPTER IN A MONOGRAPH

ZALAZNIK, Maša, KALIN, Mitjan. Tribology of the PEEK polymer filled with solid lubricants: chapter 10. V: SINHA, Sujeet Kumar (ur.). *Handbook of polymer tribology*. New Jersey [etc.]: World Scientific. 2018, p. 345-359.

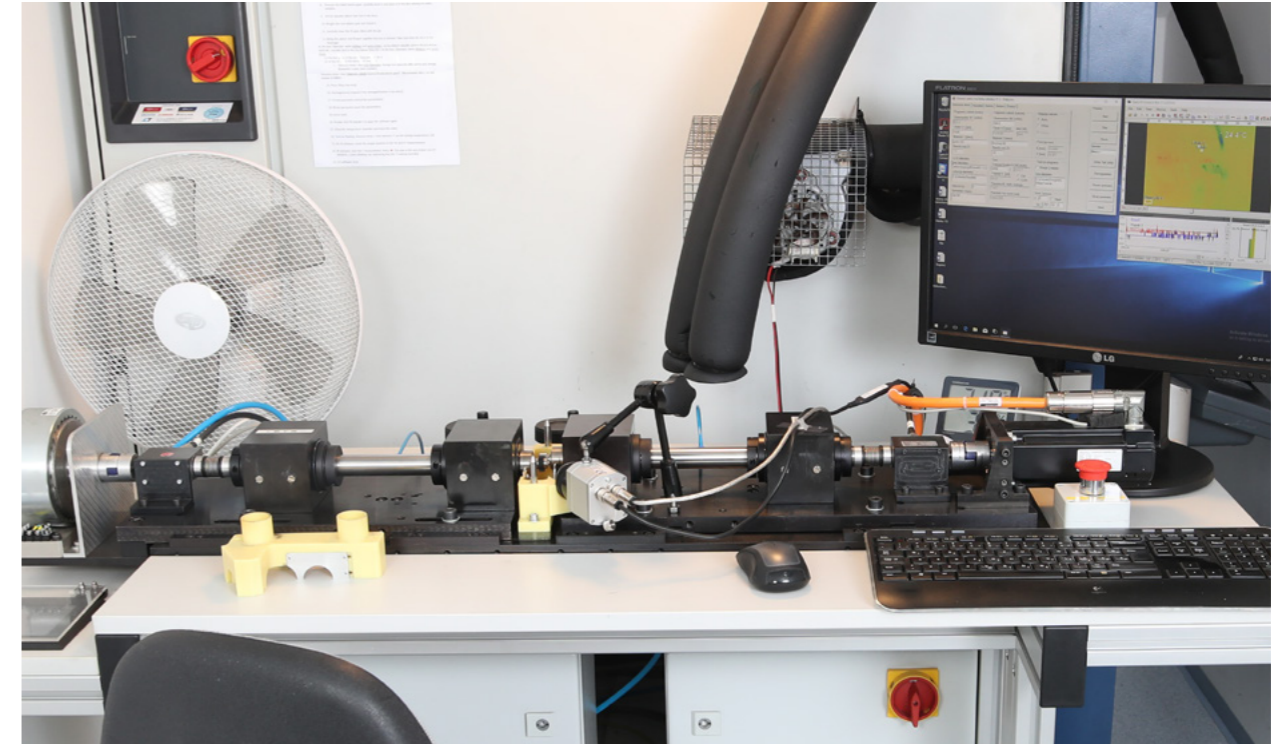
DOCTORAL DISSERTATIONS

Poljanec Dejan. Tribological optimization of axial slip rings for automotive alternators. Mentor Mitjan Kalin

PROJECTS

Slovenian Research Agency - Nano-engineered Green lubrication technology for sustainable high-performance stamping. Mitjan Kalin 1/7/2018 - 30/6/2021

Slovenian Research Agency - E-maintenance of electro-mechanical drives: prognostics and health management solutions under non-stationary operating conditions. Mitjan Kalin. (operator: IJS). 01/9/2016 - 28/2/2019



Slovenian Research Agency - Nanoscale engineering of the contact interfaces for green lubrication technology. Mitjan Kalin. 1/1/2016 - 31/12/2018

M-era.Net - Green high-performance and low-friction interfaces tailored by the reactivity of novel DLC coatings and ionic liquids (GreenCOAT). Mitjan Kalin. 01/8/2017 - 31/7/2020

LLP -Lifelong Learning Programme - Erasmus Mundus - Joint European Master on Tribology of Surfaces and Interfaces (TRIBOS). Mitjan Kalin. 2/10/2012 - 2/10/2019

ERDF - European Regional Development Fund SPS - Ecological Safe Vehicle for green mobility (EVA4green). Mitjan Kalin. 1/9/2016 - 28/2/2019

COMET - Competence Centers for Excellent Technologies - XTribology Excellence Center of Tribology (XTribology). Mitjan Kalin. 1/4/2015 - 31/3/2020

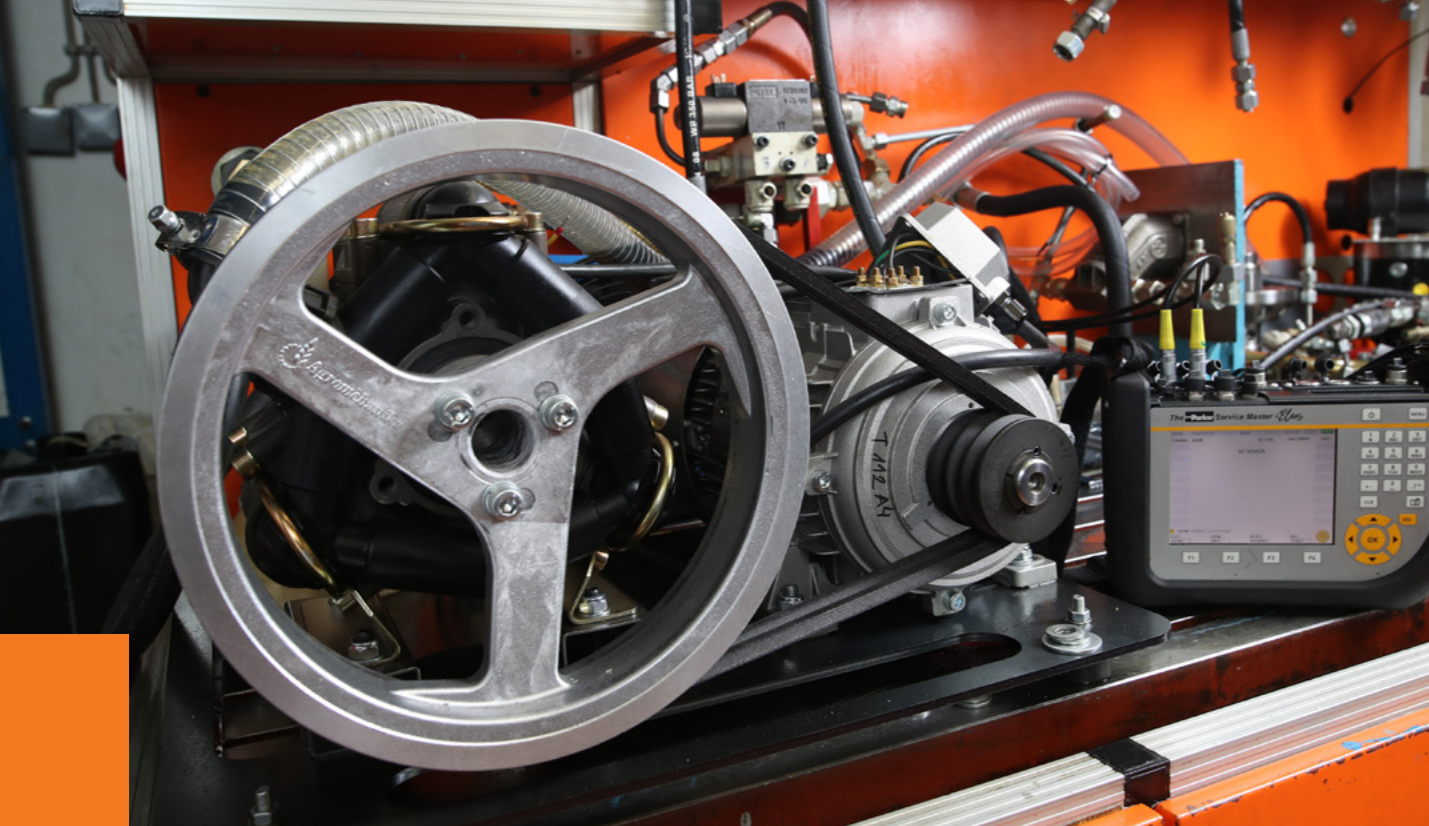
Company Akrapovič - Development of high-temperature resistant bearing materials for dry bearings to operate in corrosive conditions without the presence of lubricant. Mitjan Kalin. 1/2/2018 - 30/9/2018

Company LEK - Consultation on the methodologies for examining abrasion characteristics of agents in the pharmaceutical industry by analysing some characteristic agents. Mitjan Kalin. 26/9/2017 - 30/7/2018

CONFERENCES

POLYTRIB 2018 - The 3rd International Conference on Polymer Tribology, 24th and 25th of September in Portorož, Slovenia.

SLOTTRIB 2018 - Conference on tribology, lubricants and technical diagnostics, 20th of November 2018 in Ljubljana, Slovenia.



07 SYNERGETICS OF COMPLEX SYSTEMS AND PROCESSES

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

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

Laboratory for Fluid Power and Controls **LFT**

RESEARCH AREAS

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

DEPARTMENT HEAD Assist. Prof. Franc Majdič, PhD

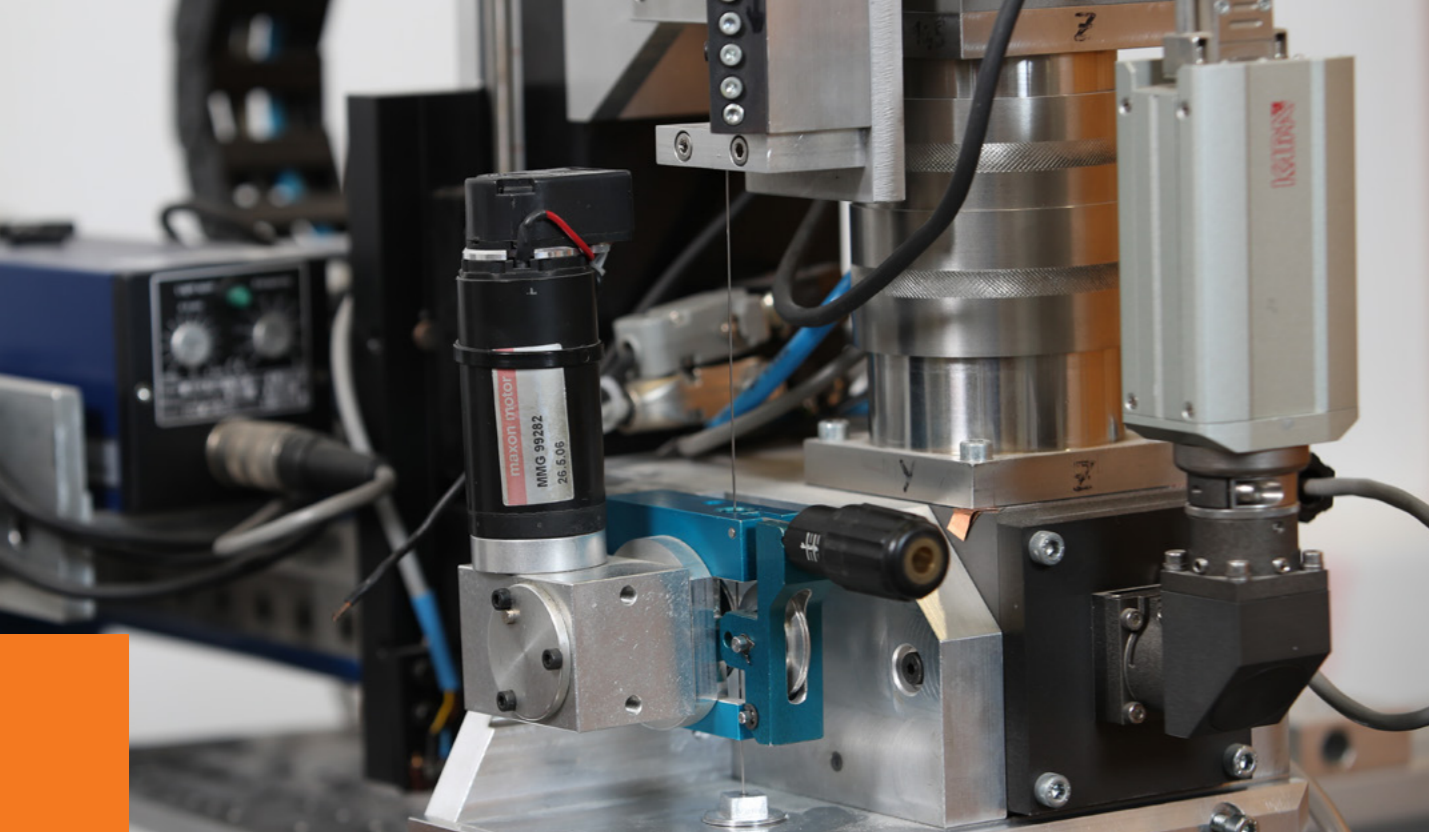
DEPARTMENT MEMBERS Assist. Ervin Strmčnik, Rok Jelovčan, Jožica Sterle

ORIGINAL SCIENTIFIC ARTICLE

STRMČNIK, Ervin, MAJDIČ, Franc. The pressure and efficiency characteristic of hydraulic gerotor motor with the floating outer ring. *Tehnicka gazeta*, Apr. 2018, vol. 25, no. 2, p. 609-615.

MAJDIČ, Franc. Raziskava uporabnosti kompozitne cevi hidravličnega valja. *Ventil : revija za fluidno tehniko in avtomatizacijo*, Feb. 2018, vol. 24, iss. 1, p. 32-38.

ČEGOVIK, Nejc, MAJDIČ, Franc. Preizkušanje hidravličnih filtrov : večprehodni test po standardu ISO 16889:2008. *Ventil : revija za fluidno tehniko in avtomatizacijo*, Oct. 2018, vol. 24, iss. 5, p. 382-389.



Laboratory for Synergetics **LASIN**

RESEARCH AREAS

Synergetics • Technology driven physics • Additive technologies • Modelling and diagnostics of technical processes • Optimisation and predictive control of processes

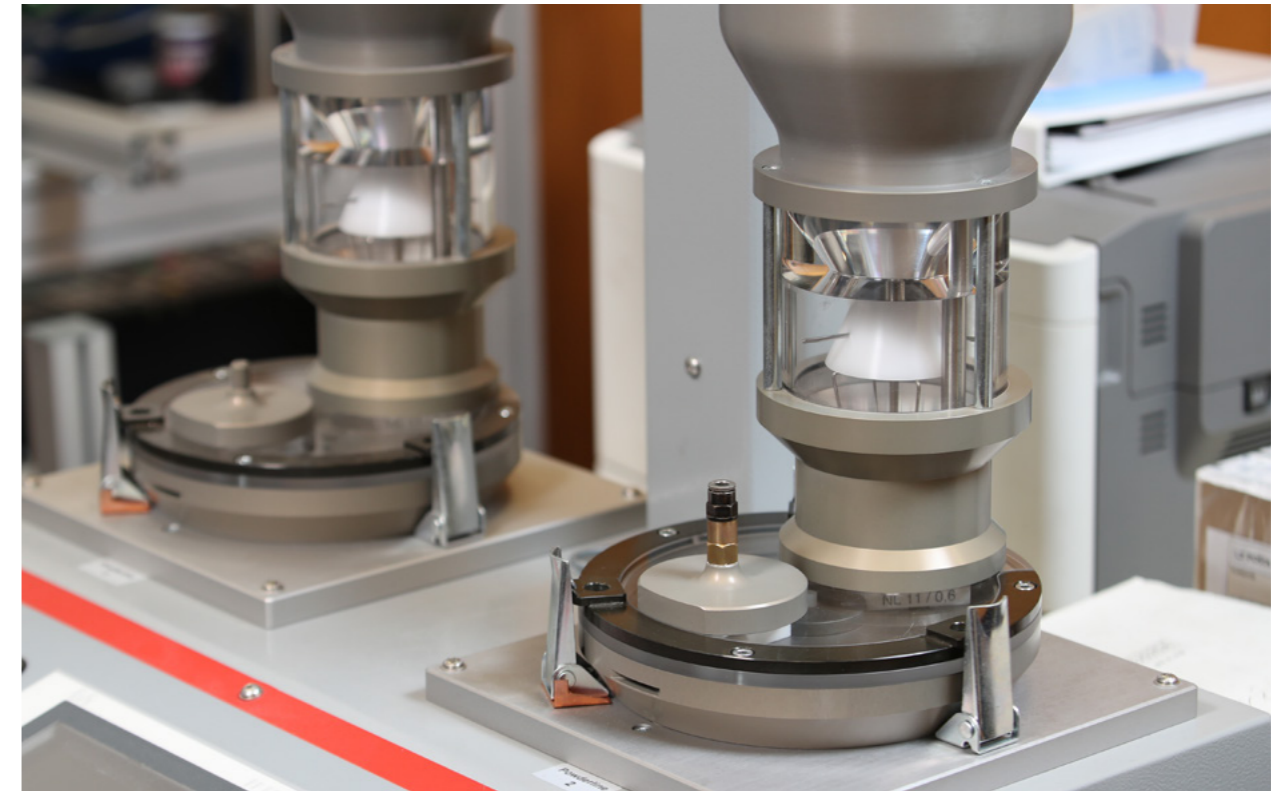
DEPARTMENT HEAD Prof. Edvard Govekar, PhD

DEPARTMENT MEMBERS Assist. Prof. Primož Potočnik, PhD, Assist. Andrej Jeromen, PhD, Assist. Blaž Krese, PhD, Assist. Alexander Kuznetsov, PhD, Assist. Ragunanth Venkatesh, Matjaž Kotar, Ana Vidregar, Marta Ilešič

ORIGINAL SCIENTIFIC ARTICLE

POTOČNIK, Primož, VIDRIH, Boris, KITANOVSKI, Andrej, GOVEKAR, Edvard. Analysis and optimization of thermal comfort in residential buildings by means of a weather-controlled air-to-water heat pump. Building and environment, Aug. 2018, vol. 140, p. 68-79.

GOVEKAR, Edvard, JEROMEN, Andrej, KUZNETSOV, Alexander, LEVY, Gideon N., FUJISHIMA, Makoto. Study of an annular laser beam based axially-fed powder cladding process. CIRP annals, May 2018, vol. 67, iss. 1, p. 241-244.



PROJECTS

ERDF - European regional development fond SPS - Intelligent home of the new generation designed on smart appliances and wood (IQ HOME). Edvard Govekar, 1/9/2016 - 28/2/2019

Company DMG Mori CO., LTD. RING AM research project phase II - RING head redesign and investigation of the continuous ring laser powder cladding process. Edvard Govekar. 1/8/2017 - 31/7/2018

AWARDS AND ACHIEVEMENTS

Research achievement entitled Annular laser head for 3D printing of metal materials ranked among the 10 most outstanding achievements of the University of Ljubljana, authors: Edvard Govekar, Alexander Kuznetsov, Andrej Jeromen, Matjaž Kotar

Research achievement entitled Annular laser beam based direct metal deposition was selected as one of most prominent achievements "Excellent in Science 2018", published in Annual Report ARRS 2018. The achievement was also selected for presentation at the national event ARRS Day 2018: Supporting Excellence.

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 Manufacture to smart factories and further on to the concept of Remote factory.



Laboratory for Alternative Technologies **LAT**

RESEARCH AREAS

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

DEPARTMENT HEAD Assoc. Prof. Joško Valentinčič, PhD

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

ORIGINAL SCIENTIFIC ARTICLE

JERMAN, Marko, LEBAR, Andrej, SABOTIN, Izidor, DREŠAR, Pavel, VALENTINČIČ, Joško. Ice jet technology. MM Science Journal, Jun. 2018, p. 2379-2384.

VALENTINČIČ, Joško, SEVŠEK, Luka, PRIJATELJ, Miha, SABOTIN, Izidor, JERMAN, Marko, LEBAR, Andrej. Towards production of microfeatures on a custom-made stereolithographic DLP printer. Proceedings in manufacturing systems, 2018, vol. 13, nr. 2, p. 51-55.

CONFERENCES

MIT Conference, Workshop 2018 - Management and Innovative Technologies. Izola, Slovenia 12-15 September 2018



Forming Laboratory **LAP**

RESEARCH AREAS

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

DEPARTMENT HEAD Assoc. Prof. Tomaž Pepelnjak, PhD

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

ORIGINAL SCIENTIFIC ARTICLE

PEPELNJAK, Tomaž, BREN, Tomaž, ŽELEZNIK, Bojan, KUŠTRA, Mitja. Computer-assisted design of sheet metal component formed from stainless steel. RMZ - Materials and geoenvironment : periodical for mining, metallurgy and geology, Oct. 2018, vol. 65, iss. 2, p. 71-78.

PROJECTS

COST - European Cooperation in science and technology. European Network of Bioadhesion Expertise: Fundamental Knowledge to Inspire Advanced Bonding Technologies. Tomaž Pepelnjak. 26/2/2016 - 20/10/2020

Laboratory for Handling, Assembly and Pneumatics **LASIM**

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. Niko Herakovič, PhD

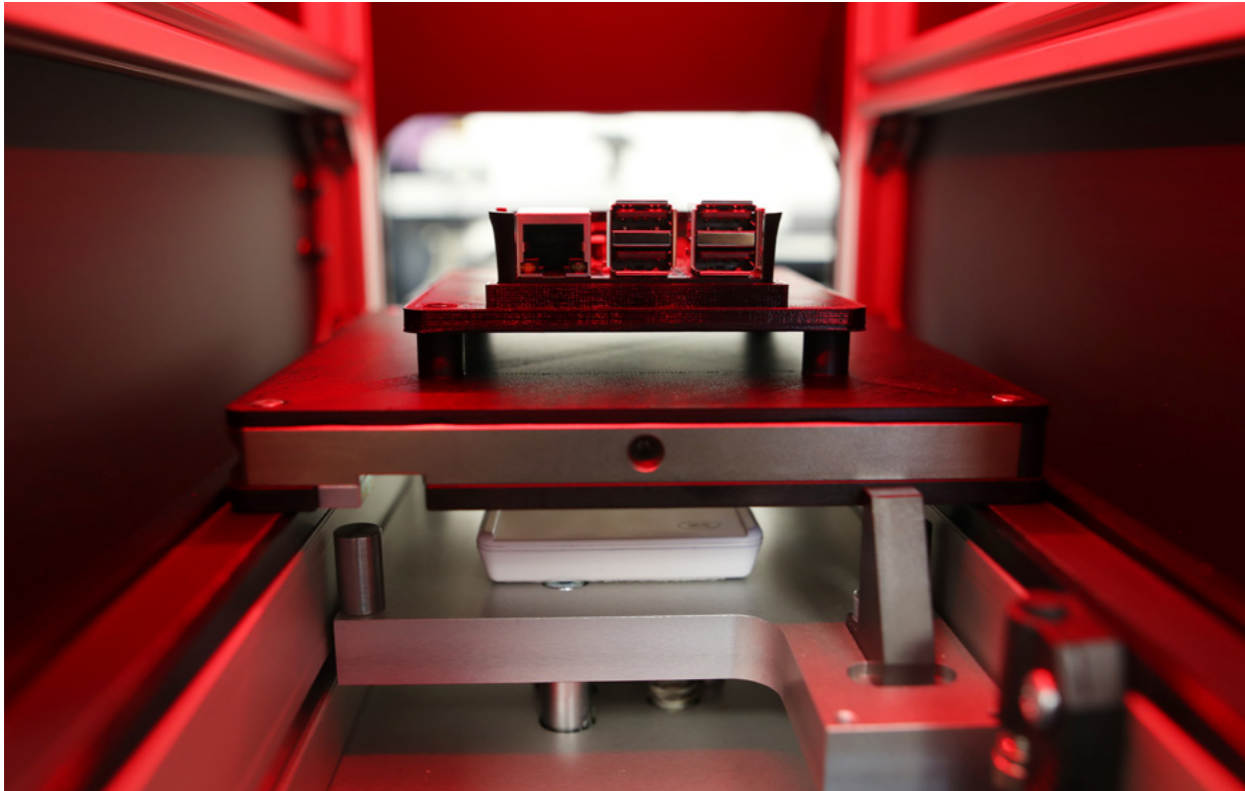
DEPARTMENT MEMBERS Assist. Prof. Marko Šimic, PhD, Assist. Mihael Debevec, PhD, Assist. Miha Pipan, PhD, Peter Metlikovič, PhD, Assist. Jernej Protner, Assist. Matevž Resman, Assist. Hugo Zupan, Edo Adrovič, Maja Turk, Tanja Plestenjak

ORIGINAL SCIENTIFIC ARTICLE

PIPAN, Miha, HERAKOVIČ, Niko. Closed-loop volume flow control algorithm for fast switching pneumatic valves with PWM signal. Control engineering practice, Jan. 2018, vol. 70, p. 114-120.

PROJECTS

ERDF - European regional development fond - Building Blocks, Tools and Systems for Factories of the Future (GOSTOP). Niko Herakovič. 1/11/2016 - 30/4/2020



CONFERENCES

ASM 2018 - Conference on automation of Handling and Assembly. Ljubljana, 6 December 2018.

AWARDS AND ACHIEVEMENTS

Niko Herakovič received an award of the Faculty of Mechanical Engineering for excellence in teaching

09 ENGINEERING DESIGN

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

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

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



Laboratory for Engineering Design **LECAD**

RESEARCH AREAS

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

DEPARTMENT HEAD Prof. Roman Žavbi, PhD / Prof. Jožef Duhovnik, PhD

DEPARTMENT MEMBERS Assoc. Prof. Janez Povh, PhD, Assoc. Prof. Jože Tavčar, PhD, Assist. Prof. Janez Benedičič, PhD, Assist. Prof. Leon Kos, PhD, Assist. Prof. Nikola Vukašinić, PhD, Assist. Vanja Čok, PhD, Assist. Ivan Demšar, PhD, Assist. Tomaž Finkšt, PhD, Assist. Janez Rihtaršič, PhD, Milan Kljajin, PhD, Assist. Borut Černe, Assist. Pavel Tomšič, Assist. Damijan Zorko, Assist. Primož Drešar, Assist. Timotej Hrga, Assist. Dejan Penko, M. Sc. Janez Krek, Mateja Maffi, Luka Sedej, Matjaž Šubelj, Ivona Vasileska, Uroš Urbas, Matic Brank, Blaž Rodič, Daria Vlah, Silva Brenčič

ORIGINAL SCIENTIFIC ARTICLE

DICKINSON, Peter J. C., POVH, Janez. A new approximation hierarchy for polynomial conic optimization. Computational optimization and applications, Jan. 2019, p. [1-31].

KOS, Leon, TSKHAKAYA, D. D. Theory of ion-matrix-sheath dynamics. AIP advances, 2018, vol. 8, p. 015202-1-015202-13.

KOS, Leon, JELIČ, Nikola, GYERGYEK, Tomaž, KUHN, S., TSKHAKAYA, David. Modeling and simulations of plasma and sheath edges in warm-ion collision-free discharges. AIP advances, Oct. 2018, vol. 8, no. 10, p. 1-23.

TAVČAR, Jože, GRKMAN, Gašper, DUHOVNIK, Jože. Accelerated lifetime testing of reinforced polymer gears. Journal of advanced mechanical design, systems and manufacturing, Jan. 2018, vol. 12, no. 1, p. 1-13.

TAVČAR, Jože, DEMŠAR, Ivan, DUHOVNIK, Jože. Engineering change management maturity assessment model with lean criteria for automotive supply chain. Journal of engineering design, Apr. 2018, vol. 29, iss. 4/5, p. 235-257.

TAVČAR, Jože, HORVÁTH, Imre. A Review of the principles of designing smart cyber-physical systems for run-time adaptation: learned lessons and open issues. IEEE transactions on systems, man, and cybernetics, Systems, 2018, p. 1-14.

BUČAR, Jože, ŽNIDARŠIČ, Martin, POVH, Janez. Annotated news corpora and a lexicon for sentiment analysis in Slovene. Language resources and evaluation, 2018, vol. 52, iss. 3, p. 895-919.

KOS, Leon, JELIČ, Nikola, KUHN, S., TSKHAKAYA, David. Introduction to the theory and application of a unified Bohm criterion for arbitrary-ion-temperature collision-free plasmas with finite Debye lengths. Physics of plasmas, 2018, vol. 25, iss. 4, p. 1-16.

KASTRIN, Andrej, KLISARA, Jelena, LUŽAR, Borut, POVH, Janez. Is science driven by principal investigators?. Scientometrics, Nov. 2018, vol. 117, iss. 2, p. 1157-1182.

KLEP, Igor, POVH, Janez, VOLČIČ, Jurij. Minimizer extraction in polynomial optimization is robust. SIAM journal on optimization, 2018, vol. 28, no. 4, p. 3177-3207.

ZORKO, Damijan, TAVČAR, Jože, DUHOVNIK, Jože. The Influence of the tooth profile shape on the stress-strain state in the gear. Machines, technologies, materials, 2018, year 12, iss. 4, p. 153-156.

PATENT

ČAKŠ, Žiga, ČORLUKA, Željko, DUHOVNIK, Jože, KOKELJ, Gašper, KRAJNC, Matija, LEJLA, Vida, OSELI, Alen, SOMOGYVÁRI, Mónika, VERDEGUER LOPEZ, Javier, VUKAŠINOVIĆ, Nikola. Handküchengerät mit zwei Abtrieben = Hand-held kitchen appliance with two drives : Europäische Patentschrift EP2394546 (B1), 2018-08-08. München: Europäisches Patentamt, 2018. 17 p., patent family: EP2394546 (A1).

DOCTORAL DISSERTATIONS

Benedik Blaž. Bearing operational parameters analysis in vacuum cleaner motor using machine learning methods. Mentor Jožef Duhovnik, Co-mentor Jože Tavčar

PROJECTS

Slovenian Research Agency, N1 0057, - High-Performance Solver for Binary Quadratic Problems. Janez Povh. 2017 - 2019

Slovenian Research Agency - Technological solutions for high-quality hay production. Janez Benedičič. (operator: Agricultural Institute of Slovenia). 2016 - 2019

Slovenian Research Agency, J1-8155, Biomedical data fusion by nonnegative matrix trifactORIZATION. Janez Povh. 2017-2020



Slovenian Research Agency, N1-0071, Extending first and second order algorithms for nested classes of optimization problems to solve computationally challenging industrial questions. Janez Povh. 2018-2020

ERDF - European regional development fond SPS. EVA4green, Ecological safe vehicle, green mobility. Jože Tavčar. 2016-2019

ERDF - European regional development fond SPS. Advanced materials, methodologies and technologies for the development of lightweight power transmission components for drives technology, - MAPgears. Jože Tavčar. 2018-2021

ERDF - European regional development fond SPS. Interreg Danube - High-performance Computing for Effective Innovation in the Danube Region (INNOHPC). Jožef Duhovnik. 2017-2019

H2020 - PRACE 5th Implementation Phase Project (PRACE-5IP). Jožef Duhovnik. 2017-2019

H2020 - European eXtreme Data and Computing Initiative (EXDCI). Jožef Duhovnik. 2015-2018

H2020, EXDCI 2: European eXtreme Data and Computing Initiative 2. Janez Povh, Leon Kos. 2018-2020

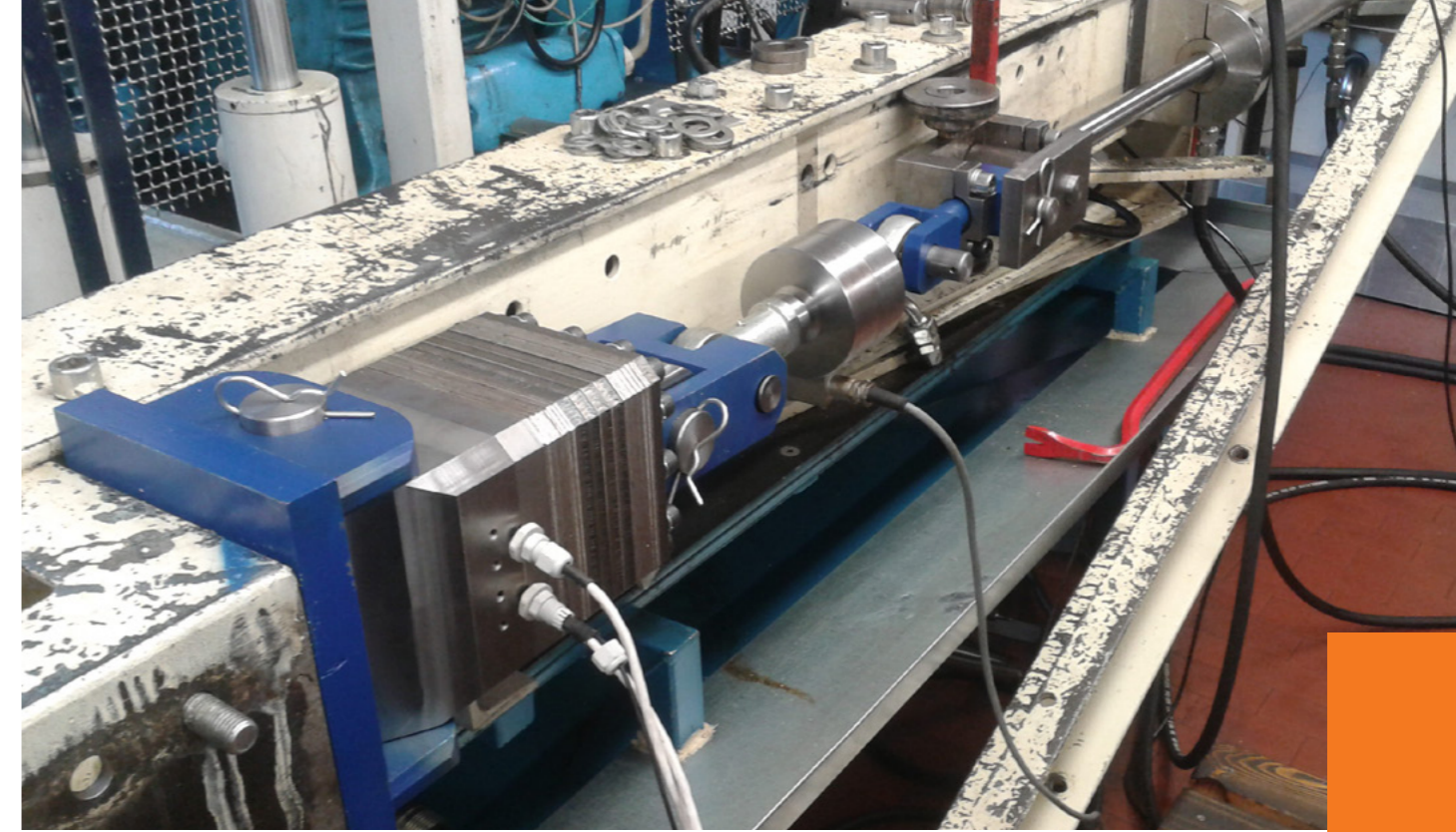
COST - European Cooperation in science and technology. Mathematics for industry network (MI-NET); Trans-Domain COST Action TD1409. Janez Povh. 2015-2019

Erasmus+, CASProD, Smart products development. Nikola Vukašinović, Roman Žavbi. 2017-2020

Erasmus+ ELPID, E-learning platform for innovative product development. Nikola Vukašinović, Roman Žavbi. 20018-2021

H2020, EUROfusion, ITER-Phys, Code Development, Education, Training, Core programing team. Leon Kos. 2014-2020

H2020, PRACE-5IP: 5th phase of the implementation of the pan-European HPC Research Infrastructure (RI). Janez Povh, Leon Kos. 2017-2019



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 Assist. Prof. Boris Jerman, PhD

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

ORIGINAL SCIENTIFIC ARTICLE

JERMAN, Boris, HLADNIK, Jurij, RESMAN, Franc, LANDSCHÜTZER, Christian. Optimization of the support structure of large axial-radial bearing of overhead type manipulator. FME Transactions, 2018, vol. 46, no. 3, p. 386-391.

HLADNIK, Jurij, JERMAN, Boris. Advanced finite element cross-country ski boot model for mass optimization directions considering flexion stiffness. Proceedings of the Institution of Mechanical Engineers. Part P, Journal of sports engineering and technology, 2018, vol. 232, iss. 3, p. 264-274.

HLADNIK, Jurij, SUPEJ, Matej, JERMAN, Boris. Force measurement system for roller-ski skating. Tehnical gazette, 2018, vol. 25, no. 5, p. 1291-1297.

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 focussed 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 focussed on management of vibration fatigue and product noise. Here, the main emphasis is on research into valid models. Research activities are also geared toward smart structures with sensing function and the development of advanced optical methods for identifying dynamic parameters of structures.

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

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

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



Laboratory for Dynamics of Machines and Structures **LADISK**

RESEARCH AREAS

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

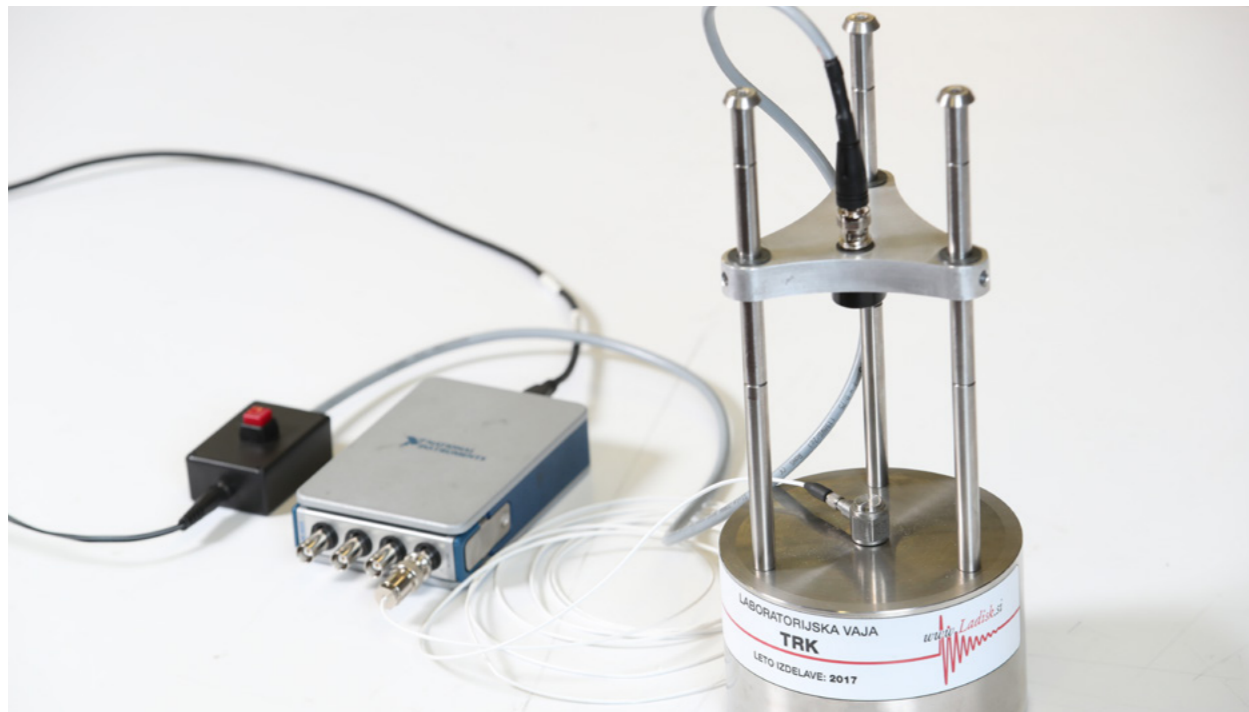
DEPARTMENT HEAD Prof. Miha Boltežar, PhD

DEPARTMENT MEMBERS Prof. Janko Slavič, PhD, Assoc. Prof. Gregor Čepon, PhD, Assist. Martin Česnik, PhD, Assist. Martin Furlan, PhD, Assist. Luka Knez, PhD, Assist. Blaž Starc, PhD, Vitoslav Bratuš, PhD, Aleš Mihelič, PhD, Assist. Matej Bogataj, Assist. Miha Kodrič, Assist. Primož Ogrinec, Assist. Miha Pogačar, Assist. Matej Razpotnik, Assist. Domen Gorjup, Assist. Klemen Zaletelj, Matic Arh, Luka Kenk, Marta Ilešič

ORIGINAL SCIENTIFIC ARTICLE

LUZGAR, Janez, SLAVIČ, Janko, BOLTEŽAR, Miha. Experimental research on structure-borne noise at pulse-width-modulation excitation. Applied acoustics, Aug. 2018, vol. 137, p. 33-39.

OBLAK, Miša, PIRNAT, Miha, BOLTEŽAR, Miha. An impedance tube submerged in a liquid for the low-frequency transmission-loss measurement of a porous material. Applied acoustics, Oct. 2018, vol. 139, p. 203-212.



- SKRINJAR, Luka, SLAVIČ, Janko, BOLTEŽAR, Miha. A Review of continuous contact-force models in multibody dynamics. *International journal of mechanical sciences*, Sep. 2018, vol. 145, p. 171-187.
- LIEDER, Michael, ASIF, Farazee, RASHID, Amir, MIHELICH, Aleš, KOTNIK, Simon. A conjoint analysis of circular economy value propositions for consumers: Using "washing machines in Stockholm" as a case study. *Journal of cleaner production*, Jan. 2018, vol. 172, p. 264-273.
- RAZPOTNIK, Matej, ČEPON, Gregor, BOLTEŽAR, Miha. A Smooth contact-state transition in a dynamic model of rolling-element bearings. *Journal of sound and vibration*, Sep. 2018, vol. 430, p. 196-213.
- JAVH, Jaka, SLAVIČ, Janko, BOLTEŽAR, Miha. Experimental modal analysis on full-field DSLR camera footage using spectral optical flow imaging. *Journal of sound and vibration*, Nov. 2018, vol. 434, p. 213-220.
- POŽENEL, Terezija, PETRIČ, Mitja, BRATUŠ, Vitoslav, VONČINA, Maja. Influence of different casting conditions and the filtering process on the electrical resistance of Al-alloy 99.7. *Materials and technologies*, 2018, vol. 52, no. 4, p. 429-434.
- DROZG, Armin, ROGELJ, Jakob, ČEPON, Gregor, BOLTEŽAR, Miha. On the performance of direct piezoelectric rotational accelerometers in experimental structural dynamics. *Measurement : journal of the International Measurement Confederation*, Oct. 2018, vol. 127, p. 292-298.
- JAVH, Jaka, SLAVIČ, Janko, BOLTEŽAR, Miha. High frequency modal identification on noisy high-speed camera data. *Mechanical systems and signal processing : MSSP*, Jan. 2018, vol. 98, p. 344-351.
- MRŠNIK, Matjaž, SLAVIČ, Janko, BOLTEŽAR, Miha. Vibration fatigue using modal decomposition. *Mechanical systems and signal processing : MSSP*, Jan. 2018, vol. 98, p. 548-556.

- DROZG, Armin, ČEPON, Gregor, BOLTEŽAR, Miha. Full-degrees-of-freedom frequency based substructuring. *Mechanical systems and signal processing*, Jan. 2018, vol. 98, p. 570-579.
- ČEPON, Gregor, ROGELJ, Jakob, KNEZ, Luka, BOLTEŽAR, Miha. On multibody-system equilibrium-point selection during joint-parameter identification: A numerical and experimental analysis. *Mechanism and Machine Theory*, Oct. 2018, vol. 128, p. 287-297.
- OGRINEC, Primož, ČEPON, Gregor, BOLTEŽAR, Miha. Introduction of welds into dynamic model of laminated structures. *Journal of Mechanical Engineering*, Feb. 2018, vol. 64, no. 2, p. 73-81.
- TUREL, Aleš, SLAVIČ, Janko, BOLTEŽAR, Miha. Wear rate vs dynamic and material properties at elevated temperatures for a copper-graphite brush. *Journal of Mechanical Engineering*, Mar. 2018, vol. 64, no. 3, p. 169-175.

PATENT

- KUHAR, Matjaž, ČEPON, Gregor, BOLTEŽAR, Miha, ŠTIMULAK, Mitja, POGOREVC, Robi, MIHELICH, Aleš. Stiraljnaja mašina s regulirujemimi oporami: RU 2644322 (C1), 2018-02-08. Moskva: Federalnaja služba pa intelektualnoj sobstvenosti, 2018.

DOCTORAL DISSERTATIONS

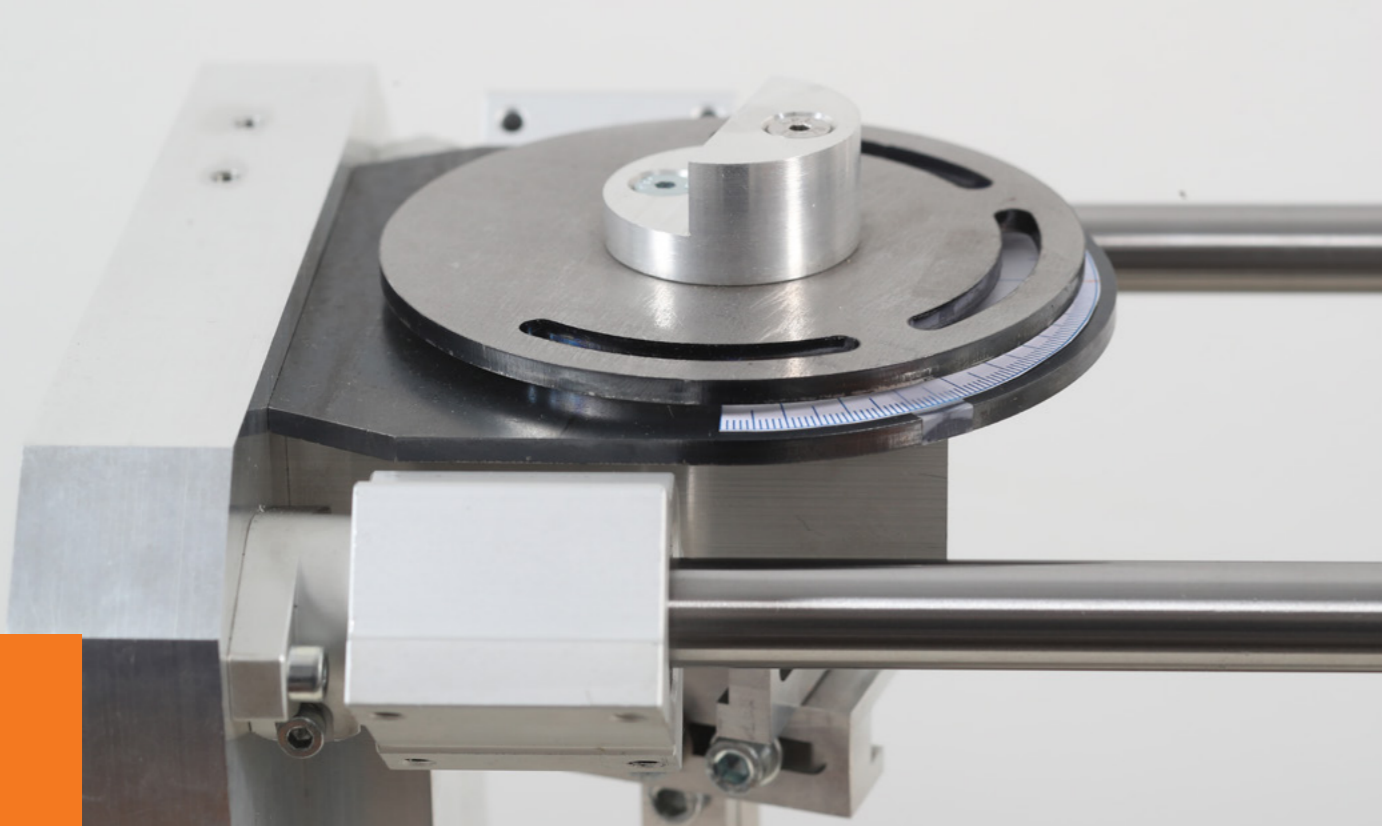
- Javh Jaka. Modal analysis based on motion measurements with a high-speed camera. Mentor Janko Slavič
- Turel Aleš. Time-variable contact development and the dynamics of the rigid multibody systems. Mentor Miha Boltežar
- Drozg Armin. Dynamic substructuring in the frequency domain. Mentor Miha Boltežar, Co-mentor Gregor Čepon

PROJECTS

- ERDF - European regional development fond SPS - Intelligent home of the new generation designed on smart appliances and wood (IQ HOME). Miha Boltežar. 1/9/2016 - 28/2/2019
- ERDF - European regional development fond SPS - Environmentally Safe Green Mobility Car (EVA4green). Miha Boltežar. 1/9/2016 - 28/2/2019
- Company ISD Strugarstvo - Turbine Hause - development of polymer connection bend of oil separator. Miha Boltežar. 21/5/2018 - 15/4/2019
- Company Gorenje - Research development cooperation and lease of capacities for numerical analyses and performance of measurements and tests. Miha Boltežar. 7/11/2018 - 6/11/2021
- Company Gorenje - Static and dynamic numerical analyses and optimization of parameters. Miha Boltežar. 27/6/2017 - 26/6/2019

AWARDS AND ACHIEVEMENTS

- Miha Boltežar received the golden award of the University of Ljubljana



Laboratory for Non-Linear Mechanics **LANEM**

RESEARCH AREAS

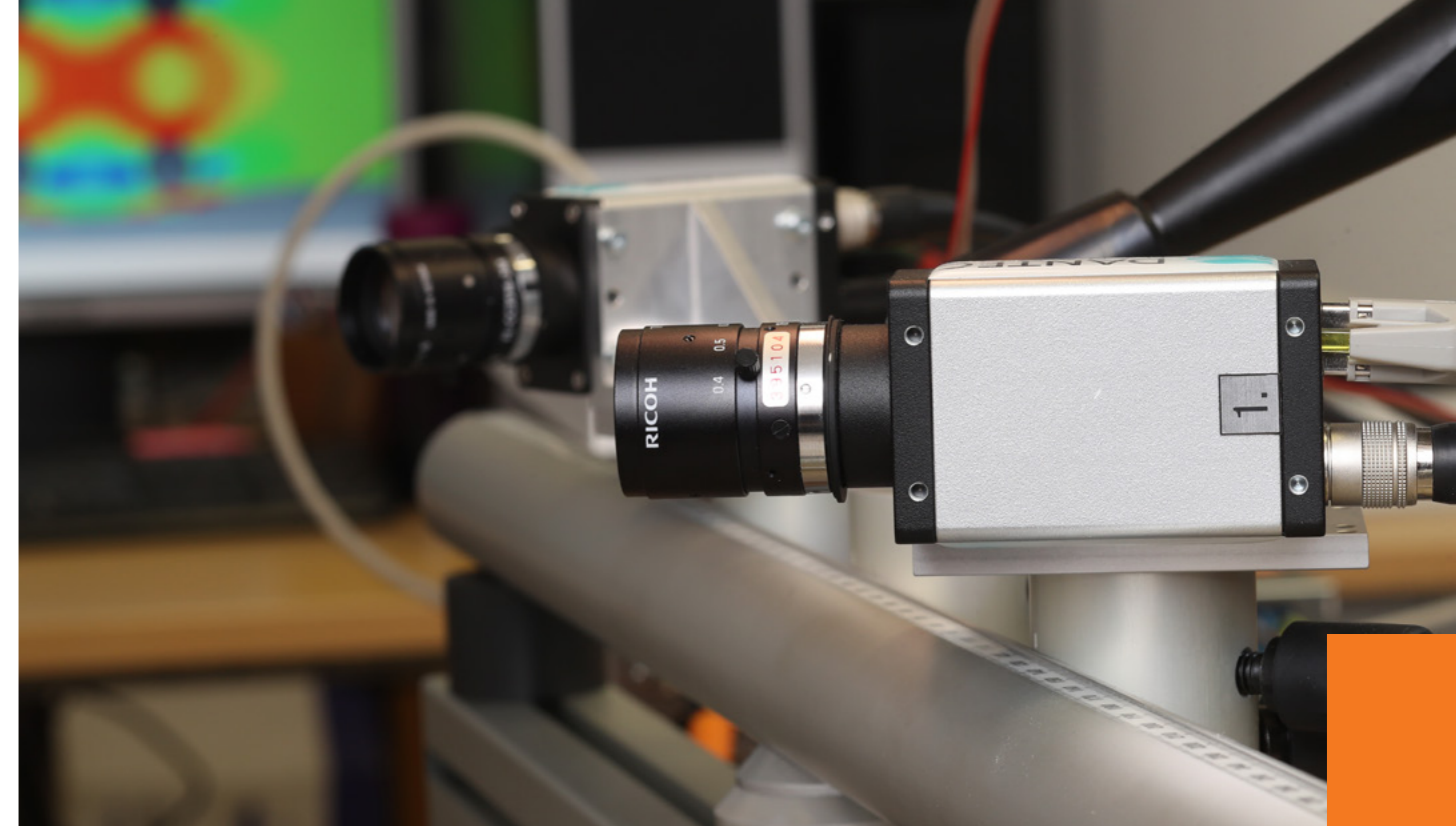
Nonlinear mechanics • Stability • Mechanics of materials • Materials with shape memory

DEPARTMENT HEAD Assist. Prof. Miha Brojan, PhD

DEPARTMENT MEMBERS Assist. Prof. Viktor Šajn, PhD, Assist. Prof. Tomaž Videnič, PhD, Assist. Matjaž Čebren, PhD, Damjan Lolič, Jonas Trojer, Matej Bogataj, Marta Ilešič

PROJECTS

Slovenian Research Agency - Crystallography of wrinkled elastic surfaces. Miha Brojan. 1/7/2018 - 30/6/2021



Laboratory for Numerical Modelling and Simulation **LNMS**

RESEARCH AREAS

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

DEPARTMENT HEAD Assist. Prof. Miroslav Halilovič, PhD

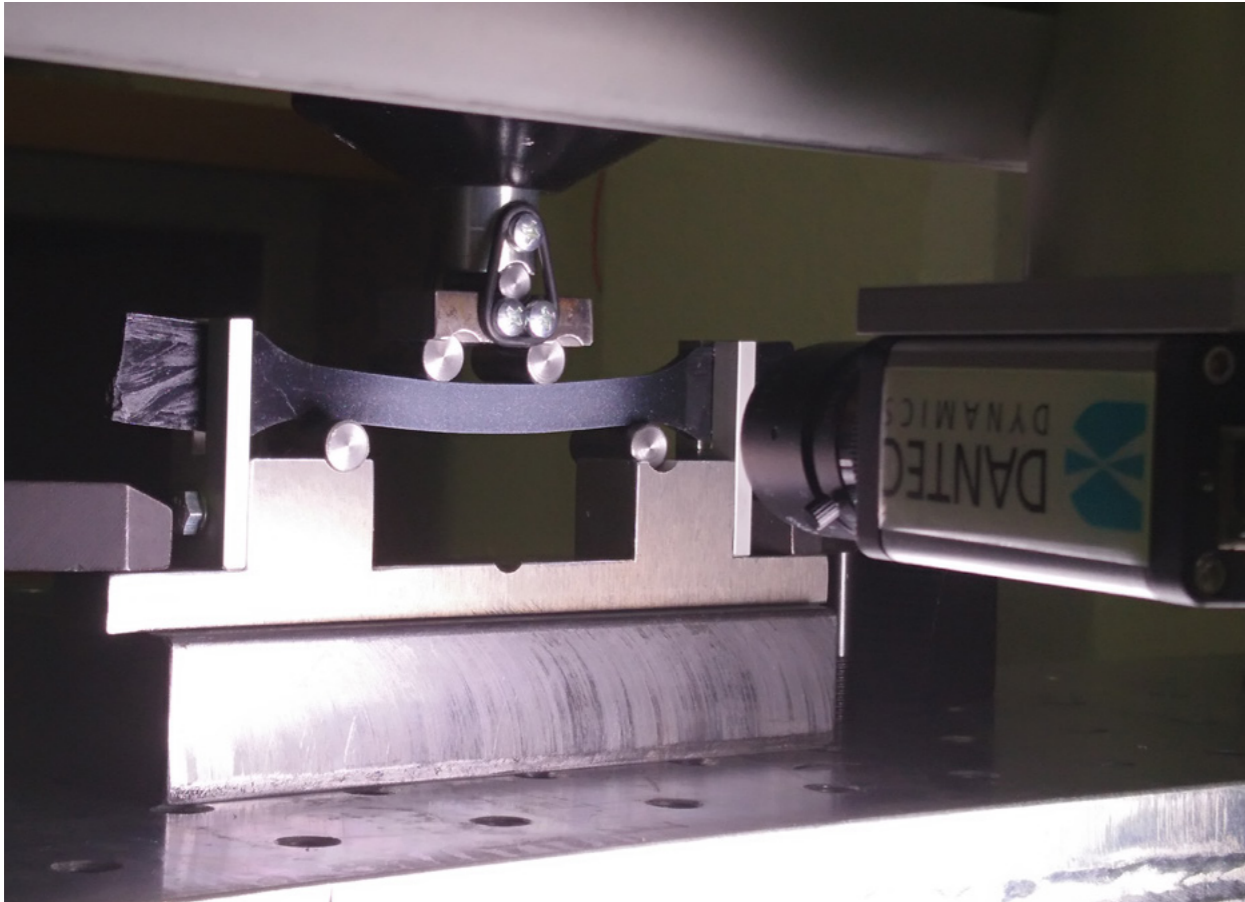
DEPARTMENT MEMBERS Assoc. Prof. Nikolaj Mole, PhD, Assist. Prof. Pino Koc, PhD, Assist. Primož Rus, PhD, Assist. Bojan Starman, PhD, Assist. Janez Urevc, PhD, M. Sc. Andrej Kotar, Assist. Kristjan Krebelj, Assist. Andraž Maček, Assist. Matija Nabergoj, Marta Ilešič

ORIGINAL SCIENTIFIC ARTICLE

MOLE, Nikolaj, BOJINOVIČ, Marko, KOC, Pino, ŠTOK, Boris. Effects of prior microstructure and heating rate on the depth of increased hardness in laser hardening : comparison of computer simulation and experimental results. Metals, Dec. 2018, vol. 8, iss. 12, p. 1-16.

PROJECTS

ERDF - European regional development fond SPS - Sustainable and innovative construction of smart buildings (TIGR4smart). Miroslav Halilovič. 1/9/2016 - 28/2/2019



EIT - European Institute of Innovation & Technology - RawMaterials - Closing the loop of the Spent Pot-line (SPL) in Al smelting process (SPL-Cycle), Miroslav Halilović. 2018 - 2021

AWARDS AND ACHIEVEMENTS

Bojan Starman received an award of the Faculty of Mechanical Engineering for excellence in teaching

Janez Urevc received an award of the Faculty of Mechanical Engineering for excellence in teaching



Laboratory for aeronautics **AEROL**

RESEARCH AREAS

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

DEPARTMENT HEAD Assoc. Prof. Tadej Kosel, PhD

ČLAN LABORATORIJA Assist. Igor Petrović, PhD, Marta Ilešič

11

SUSTAINABLE POLYMER MATERIALS AND TECHNOLOGIES

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

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

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

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



Laboratory for Experimental Mechanics **LEM**

RESEARCH AREAS

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

DEPARTMENT HEAD Assist. Prof. Lidija Slemenik Perše, PhD

DEPARTMENT MEMBERS Assist. Alexandra Aulova, PhD, Assist. Ted Prodan, PhD, Assist. Marko Bek, PhD, Assist. Alen Oseli, Król Elžbieta, Alenka Rogelj Ritonja

ORIGINAL SCIENTIFIC ARTICLE

AULOVA, Alexandra, CVENKEL, Anže, ŽAKELJ, Simon, PLANINŠEK, Odon, KRISTL, Albin, EMRI, Igor. Mechanical properties and drug permeability of the PA6 membranes prepared by immersion precipitation from PA6 - formic acid - water system. Journal of membrane science, Sep. 2018, vol. 562, p. 67-75.

MIHELČIČ, Mohor, SLEMENIK PERŠE, Lidija, ŠEST, Ervin, JERMAN, Ivan, GIULIANI, Chiara, DI CARLO, Gabriella, LAVORGNA, Marino, SURCA, Angelja Kjara. Development of solvent- and water-borne fluoropolymer protective coatings for patina-free bronze discs. Progress in organic coatings, Dec. 2018, vol. 125, p. 266-278.



BAŠNEC, Kristina, SLEMENIK PERŠE, Lidija, ŠUMIGA, Boštjan, HUSKIĆ, Miroslav, MEDEN, Anton, HLADNIK, Aleš, BOH PODGORNIK, Bojana, KLANJŠEK GUNDE, Marta. Relation between colour- and phase changes of a leuco dye-based thermochromic composite. Scientific reports, Apr. 2018, vol. 8, p. 1-10.

INDEPENDENT SCIENTIFIC COMPONENT PART OR A CHAPTER IN A MONOGRAPH

AULOVA, Alexandra, OSELI, Alen, BEK, Marko, PRODAN, Ted, EMRI, Igor. Effect of pressure on material properties of polymers. V: ALTENBACH, Holm (ur.), ÖCHSNER, Andreas (ur.). Encyclopedia of continuum mechanics. Berlin; Heidelberg: Springer. 2018, p. 1-14.

OSELI, Alen, AULOVA, Alexandra, GERGESOVA, Marina, EMRI, Igor. Effect of temperature on material properties of polymers. V: ALTENBACH, Holm (ur.), ÖCHSNER, Andreas (ur.). Encyclopedia of continuum mechanics. Berlin; Heidelberg: Springer. 2018, p. 1-20.

PATENT

ČAKŠ, Žiga, ČORLUKA, Željko, DUHOVNIK, Jože, KOKELJ, Gašper, KRAJNC, Matija, LEJLA, Vida, OSELI, Alen, SOMOGYVÁRI, Mónika, VERDEGUER LOPEZ, Javier, VUKAŠINOVIĆ, Nikola. Handkühengerät mit zwei Abtrieben = Hand-held kitchen appliance with two drives : Europäische Patentschrift EP2394546 (B1), 2018-08-08. München: Europäisches Patentamt, 2018. 17 p., patentna družina: EP2394546 (A1).

PROJECTS

Slovenian Research Agency – Electrospun nanofibrous materials for solid state drug delivery system. Igor Emri. 1/9/2016 - 28/2/2019

Slovenian Research Agency - Rheological behavior and mechanical properties for processing of highly filled powder – polymer systems. Lidija Slemenik Perše. 1/11/2018 – 31/10/2021

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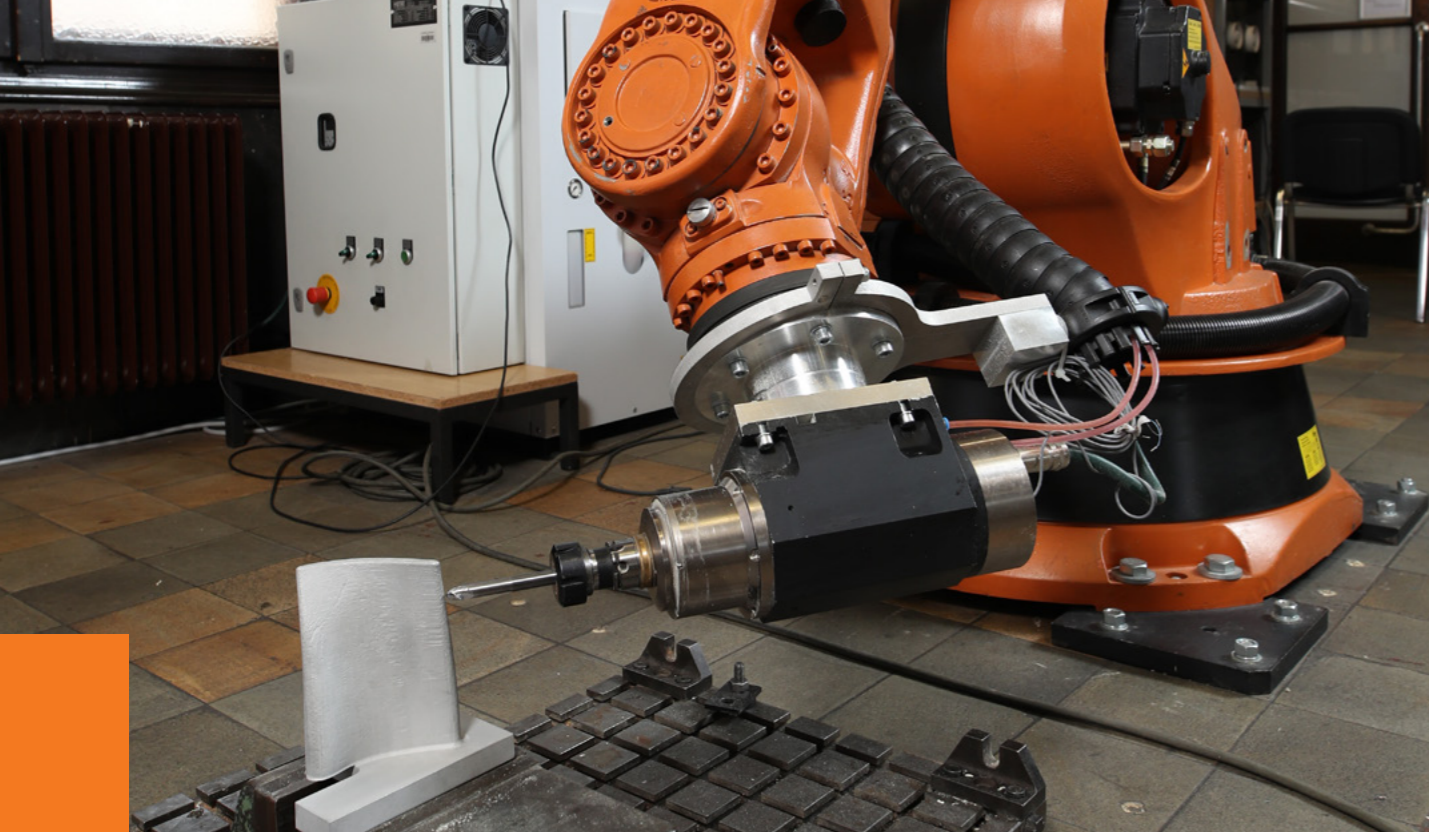
ADVANCED MANUFACTURING TECHNOLOGIES FOR HIGH QUALITY AND SUSTAINABLE PRODUCTION

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

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

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

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



Laboratory for Cutting **LABOD**

RESEARCH AREAS

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

DEPARTMENT HEAD Assoc. Prof. Franci Pušavec, PhD

DEPARTMENT MEMBERS Prof. Janez Kopač, PhD, Assoc. Prof. Peter Krajnik, PhD, Radovan Dražumerič, PhD, Assist. David Homar, PhD, Jani Kenda, PhD, Assist. Jaka Dugar, Assist. Damir Grguraš, Assist. Matjaž Kern, David Muženič, Vinko Rotar, Luka Sterle, Marija Jeretina

ORIGINAL SCIENTIFIC ARTICLE

SODJA, Jurij, BREUKER, Roeland de, NOŽAK, Dejan, DRAŽUMERIČ, Radovan, MARZOCCA, Pier. Assessment of low-fidelity fluid-structure interaction model for flexible propeller blades. *Aerospace science and technology : AST*, 2018, vol. 78, p. 71-88.

DRAŽUMERIČ, Radovan, BADGER, Jeffrey A., KLEMENT, Uta, KRAJNIK, Peter. Truing of diamond wheels - geometry, kinematics and removal mechanisms. *CIRP annals*, 2018, vol. 67, iss. 1, p. 345-348.

DAVID, Elena, KOPAČ, Janez. Toxic compounds generated by metalworking fluids and aluminum slag landfill and their effects on environment and people. *Environmental engineering and management journal*, Mar. 2018, vol. 17, no. 3, p. 739-748.

DAVID, Elena, KOPAČ, Janez. Pyrolysis of rapeseed oil cake in a fixed bed reactor to produce bio-oil. *Journal of analytical and applied pyrolysis*, Sep. 2018, vol. 134, p. 495-502.

DRAŽUMERIČ, Radovan, ROININEN, Roope, BADGER, Jeffrey A., KRAJNIK, Peter. Temperature-based method for determination of feed increments in crankshaft grinding. *Journal of materials processing technology*, 2018, vol. 259, p. 228-234.

HAFNER, Rok, GRGURAŠ, Damir, KRAMAR, Davorin. Milling process optimization for the best surface coat adhesion of the rigid polyurethane foam. *Journal of polymer engineering*, 2018, vol. 38, iss. 10, p. 995-1005.

HRIBERŠEK, Matija, PUŠAVEC, Franci, RECH, Joël, KOPAČ, Janez. Modeling of machined surface characteristics in cryogenic orthogonal turning of inconel 718. *Machining science and technology*, May 2018, vol. 22, iss. 5, p. 829-850.

KADIVAR, Mohammadali, AZARHOUSHANG, Bahman, SHAMRAY, Sergey, KRAJNIK, Peter. The effect of dressing parameters on micro-grinding of titanium alloy. *Precision engineering : journal of the International Societies for Precision Engineering and Nanotechnology*, Jan. 2018, vol. 51, p. 176-185.

MALAKIZADI, Amir, GHASEMI, Rohollah, BEHRING, Carsten, OLOFSSON, Jakob, JARFORS, Anders E. W., NYBORG, Lars, KRAJNIK, Peter. Effects of workpiece microstructure, mechanical properties and machining conditions on tool wear when milling compacted graphite iron. *Wear*, Sept. 2018, vol. 410/411, p. 190-201.

PATENT

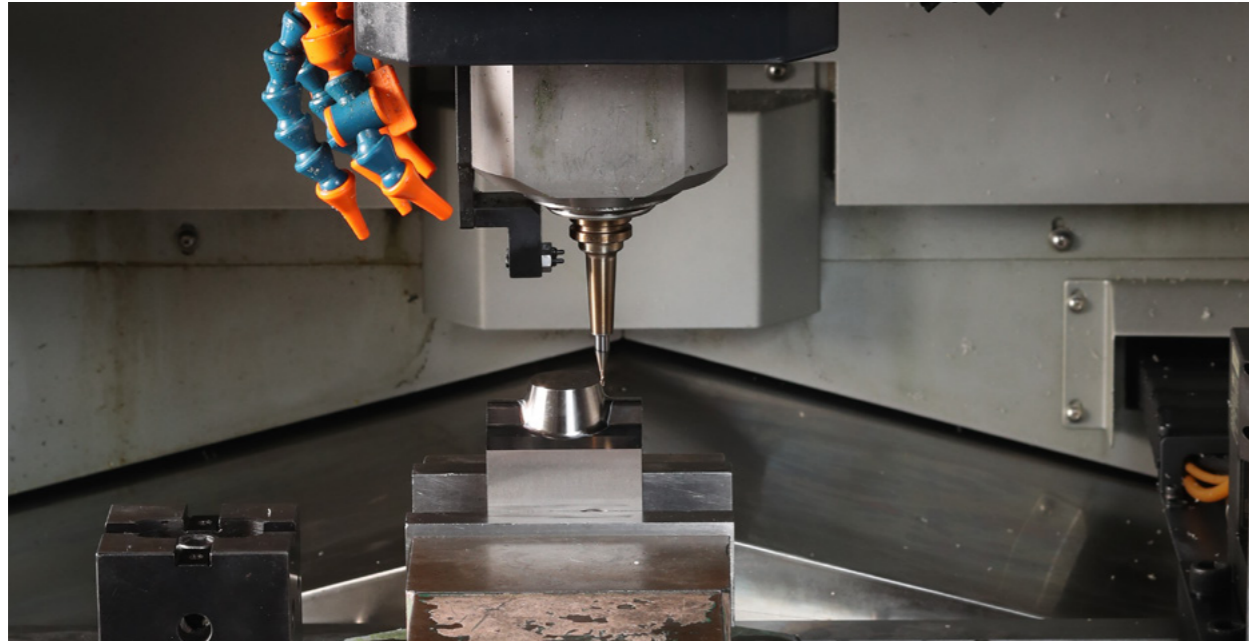
KRAJNIK, Peter, DRAŽUMERIČ, Radovan. Method of grinding a workpiece and method for determining processing parameters : JP6301012 (B2), 2018-03-28. Chiyada-ku Tokyo: Japan Patent Office, 2018, patent family: JP2017516677 (A).

KRAJNIK, Peter, ROININEN, Roope, DRAŽUMERIČ, Radovan. Method of grinding a workpiece having a cylindrical bearing surface and method for determining processing parameters : European patent specification EP3115149 (B1), 2018-03-14. Munich: European Patent Office, 2018. 25 p., patent family: EP3115149 (A1).

DOCTORAL DISSERTATIONS

Hriberšek Matija. Modeling of Machined Surface Characteristics in Cryogenic Machining. Mentor Franci Pušavec, Co-mentor Janez Kopač

Homar David. Combining additive and machining technologies to get optimized mould. Mentor. Janez Kopač

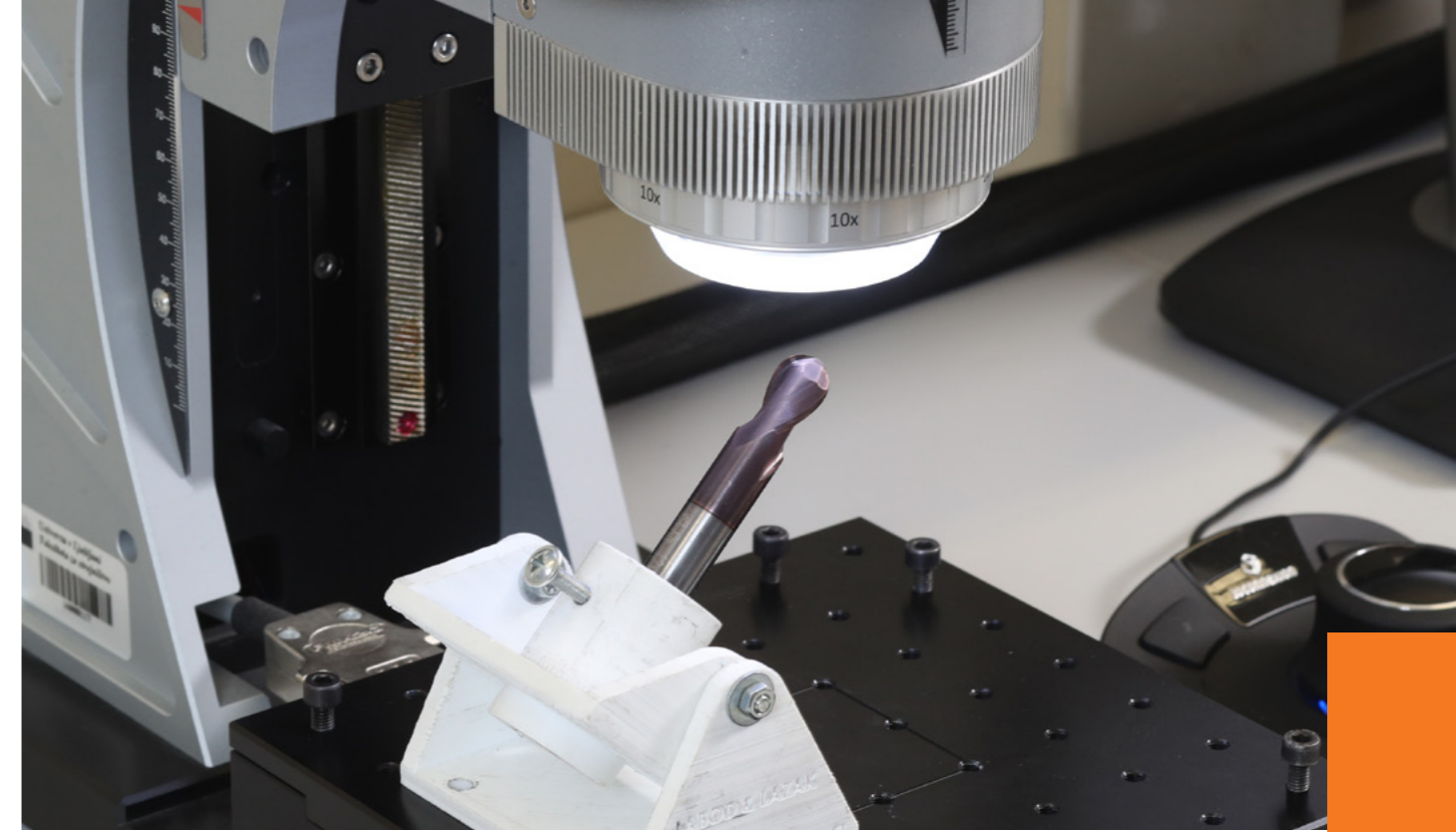


PROJECTS

Slovenian Research Agency - Development and implementation of cryogenic machining into serial production industry for increasing productivity of drilling and milling processes. Franci Pušavec. 1/5/2017 - 30/4/2020

AWARDS AND ACHIEVEMENTS

At the Innovation Days Luka Sterle, Damir Grguraš and Assoc. Prof. Dr. Franci Pušavec, received the golden award from the Chamber of Commerce and Industry of Slovenia (the Chamber of Central Slovenia) for the innovation of SingleCRYOlub.



Laboratory for Quality Assurance **LAZAK**

RESEARCH AREAS

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

DEPARTMENT HEAD Assoc. Prof. Davorin Kramar, PhD

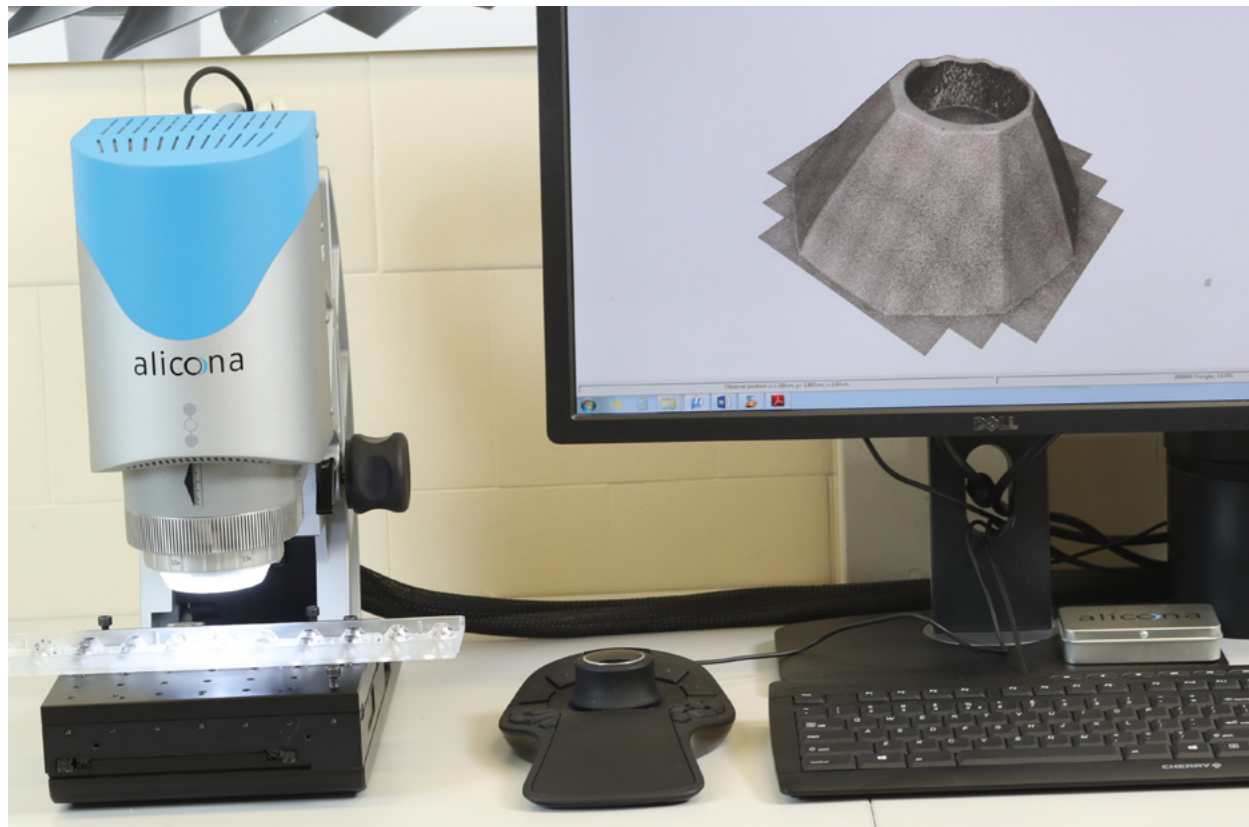
DEPARTMENT MEMBERS Assist. Luka Čerče, PhD, Luka Kastelic, David Muženič, Marija Jeretina

ORIGINAL SCIENTIFIC ARTICLE

BOROJEVIC, S., LUKIC, Dejan, MILOŠEVIĆ, Miloš, VUKMAN, J., KRAMAR, Davorin. Optimization of process parameters for machining of Al 7075 thin-walled structures. Advances in production engineering & management, 2018, vol. 13, no. 2, p. 125-135.

CICA, Djordje, KRAMAR, Davorin. Intelligent process modeling and optimization of porosity formation in high-pressure die casting. International journal of metalcasting, Oct. 2018, vol. 12, iss. 4, p. 814-824.

SREDANOVIĆ, Branislav, GLOBOČKI-LAKIĆ, Gordana, KRAMAR, Davorin, PUŠAVEC, Franci. Influence of workpiece hardness on tool wear in profile micro-milling of hardened tool steel. Tribology in industry, 2018, vol. 40, no. 1, p. 100-107.



ČERČE, Luka, BOROJEVIC, S., KRAMAR, Davorin. Optimization of the process parameters for stabilization and improvement of the turning process capability. Journal of production engineering 2018, vol. 21, nr. 2, p. 6-12.

INDEPENDENT SCIENTIFIC COMPONENT PART OR A CHAPTER IN A MONOGRAPH

CICA, Djordje, KRAMAR, Davorin. The estimation of cutting forces in the turning of Inconel 718 assisted with a high pressure coolant using bio-inspired artificial neural networks : chapter 7. V: RABELO, Luis (ur.), BHIDE, Sayli (ur.), GUTIERREZ, Edgar (ur.). Artificial intelligence : advances in research and applications, (Computer science, technology and applications). New York: Nova Science Publishers. cop. 2018, p. 147-169.

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:

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

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

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

The Joining of materials section performs the following research:

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

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



Laboratory for Heat Treatment and Materials Testing **LATOP**

RESEARCH AREAS

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

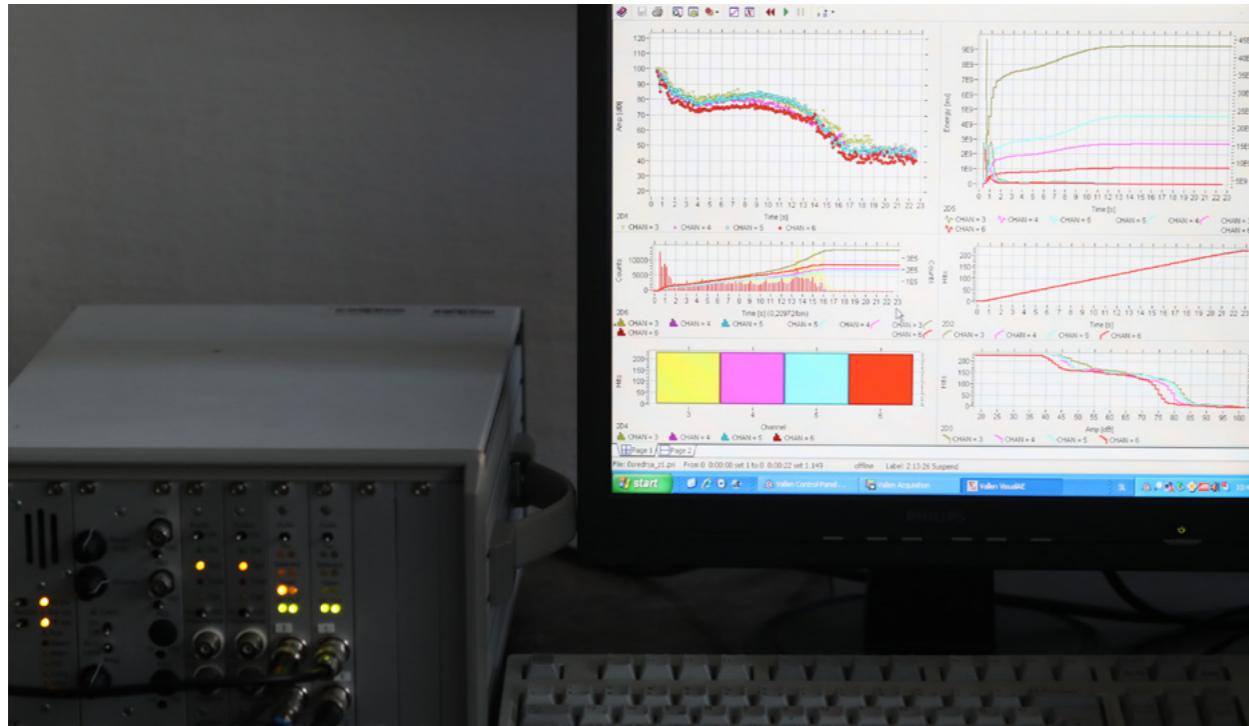
DEPARTMENT HEAD Prof. Roman Šturm, PhD

DEPARTMENT MEMBERS Assist. Prof. Tomaž Kek, PhD, Assist. Prof. Uroš Trdan, PhD, Assist. Janez Sušnik, PhD, Assist. Sebastjan Žagar, PhD, Assist. Zoran Bergant, PhD, Assist. Boštjan Pečnik, PhD, Assist. Dunja Ravnikar, PhD, Assist. Matjaž Žnidaršič, PhD, Assist. Bor Mojšker, Vane Kralj, Rok Markežič, Anja Vrhovec, Dušanka Grubor Železnik

ORIGINAL SCIENTIFIC ARTICLE

MOJŠKERC, Bor, KEK, Tomaž, GRUM, Janez. Feasibility study of monitoring the steel quenching process using acoustic emission technology. *Applied Acoustics*, 2018, vol. 129, p. 335-345.

RAVNIKAR, Dunja, RAJAMURE, Ravi Shanker, TRDAN, Uroš, DAHOTRE, Narendra B., GRUM, Janez. Electrochemical and DFT studies of laser-alloyed TiB₂/TiC/Al coatings on aluminium alloy. *Corrosion science*, May 2018, vol. 136, p. 18-27.



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 Assist. Prof. Damjan Klobčar PhD / Prof. Janez Tušek, PhD

DEPARTMENT MEMBERS Matej Pleterski, PhD, Assist. Maja Lindič, Peter Kolar, Andraž Logar, Dušanka Grubor Železnik

ORIGINAL SCIENTIFIC ARTICLE

TRDAN, Uroš, TOMOKAZU, Sano, KLOBČAR, Damjan, SANO, Yuji, GRUM, Janez, ŠTURM, Roman. Improvement of corrosion resistance of AA2024-T3 using femtosecond laser peening without protective and confining medium. *Corrosion science*, Oct. 2018, vol. 143, p. 46-55.

LINDIČ, Maja, PODLIPEC, Boštjan, BUŠIČ, Matija, KLOBČAR, Damjan. Toplotna obdelava maraging jekla, navarjenega s postopkom oblikovnega obločnega navarjanja z žico. Ventil: revija za fluidno tehniko in avtomatizacijo, 2018, vol. 24, no. 4, p. 302-307.

TRDAN, Uroš, TOMOKAZU, Sano, KLOBČAR, Damjan, SANO, Yuji, GRUM, Janez, ŠTURM, Roman. Improvement of corrosion resistance of AA2024-T3 using femtosecond laser peening without protective and confining medium. *Corrosion science*, Oct. 2018, vol. 143, p. 46-55.

STEINER PETROVIČ, Darja, ŠTURM, Roman. Sensitivity of Weck's reagent to the microstructure inhomogeneities of a pulse-laser-modified AISi12CuNiMg alloy. *Materials and technology*, 2018, vol. 52, iss. 6, p. 687-693.

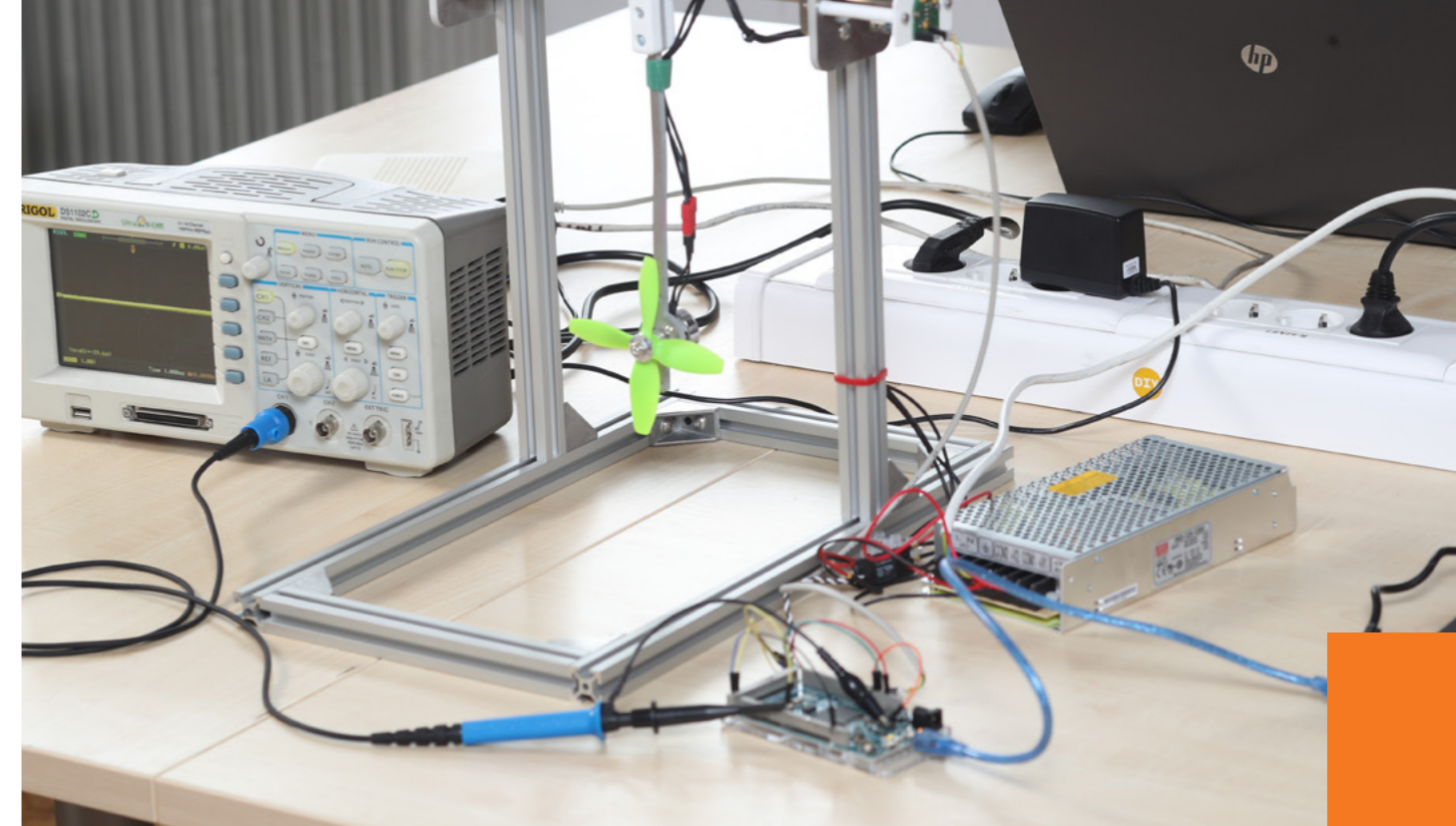
SUBADRA, Sharath Peethambaran, KEK, Tomaž, BERGANT, Zoran, GRIŠKEVIČIUS, Paulius. Study of acoustic emission signals during crack propagation in multiscale nano-composites. *Mechanika*, 2018, vol. 24, nr. 4, p. 391-398.

BERGANT, Zoran, SAVIN, Adriana, GRUM, Janez. Effects of manufacturing technology on static, multi-frequency dynamic mechanical analysis and fracture energy of cross-ply and quasi-isotropic carbon/epoxy laminates. *Polymers & polymer composites : incorporating Engineering plastics*, 2018, vol. 26, iss. 5/6, p. 358-370.

BABIČ, Matej, SKALA, Karolj, KUMAR, Dookhitram, ŠTURM, Roman. New hybrid system of machine learning and statistical pattern recognition for a 3D visibility network. *Journal of Mechanical Engineering*, 2018, vol. 64, no. 6, p. 393-400.

KEK, Tomaž, KUSIČ, Dragan, SVEČKO, Rajko, HANČIČ, Aleš, GRUM, Janez. Acoustic emission signal analysis for the integrity evaluation. *Journal of Mechanical Engineering*, 2018, vol. 64, no. 11, p. 665-671.

TRDAN, Uroš, SKARBA, M., PORRO, Juan A., OCAÑA, Jose Luis, GRUM, Janez. Application of massive laser shock processing for improvement of mechanical and tribological properties. *Surface & coatings technology*, May 2018, vol. 342, p. 1-11.



Laboratory for Digital Systems and Electrical Engineering **LDSE**

RESEARCH AREAS

Modelling • Simulation • Automation • Hardware • Software

DEPARTMENT HEAD Prof. Janez Diaci, PhD

DEPARTMENT MEMBERS Assist. Prof. Marjan Jenko, PhD, Assist. Marko Corn, PhD, Assist. Tomaž Požrl, PhD, Anja Juriševič, Rožman Nejc, Alenka Rogelj Ritonja

PATENT

LEGEN, Igor, BEVC, Alenka, BERGLEZ, Sandra, DIACI, Janez, KUŠČER, Lovro. Apparatus for simulating the function of human stomach and/or human intestine : United States patent US10127839 (B2), 2018-11-13. Alexandria: United States Patent and Trademark Office, 2018. 25 p., patent family: US2016351079 (A1).

PROJECTS

ERDF - European regional development fond SPS - Building Blocks, Tools and Systems for Factories of the Future (GOSTOP). Janez Diaci. 1/11/2016 - 30/4/2020

PROJECTS

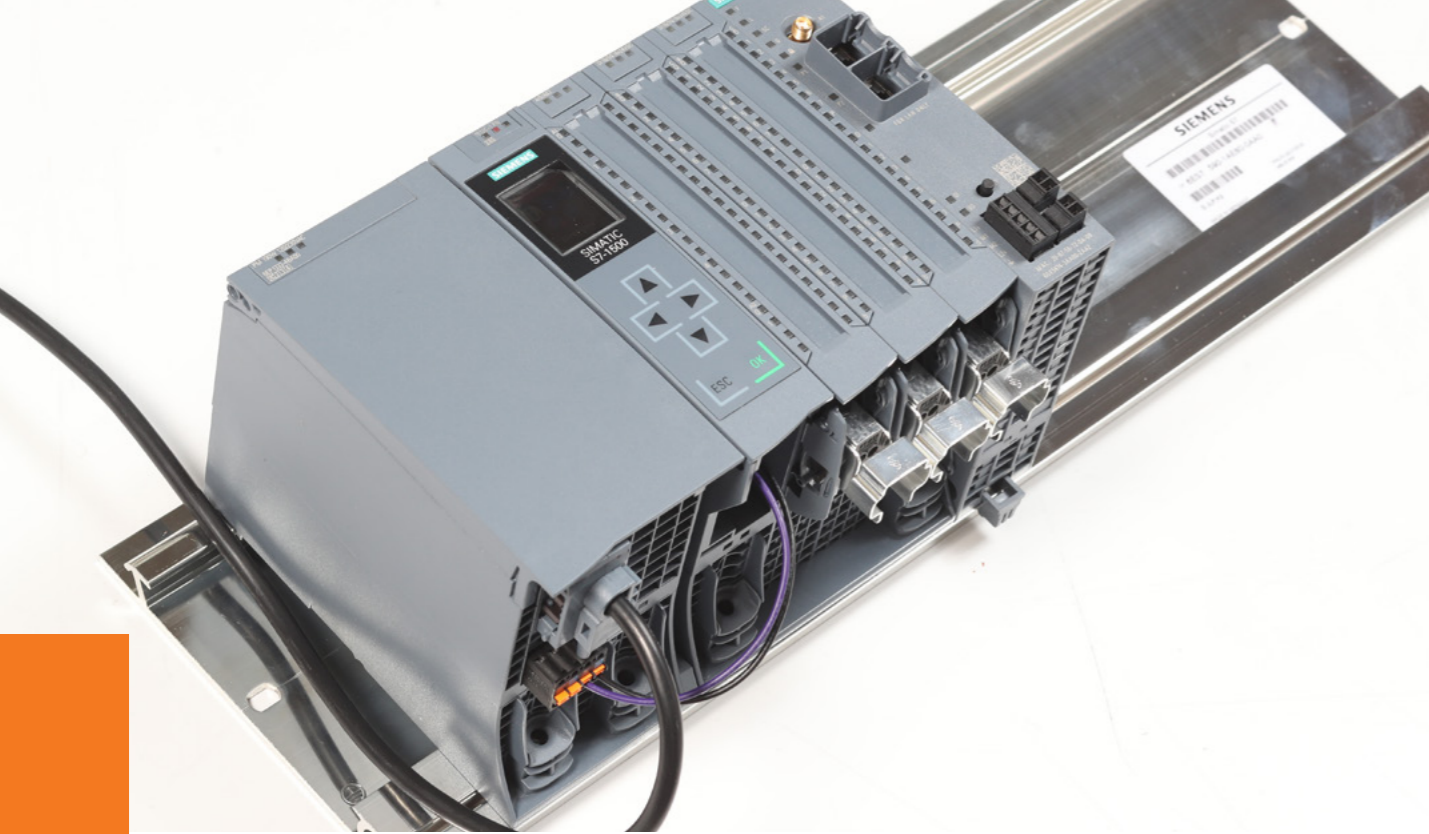
Slovenian Research Agency - Selective plasma oxidation of FeCrAl alloys for extended-lifetime of glow plugs for diesel engines. Damjan Klobčar / Janez Tušek (operator: IJS). 1/5/2017 - 30/4/2020

COST - European Cooperation in science and technology. Advanced fibre laser and coherent source as tools for society, manufacturing and lifescience. Damjan Klobčar. 10/12/2014 - 9/12/2018

COST - European Cooperation in science and technology. Solutions for Critical Raw Materials Under Extreme Conditions. Damjan Klobčar. 10/3/2016 - 9/3/2020

COST - European Cooperation in science and technology. Electrochemical processing methodologies and corrosion protection for device and systems miniaturization. Damjan Klobčar. 23/4/2015 - 22/4/2019

ERDF - European regional development fond SPS - MAtErials and Technologes for New Applications (MARTINA). Damjan Klobčar 1/8/2016 - 31/7/2019



Laboratory for Process Automation **LPA**

RESEARCH AREAS

Analysis of control systems • Design of control systems • Optimal control laws • Energy devices and processes

DEPARTMENT HEAD Assoc. Prof. Primož Podržaj, PhD

DEPARTMENT MEMBERS Assist. Prof. Samo Simončič, PhD, Miha Finžgar, Matic Kelvišar, Alenka Rogelj Ritonja

ORIGINAL SCIENTIFIC ARTICLE

FINŽGAR, Miha, PODRŽAJ, Primož. A wavelet-based decomposition method for a robust extraction of pulse rate from video recordings. PeerJ, Nov. 2018, vol. 6, p. 1-26.

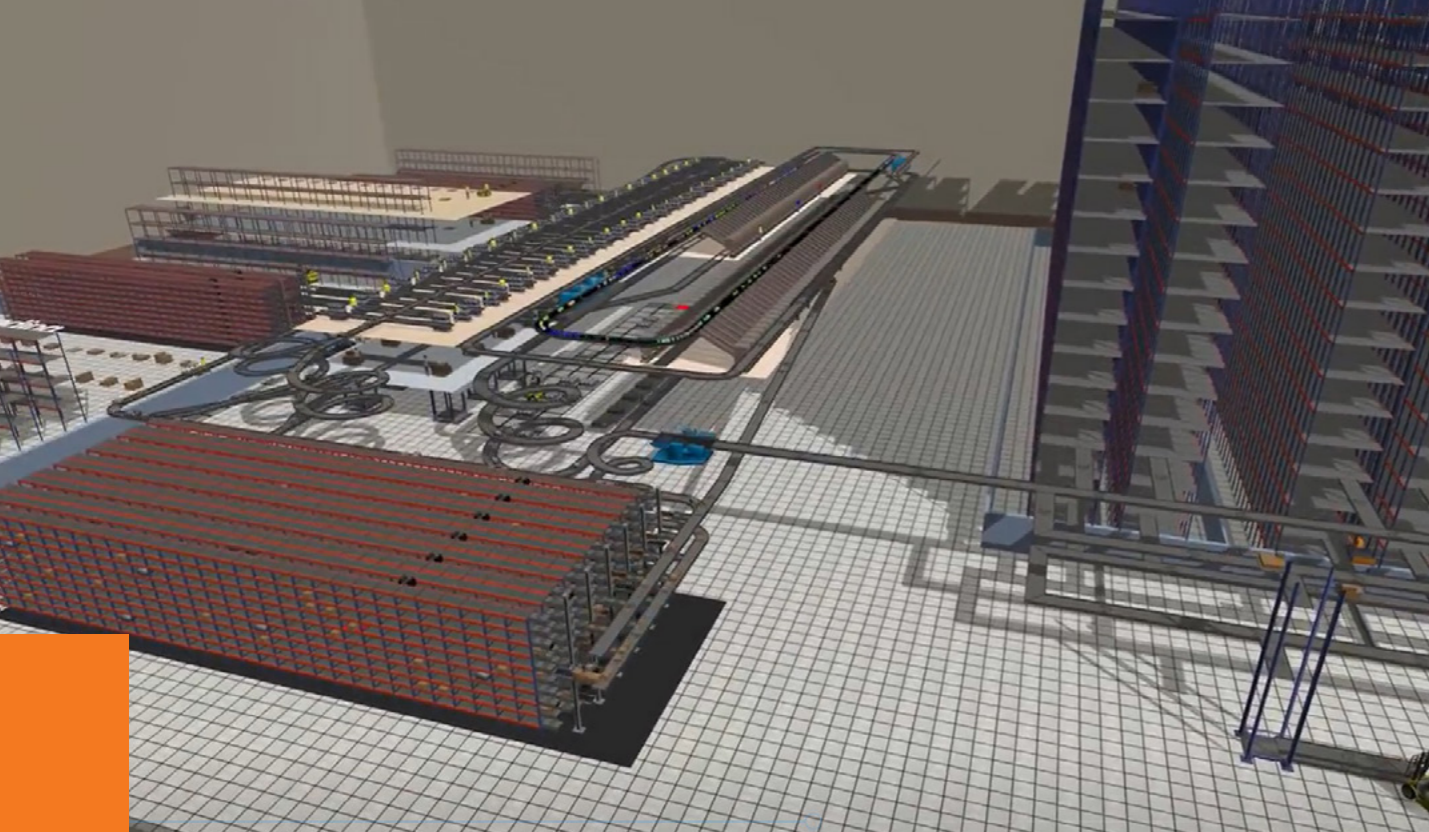
Laboratory for Manufacturing Cybernetics and Experimentation **MCE**

RESEARCH AREAS

Quality • Computer integrated manufacturing • Adaptive control • Machine vision • Internet of Things • Mechatronics • Biologically inspired robotics

DEPARTMENT HEAD Assist. Prof. Drago Bračun, PhD

DEPARTMENT MEMBERS Assist. Luka Selak, PhD, Assist. Gašper Škulj, PhD, Alenka Rogelj Ritonja



Laboratory for Manufacturing Systems and Production Process Planning **LAPS**

RESEARCH AREAS

Production systems • Production planning and control • Logistics of material and information flows • Work and time studies • Project management • Concurrent engineering • Operational research

DEPARTMENT HEAD Assoc. Prof. Janez Kušar, PhD

DEPARTMENT MEMBERS Assist. Prof. Tomaž Berlec, PhD, Assist. Lidija Rihar, PhD, Tadeja Kavčič, Tena Žužek, Alenka Rogelj Ritonja

ORIGINAL SCIENTIFIC ARTICLE

RIHAR, Lidija, KUŠAR, Janez. Introduction of concurrent engineering into the company. Projektna mreža Slovenije : the journal of the Slovenian project management association, Oct. 2018, vol. 21, iss. 2, p. 4-12.

JEŽ, Miha, KUŠAR, Janez, BERLEC, Tomaž. Projekt obvladovanja investicijskega procesa. Ventil : revija za fluidno tehniko in avtomatizacijo, Oct. 2018, vol. 24, iss. 5, p. 390-398.



Laboratory for control and manufacturing systems **LAKOS**

RESEARCH AREAS

Mechatronics • Robotics • Flexible manufacturing systems • Computer-integrated manufacturing • Distributed control • Multi-agent systems • Reinforcement learning • Engineering informatics • Manufacturing data analytics

DEPARTMENT HEAD Assist. Prof. Rok Vrabič, PhD / Prof. Peter Butala, PhD

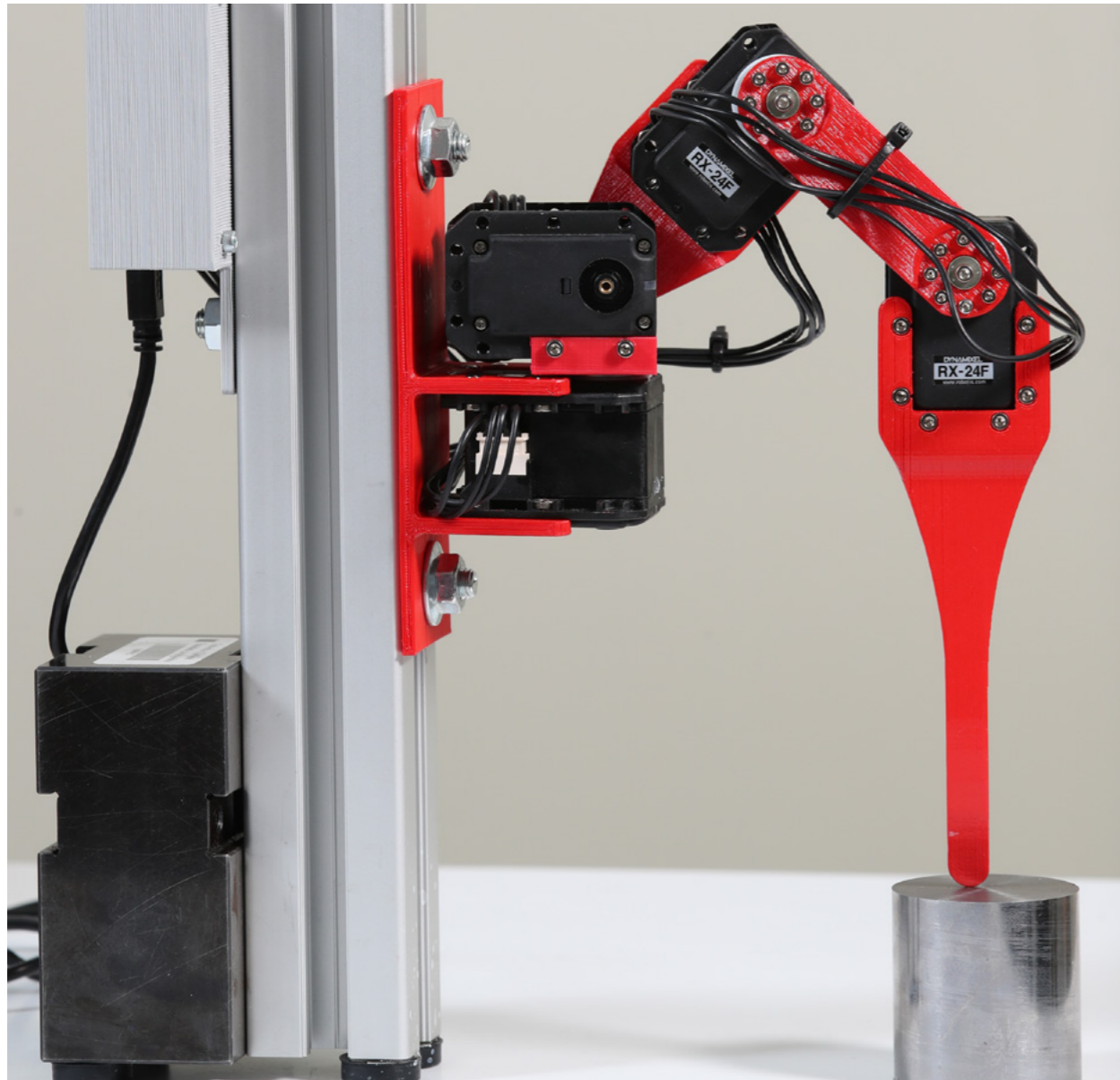
DEPARTMENT MEMBERS Assist. Andreja Malus, Dominik Kozjek, Dominik Rupert, Alenka Rogelj Ritonja

ORIGINAL SCIENTIFIC ARTICLE

ZALETTELJ, Viktor, VRABIČ, Rok, HOZDIČ, Elvis, BUTALA, Peter. A Foundational ontology for the modelling of manufacturing systems. Advanced engineering informatics : the science of supporting knowledge-intensive activities, Oct. 2018, vol. 38, p. 129-141.

VRABIČ, Rok, KOZJEK, Dominik, MALUS, Andreja, ZALETTELJ, Viktor, BUTALA, Peter. Distributed control with rationally bounded agents in cyber-physical production systems. CIRP annals, 2018, vol. 67, iss. 1, p. 507-510.

KOZJEK, Dominik, VRABIČ, Rok, ERŽEN, Gregor, BUTALA, Peter. Identifying the business and social networks in the domain of production by merging the data from heterogeneous internet sources. International journal of production economics, Jun. 2018, vol. 200, p. 181-191.



PROJECTS

Erasmus+ - Improving Governance Practices at Palestinian Higher Education Institutions (UniGov). Peter Butala. 15/10/2016 - 14/10/2019

ERDF - European regional development fund SPS - Building Blocks, Tools and Systems for Factories of the Future (GOSTOP). Peter Butala. 1/11/2016 - 30/4/2020

14

OPTODYNAMICS

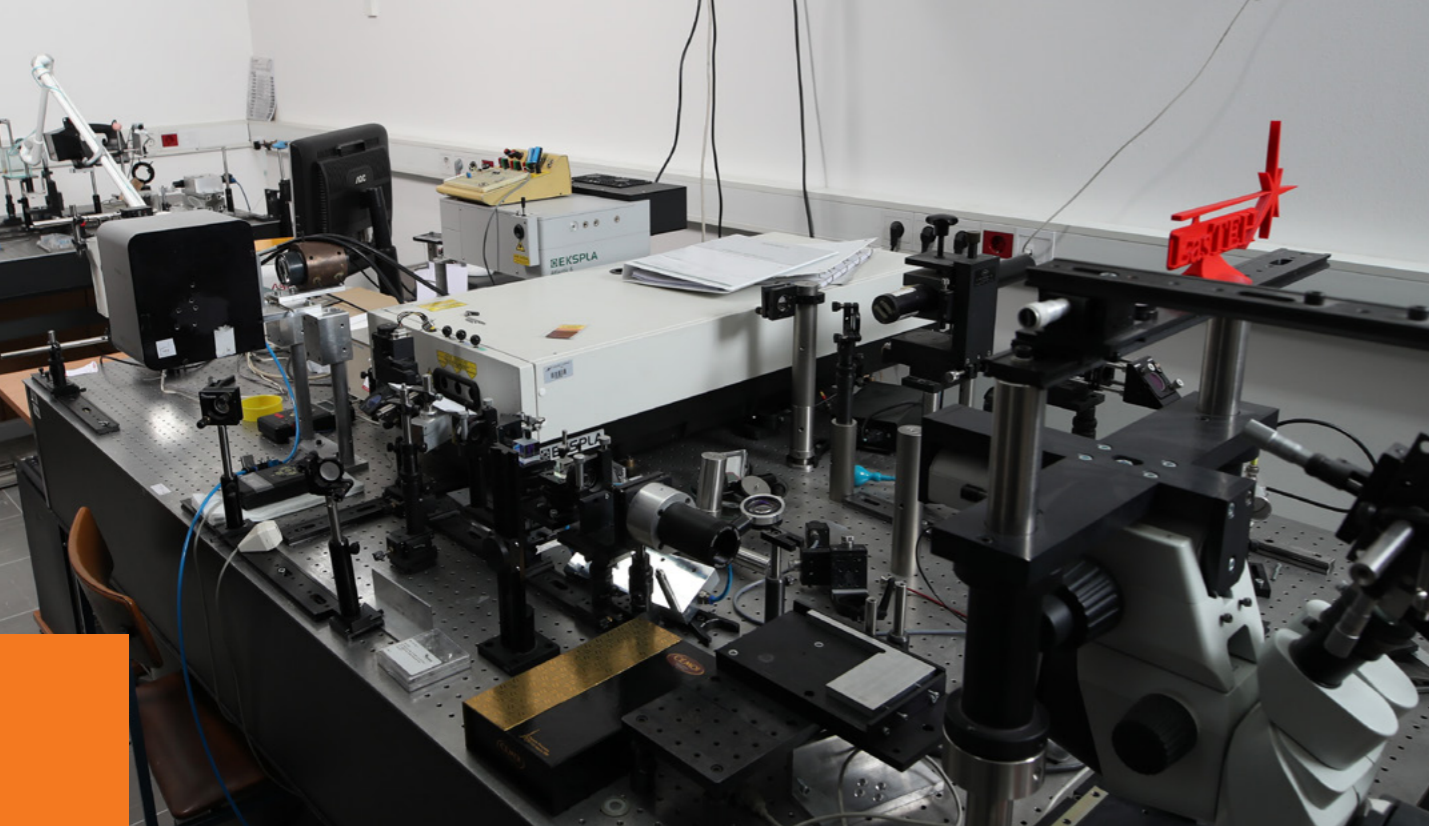
Optodynamics explores the dynamic aspects of light-to-substance interaction, which are the basis of most laser machining processes and laser-based medical interventions. Since optodynamic responses are an important source of information on the interaction between light and matter, their simultaneous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

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

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

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

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



Laboratory for Laser Techniques **LASTEH**

RESEARCH AREAS

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

DEPARTMENT HEAD Assoc. Prof. Matija Jezeršek, PhD

DEPARTMENT MEMBERS Assist. Prof. Peter Gregorčič, PhD, , Assist. Aleš Babnik, PhD, Assist. Urban Pavlovčič, PhD, Assist. Jernej Laloš PhD, Ladislav Grad, PhD, Nejc Lukač, PhD, Assist. Luka Hribar, Assist. Jure Košir, Assist. Matjaž Kos Assist Matej Senegačnik, Teja Jereb, Alenka Rogelj Ritonja

ORIGINAL SCIENTIFIC ARTICLE

DONIK, Črtomir, KOCIJAN, Aleksandra, PAULIN, Irena, HOČEVAR, Matej, GREGORČIČ, Peter, GODEC, Matjaž. Improved biodegradability of Fe-Mn alloy after modification of surface chemistry and topography by a laser ablation. *Applied Surface Science*, 2018, vol. 453, p. 383-393.

LALOŠ, Jernej, GREGORČIČ, Peter, JEZERŠEK, Matija. Observation of laser-induced elastic waves in agar skin phantoms using a high-speed camera and a laser-beam-deflection probe. *Biomedical optics express*, Apr. 2018, vol. 9, no. 4, p. 1893-1905.

LUKAČ, Nejc, JEZERŠEK, Matija. Amplification of pressure waves in laser-assisted endodontics with synchronized delivery of Er:YAG laser pulses. *Lasers in medical science*, May 2018, vol. 33, iss. 4, p. 823-833.

MILANIČ, Matija, TAŠIČ MUC, Blaž, JEZERŠEK, Matija, LUKAČ, Matjaž. Experimental and numerical assessment of hyperthermic laser lipolysis with 1,064 nm Nd: YAG laser on a porcine fatty tissue model. *Lasers in surgery and medicine*, 2018, vol. 50, iss. 2, p. 125-136.

GREGORČIČ, Peter, CONRADI, Marjetka, HRIBAR, Luka, HOČEVAR, Matej. Long-term influence of laser-processing parameters on (super)hydrophobicity development and stability of stainless-steel surfaces. *Materials*, Nov. 2018, vol. 11, iss. 11, p. 1-15.

GREGORČIČ, Peter, ZUPANČIČ, Matevž, GOLOBIČ, Iztok. Scalable surface microstructuring by a fiber laser for controlled nucleate boiling performance of high- and low-surface-tension fluids. *Scientific reports*, 2018, vol. 8, p. 1-8.

CONRADI, Marjetka, DRNOVŠEK, Aljaž, GREGORČIČ, Peter. Wettability and friction control of a stainless steel surface by combining nanosecond laser texturing and adsorption of superhydrophobic nanosilica particles. *Scientific reports*, 2018, vol. 8, p. 1-9.

PAVLOVČIČ, Urban, JEZERŠEK, Matija. Handheld 3-dimensional wound measuring system. *Skin research and technology*, May 2018, vol. 24, iss. 2, p. 326-333.

DOCTORAL DISSERTATIONS

Laloš Jernej. Optodynamic conversion of finite-sized laser pulses. Mentor Janez Možina, Co-mentor Matija Jezeršek

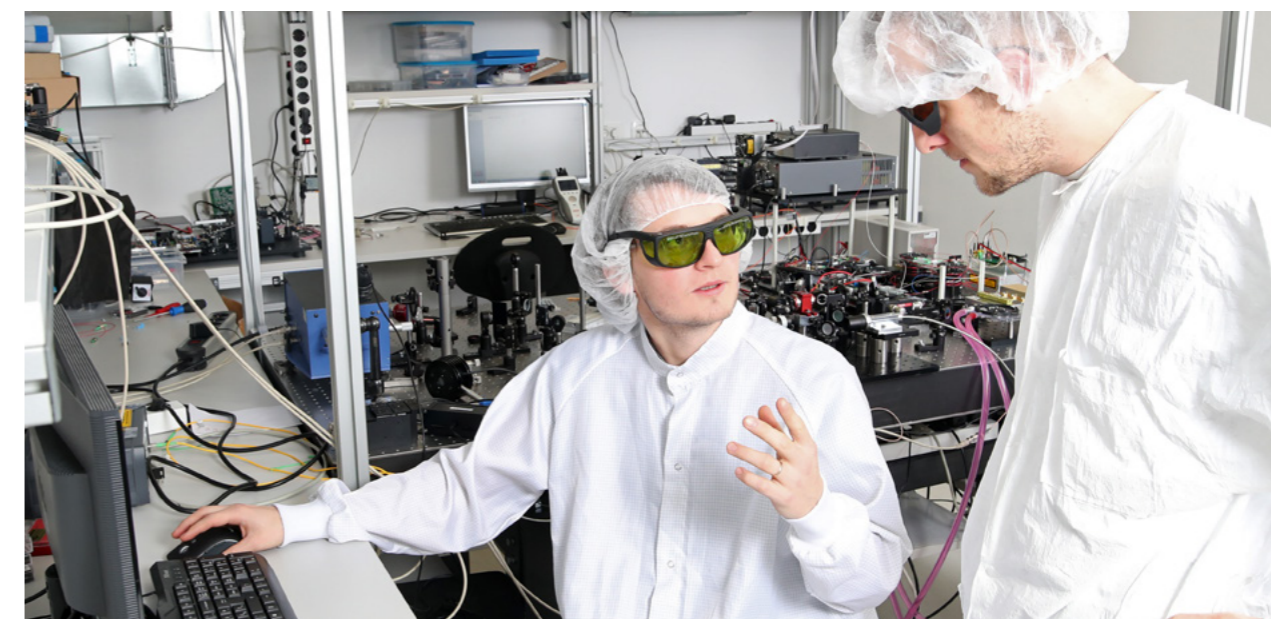
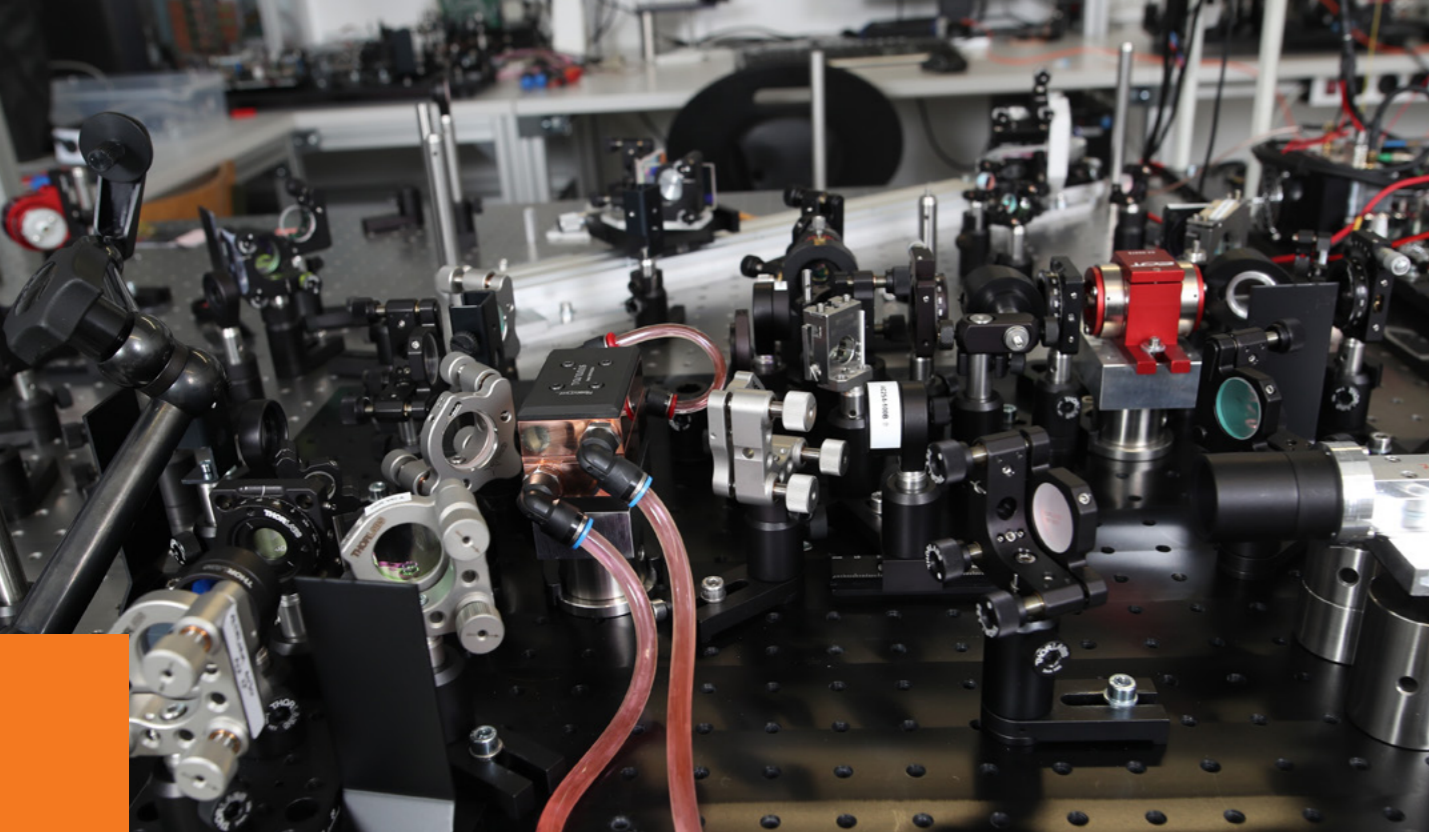
PROJECTS

Slovenian Research Agency – Combined multispectral and thermographic imaging for screening and monitoring of small joint arthritis. Matija Jezeršek (operator: FMF). 1/5/2017 - 30/4/2020

Slovenian Research Agency – Optodynamic optimisation of laser root canal irrigation. Matija Jezeršek. (operator: UKC). 1/9/2016 - 28/2/2019

ERDF - European regional development fond SPS - Building blocks, tools and systems for the Factories of the Future (GOSTOP). Matija Jezeršek. 1/11/2016 - 30/4/2020

Company Fotona - Research and development of laser medical systems. Matija Jezeršek. 1/9/2018 -1/9/2021



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 • Rapid photography • Laser interferometric methods • Optodynamics

DEPARTMENT HEAD Assoc. Prof. Rok Petkovšek, PhD

DEPARTMENT MEMBERS PhD, Assist. Prof. Vid Agrež, Assist. Luka Černe, PhD, Assist. Darja Horvat, PhD, Phd, Assist. Jernej Jan Kočica, Assist. Žiga Lokar, Assist. Jaka Mur, PhD, Uroš Orthaber, PhD, Assist. Jaka Petelin, PhD, Marko Šajn, Assist. Prof. Tomaž Požar, Assist. Peter Šušnjar, Blaž Kmetec, Phd, Vid Novak, PhD, Alenka Rogelj Ritonja

ORIGINAL SCIENTIFIC ARTICLE

MUR, Jaka, PETKOVŠEK, Rok. Precision and resolution in laser direct microstructuring with bursts of picosecond pulses. Applied physics. A, Materials science & processing, Jan. 2018, vol. 124, p. 1-6.

POŽAR, Tomaž, HALILOVIČ, Miroslav, HORVAT, Darja, PETKOVŠEK, Rok. Simulation of wave propagation inside a human eye : acoustic eye model (AEM). Applied physics. A, Materials science & processing, Feb. 2018, vol. 124, iss. 2, p. 1-9.

HORVAT, Darja, ORTHABER, Uroš, SCHILLE, J., HARTWIG, L., LÖSCHNER, Udo, VREČKO, Andrej, PETKOVŠEK, Rok. Laser-induced bubble dynamics inside and near a gap between a rigid boundary and an elastic membrane. International journal of multiphase flow, Mar. 2018, vol. 100, p. 119-126.

POŽAR, Tomaž, LALOŠ, Jernej, BABNIK, Aleš, PETKOVŠEK, Rok, LUKASIEVICZ, G. V. B., BETHUNE-WADDELL, Max, CHAU, Kenneth J., ASTRATH, N. G. C. Isolated detection of elastic waves driven by the momentum of light. Nature communications, 2018, vol. 9, p. 1-11.

ŠUŠNJAR, Peter, AGREŽ, Vid, PETKOVŠEK, Rok. Photodarkening as a heat source in ytterbium doped fiber amplifiers. Optics express, 2018, vol. 26, no. 5, p. 6420-6426.

PATENT

BUENTING, Udo, PODOBNIK, Boštjan, PETKOVŠEK, Rok, OSTHOLT, Roman. Method and apparatus for transferring printing substance onto a substrate by means of laser radiation : US 9,849,692 (B2), 2017-12-26. Alexandria: United States Patent and Trademark Office, 2017. 1 listina, patent family: EP3210793 (B1).

PROJECTS

ERDF - European regional development fond SPS - Building blocks, tools and systems for the Factories of the Future (GOSTOP). Rok Petkovšek. 1/11/2016 - 30/04/2020

Slovenian Research Agency - High power highly adaptable fiber lasers for the industrial applications. Vid Agrež / Janez Grum. 1/5/2017 - 30/4/2020

Slovenian Research Agency - Spatial and temporal shaping of laser light for minimally invasive ophthalmic procedures. Požar Tomaž. 1/7/2018 - 30/6/2021

Slovenian Research Agency - Ultrashort pulses on demand. Rok Petkovšek. 1/7/2018 - 30/6/2021



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.



Unit for supplementary division **EDZ**

MEMBERS Bratuž Jože, Bratuž Žiga

ACTIVITIES OF UNIT FOR SUPPLEMENTARY DIVISION IN 2018

- Organization of indoor sports activities for students (basketball, volleyball, futsal, fitness, boxing, swimming, dancing...)
- Alpine skiing course for students in Kranjska Gora
- 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, triathlon, fencing, swimming, squash, orientation, billiards, shooting)

TOP RESULTS OF STUDENTS OF THE FACULTY OF MECHANICAL ENGINEERING IN 2018 COMPETITION

| | | |
|-----------|--------------------------|----------------|
| 1st place | Fencing (foil) | Simon Dobelšek |
| 1st place | Shooting (air rifle) | Domen Jarni |
| 1st place | Squash | Mark Hafner |
| 2nd place | Orientation | Simon Stanonik |
| 3rd place | Fencing (epee) | Simon Dobelšek |
| 3rd place | Fencing (saber) | Simon Dobelšek |
| 3rd place | Swimming (50m freestyle) | Nejc Kos |
| 3rd place | Orientation | Peter Tušar |



Mathematics Research Team **RSMAT**

RESEARCH AREAS

Diverse fields from PURE and APPLIED MATHEMATICS

DEPARTMENT HEAD Prof. Janez Žerovnik, PhD

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

ORIGINAL SCIENTIFIC ARTICLE

REPOLUSK, Polona, ŽEROVNIK, Janez. Formulas for various domination numbers of products of paths and cycles. *Ars combinatoria*, 2018, vol. 137, p. 177-202.

NOVAK, Tina, RUPNIK POKLUKAR, Darja, ŽEROVNIK, Janez. The Hosoya polynomial of double weighted graphs. *Ars mathematica contemporanea*, 2018, vol. 15, nr. 2, p. 441-466.

MÜLLER, Vladimir, PEPERKO, Aljoša. Lower spectral radius and spectral mapping theorem for suprema preserving mappings. *Discrete and continuous dynamical systems*, Aug. 2018, vol. 38, no. 8, p. 4117-4132.

PEPERKO, Aljoša. Uniform boundedness principle for nonlinear operators on cones of functions. *Journal of Function Spaces*, 2018, vol. 2018, p. 1-5.

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PROJECTS

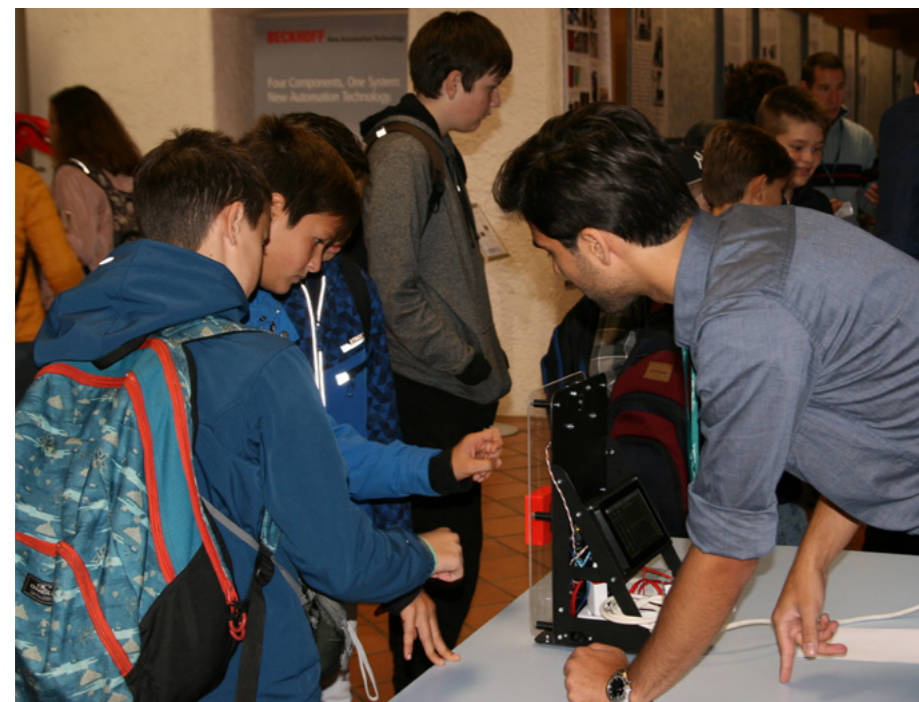
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PROMOTION OF MECHANICAL ENGINEERING

Mechanical engineering offers many possibilities for engagement and provides opportunities for designing creative solutions which have a practical value and are interesting for man and the environment in which he lives. Mechanical engineers have the mission to transform ideas into products that co-create the modern reality. The Faculty of Mechanical Engineering of the University of Ljubljana actively follows modern trends, promotes mechanical engineering in all its forms, organises events and conferences, runs workshops and published periodicals. With its active engagement, the Faculty helps to popularise mechanical engineering among the public and spread the awareness of the importance of engineering in everyday life.

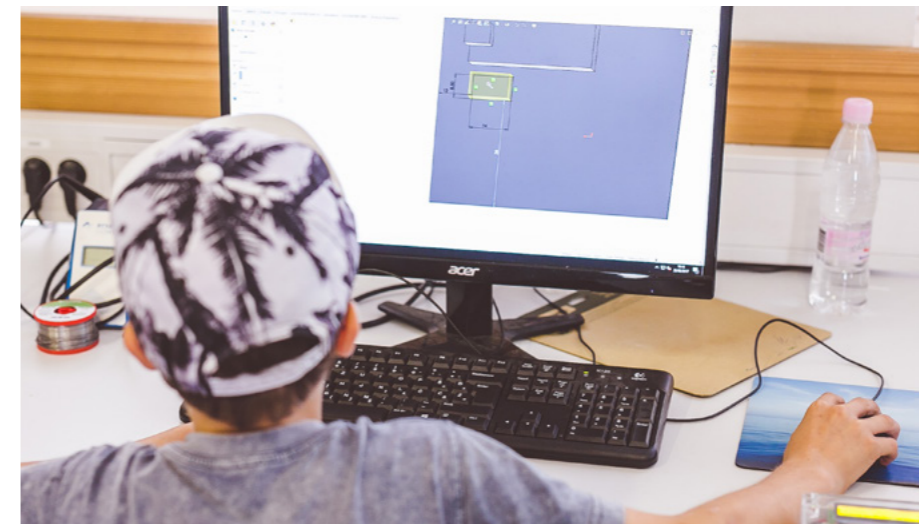
MECHANICAL ENGINEERING DAYS

The Mechanical engineering days event takes place every year in September in collaboration with the Technical museum of Slovenia in Bistra near Vrhnika where visitors are offered a glimpse into the appealing world of engineering design which is the result of collaboration between the students and researchers at the Faculty of Mechanical Engineering.



MECHANICAL ENGINEERING SUMMER CAMP

As a part of engineering, mechanical engineering is a creative endeavour and for this reason, we want to excite primary school pupils in grade 8h and 9 and secondary school students from year 1 to 4 about the technical science by organising Mechanical engineering summer camp in August every year. The participants are divided into smaller groups within thematic workshops, such as a mobile robot, 3D printing, water hydraulic press and construction of a remote control airplane where they learn about and make products. Participant take the finished products home at the end of the summer camp.



INFORMATIVA

Informativa is an all-Slovenian educational and career fair which takes place at the Ljubljana Exhibition and Convention Center Gospodarsko razstavišče every year at the end of January. The one-stop shop offers an overview of educational programs available in Slovenia and abroad – from secondary schools to higher education and postgraduate programs, additional education and training, language courses and lifelong learning. Every year the Faculty of Mechanical Engineering participates in Informativa fair as a part of the University of Ljubljana university city.



PROMOTION OF MECHANICAL ENGINEERING IN SECONDARY SCHOOLS AND GYMNASIA

The Faculty of Mechanical Engineering pays special attention to the promotion of mechanical engineering in secondary schools and gymnasias with intent of raising awareness in young people about the importance of the engineering profession. Every year, mechanical engineering is presented to students at more than 20 secondary schools and gymnasias. By joining the Let's Be Engineers! project we further excite young people about engineering, technology and innovation.



STUDENT CONFERENCE ON ENGINEERING - ŠTeKam

The Faculty of Mechanical Engineering offers successful students the first step into the scientific world by presenting their contributions at the **ŠTeKam Student conference on Engineering** in September each year. At the conference, students from other faculties can also participate, thus widening the horizons and connecting with other research areas. **Students can claim their attendance at the conference as an exceptional achievement, which is a prerequisite for obtaining a scholarship.** All contributions are published in a comprehensive conference proceedings and are entered into the Cobiss system.



THEMATIC CONFERENCES

Within the framework of chairs and laboratories, thematic conferences are organized throughout the year, bringing together domestic and foreign researchers. Some conferences are held traditionally every year as a linking element between researchers in the same field.



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