Lodz University
of Technology

STER PROGRAMME
INTERNATIONALISATION
OF DOCTORAL SCHOOLS

The portfolio of research groups was created as part of the Programme "STER" – Internationalisation of doctoral schools" as part of the realization of the project "Curriculum for advanced doctoral education & taining – CADET Academy of Lodz University of Technology".

name of the unit:

DIVISION OF MEDICAL APPARATUS

Institute of Turbomachinery, Lodz University of Technology

symbol:

I-12

http://www.imp.p.lodz.pl

head of the unit:

Prof. Krzysztof Jóźwik, PhD, DSc

potential promoters:

Prof. Krzysztof Jóźwik, PhD, DSc
Damian Obidowski, PhD, DSc, TUL Prof.

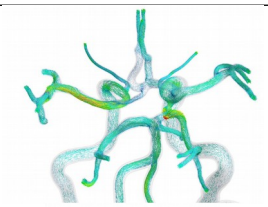
contact person:

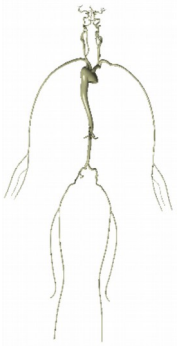
Damian Obidowski,
PhD, DSc, TUL Prof.
phone: 48-42-631-23-88
damian.obidowski@p.lodz.pl

scope of activities:

The main areas of interest and research directions are the following problems falling within the general concept of Biomedical Engineering:

- long-term tests of an artificial heart valve with a ring covered with nanocrystalline diamond on the test stand designed at the Institute of Turbomachinery, TUL,
- investigations on conduction of regenerated peripheral nerves in rats and the use of freezing and heating techniques in the removal of focal lesions of the thyroid lobes, conducted in cooperation with the Division of Flow Metrology,
- research on diamond microfluidic devices for DNA and protein analysis within the international MNT ERANET project,
- numerical simulations of the blood flow through arteries in the human body and ventricular assist devices, and of the air flow through the respiratory tract.





present activities:

We prepare personalized anatomical models of the respiratory tract and arterial and vein channels on the basis of the data saved in the DICOM format, obtained during diagnostic tests employing computed tomography. We develop algorithms for automatic segmentation (separation) of appropriate areas from the biomedical images provided, and then we generate spatial models for numerical calculations and construction of phantoms in 3D printing technology.

We carry out numerical and experimental tests of the flow using the PIV (Particle Image Velocimetry) technique and traditional methods, i.e., measurements with ultrasonic flowmeters and pressure transducers.

In numerical investigations, we determine velocity and pressure fields, mass flow rates in individual branches of the system, and predict patterns of particle deposition on the walls of 3D models. We perform numerical simulations in a pulsating flow. We use non-Newtonian rheological models that are close to the physiological properties of blood. We conduct calculations with the use of deformable walls owing to a combination of flow and structural solvers.

future activities:

Development of current and generation of new, more comprehensive numerical models to describe better the properties of blood vessel walls, autocontrol of blood circulation and tissue aging processes.

Publications/patents, awards, projects:

- Reorowicz, P., Obidowski, D., Klosinski, P., Szubert, W., Stefanczyk, L., Jozwik, K. (2014). Numerical simulations of the blood flow in the patient-specific arterial cerebral circle region. Journal of Biomechanics, 47(7), 1642-1651.
- Tyfa, Z., Jóźwik, P., Obidowski, D., Reorowicz, P., Jodko, D., Kapka, K., Makosiej R., Czkwianianc E., Jóźwik, K. (2020). Inhaled drug airflow patterns and particles deposition in the paediatric respiratory tract. Acta of Bioengineering and Biomechanics, 22(2), 101-110.

We conduct the following research projects:

- “Prediction of Endovascular Treatment Results by Individualized Numerical Analysis” – project financed by the National Centre for Research and Development, Competition „LIDER X”, 01.2020-12.2022;
- "Sol-gel antibacterial layers containing carbon nanoparticles" – International project M-ERA.NET Call 2019, in cooperation with the Technical University of Liberec and PPHU Termex, Ltd., 05.2020 – 05.2023.
- "Creating an absorbable dressing based on active exogenous tropocollagen from fish skins with the addition of modified carbon nanopowders", National Centre for Research and Development, Competition "Application Projects" in cooperation with Sancoll Ltd and Nicolaus Copernicus University in Toruń , 01.2021 – 01.2024.

keywords:

heart valves, extracorporeal heart assist pumps, blood flow tests, blood flow modelling, laser (PIV) flow testing, dialysis fistulas, 3D model reconstruction, DICOM

List of internship proposal in this research team:

- Co-operation during validation tests of FSI-type numerical calculations on the test stand

name of the unit:

DIVISION OF DIAGNOSTICS AND AUTOMATICS OF TURBOMACHINERY

Institute of Turbomachinery, Lodz University of Technology

symbol:

I-12

http://www.imp.p.lodz.pl

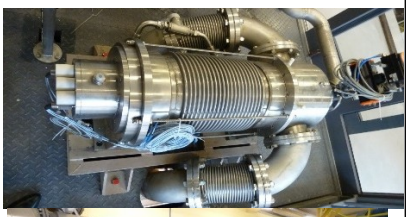
head of the unit:	potential promoters:	contact person:
Prof. Zbigniew Kozanecki, PhD, DSc	Jakub Łagodziński, PhD, DSc	Jakub Łagodziński, PhD, DSc phone: 48-42-631-23-87 jakub.lagodzinski@p.lodz.pl

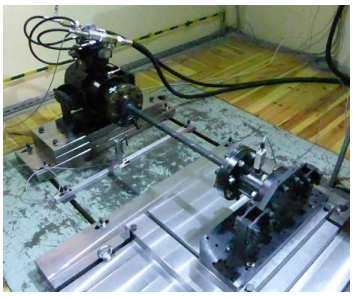
scope of activities:

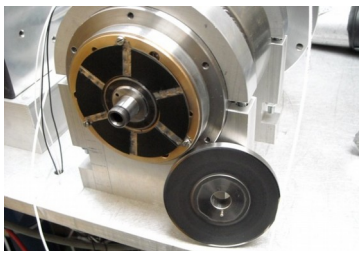
The search for new solutions of turbomachines with special technological requirements increases the interest in the technology of untypical support of the rotating shafts of these machines. More and more often, specific functional conditions make an application of traditional, commonly known solutions in the support system of the machine rotating shaft difficult or even impossible. This applies in particular to machines operating in closed, hermetic flow circuits or in machines operating under unusual temperatures. Bearings and supports, the design of which employs the principle of operation or a working medium that is unusual for a given field of application, are called unconventional bearings. An interesting alternative to the development of this technology is the use of the turbomachine working medium as a lubricant.

Due to the complexity and variety of modern technical solutions of turbomachines, knowledge from many fields related to thermodynamics, fluid mechanics, materials engineering, manufacturing technology, tribology and dynamics should be combined at the stage of their design. The operation of these machines places equally high demands, because also here interdisciplinary knowledge on an interaction of phenomena related to their operation is an essential factor in correct and safe operation. The basic element of these activities is the use of numerical methods for technical analyses of new machine design concepts, with particular emphasis on the dynamics of the rotating system, which determines the reliability of performance and the competitiveness of innovative technical solutions of turbomachines.

A separate and very important issue is the technical implementation of prototypes and technology demonstrators of the proposed technical solutions, because their correct operation allows for real interest of potential industrial partners in the development and implementation of the proposed technologies into industrial practice.







present activities:

The main areas of interest and directions of the research currently carried out at the Division are the following issues:

- design of prototypes and technology demonstrators of innovative turbomachines with unconventional bearings,
- development of design and tests of new generation foil gas bearings and their implementation into prototype high-speed turbomachines,
- analyses, numerical simulations and expert opinions related to the dynamics of industrial machines working in chemical and petrochemical industries,
- HCF and LCF tests, as well as dynamic and destructive tests of prototype components of the helicopter power transmission system conducted on test stands designed at the Division of Automatics and Diagnostics of Turbomachinery.

future activities:

Developing current research directions and building new, more complex numerical models that will describe more accurately the dynamic properties and the physics of phenomena in unconventional technical solutions of machines under investigation.

keywords:

turbomachines, unconventional bearings, dynamics of rotating systems, shaft fatigue tests, foil bearings, gas bearings

list of internship proposal in this research team:

- Co-operation in tests and generation of numerical models of rotating systems of turbomachines

name of the unit:

DIVISION OF HYDROMACHINES AND FLUID MECHANICS

Institute of Turbomachinery, Lodz University of Technology

symbol:

I-12

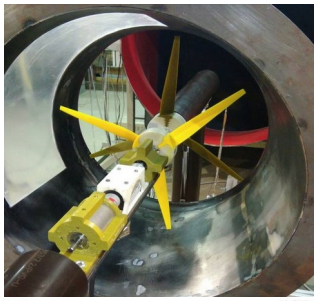
http://www.imp.p.lodz.pl

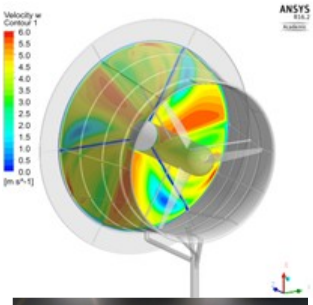
head of the unit:	potential promoters:	contact person:
Krzysztof Sobczak, PhD, DSc	Krzysztof Sobczak, PhD, DSc	Krzysztof Sobczak, PhD, DSc phone: 48-42-631-23-62 krzysztof.sobczak@p.lodz.pl

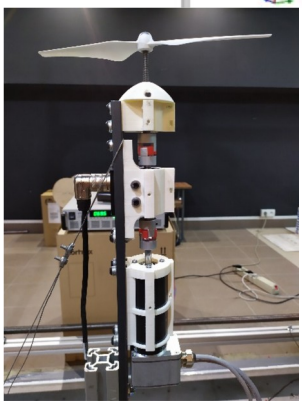
scope of activities:

The main areas of interest and research directions are:

- design and investigations of small wind turbines: modelling and optimization of rotors, investigations of aerodynamic airfoils, rapid 3D prototyping and measurements of power and thrust of turbine models,
- design and investigations of centrifugal pumps: determination of characteristics, testing of transient states (water hammer), flow simulations in pumps and water turbines,
- investigations of rotors for small flying vehicles: power and thrust determination; design and development of multi-rotor structures, rotors equipped with winglets, duct augmented rotors, etc.,
- measurements in the low-speed wind tunnel: tests of aerodynamic forces, pressure distributions, measurements of velocity and turbulence, flow visualization,
- modelling of incompressible and compressible (subsonic and supersonic) flows.







present activities:

The investigations carried out at the Division are focused on the development of small wind turbines with horizontal and vertical rotation axes (HAWT and VAWT). These works integrate classic methods of rotor design and optimization with data obtained from two research paths: numerical (CFD methods) and experimental (measurements of power and aerodynamic forces as well as flow fields) in our low-speed wind tunnel and in cooperation with scientific and industrial overseas partners. The Division is currently investigating, inter alia, duct augmented wind turbines and vertical axis wind turbines with variable blade geometry. The Power Engineering Students Association conducts the research within the GUST home wind turbine project.

The Division members are also conducting research on rotors for small flying vehicles. Concepts of systems of counter-rotating rotors working in channels, blades with a variable pitch, etc. are being developed.

Thanks to the experience in conducting investigations employing various techniques (including pneumatic measurements, thermoanemometry, PIV laser flow visualization) and rapid prototyping (3D printing), the Division can conduct aerodynamic tests of a wide range of objects.

future activities:

Development of numerical flow models and optimization procedures. Experimental investigations of various designs of wind turbines. Aerodynamic and aeroacoustic measurements of rotors.

Publications/patents, awards, projects:

- Sobczak K., Obidowski D., Reorowicz P., Marchewka E.: Numerical Investigations of the Savonius Turbine with Deformable Blades, Energies, 2020 (DOI: 10.3390/en13143717)
- Lipian M., Dobrev I., Karczewski M., Massouh F., Jozwik K.: Small wind turbine augmentation: Experimental investigations of shrouded- and twin-rotor wind turbine systems, Energy, 2019 (DOI: 10.1016/j.energy.2019.115855)

We conduct the following research projects:

- Twin shrouded rotor for a small aerial vehicle NUTRIA – project Lider XI (2021/01 – 20224/01), https://www.researchgate.net/project/Twin-shrouded-rotor-for-small-aerial-vehicle-NUTRIA
- Small Wind Turbine GUST – project of the Power Engineering Students Association, financed by Najlepsi z Najlepszych!, Łódź Naukowa Łódź Akademicka, https://www.facebook.com/GUSTprojectPL/

keywords:

applied aerodynamics; wind turbines; rotors; computational fluid dynamics (CFD); experimental investigations in the wind tunnel; hydraulic machines; pumps; water turbines

List of internship proposal in this research team:

- Modelling of flows based on CFD methods; hybrid, analytical and other models.
- Wind tunnel aerodynamic tests of various objects (wind turbines, rotors, etc.).

name of the unit:

DIVISION OF FLOW METROLOGY

Institute of Turbomachinery, Lodz University of Technology

symbol:

I-12

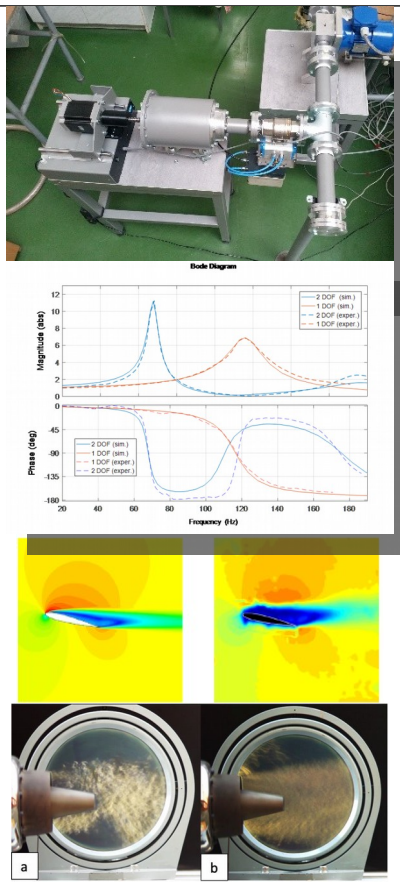
http://www.imp.p.lodz.pl

head of the unit:	potential promoters:	contact person:
Aleksander Olczyk, PhD, DSc		Aleksander Olczyk, PhD, DSc, TUL Prof. phone: 48-42-631-23-84 aleksander.olczyk@p.lodz.pl

scope of activities:

Our main areas of interest are:

- investigations of unsteady flow phenomena in pipes supplied with pulsating flow ,
- calibration of pneumatic and hot-wire probes for 1-D, 2-D and 3-D flows, methods of approximation of calibration characteristics
- Identification and correction of fast-response gas temperature sensors
- Low-speed wind tunnel testing including:
  - Flow measurements through wind turbine and drone rotors (PIV, CTA, pressure measurements)
  - Determination of rotor characteristics (through measurements of torque and rotational speed, balance measurements)
  - Airfoil characteristic determination with PIV method, balance measurements and surface pressure distribution;
- Acoustic tests of sound absorption for different types of fabrics in anechoic acoustic chamber



present activities:

- Experimental study of flow through drone rotor (in the frame of NCBiR Lider project: "Twin shrouded rotor for small aerial vehicle";
- Investigations of flow dynamics phenomena in a system of pipes supplied with pulsating flow containing Helmholz resonator.

future activities:

- Development of flow visualization techniques based on Schlieren method (and related methods, e.g. BOS)
- Automation of the process of pneumatical probes calibration
- Development of the method of dynamical calibration of temperature transducers with use of the impulse excitation method

Publications/patents, awards, projects:

- Olasek Krzysztof, Karczewski Maciej: Velocity data-based determination of airfoil characteristics with circulation and fuid momentum change methods, including a control surface size independence test. EXPERIMENTS IN FLUIDS, 2021, vol. 62, no 5, p. 1-21, AF: I-10, DOI: 10.1007/s00348-021-03193-9.
- Pałczyński Tomasz, Kantyka Krzysztof: Experimental and Numerical Investigations of Pipeline with Resonator. Mechanics and Mechanical Engineering, 2019, vol. 23, no 1, p. 17-22, AF: I-10, DOI: 10.2478/mme-2019-0003
- Samuel Bethalihem, Barburski Marcin, Błaszczak Jarosław, Witczak Ewa, Abramczyk Katarzyna: The Influence of Yarn and Weave Structures on Acoustic Materials and the Effect of Different Acoustic Signal Incidence Angles on Woven Fabric Absorption Possibilities. Materials, 2021, vol. 14, no 11, p. 1-16, DOI: 10.3390/ma14112814.

keywords:

pulsating flow, wave propagation phenomena in pipes, wind tunnel, PIV (Particle Image Velocimetry), CTA (Constant Temperature Anemometry), flow metrology, fast response sensors

List of internship proposal in this research team:

- Identification of dynamic characteristics of temperature transducers for different flow parameters

name of the unit:

DIVISION OF HEAT TECHNOLOGY AND REFRIGERATION

Institute of Turbomachinery, Lodz University of Technology

symbol:

I-12

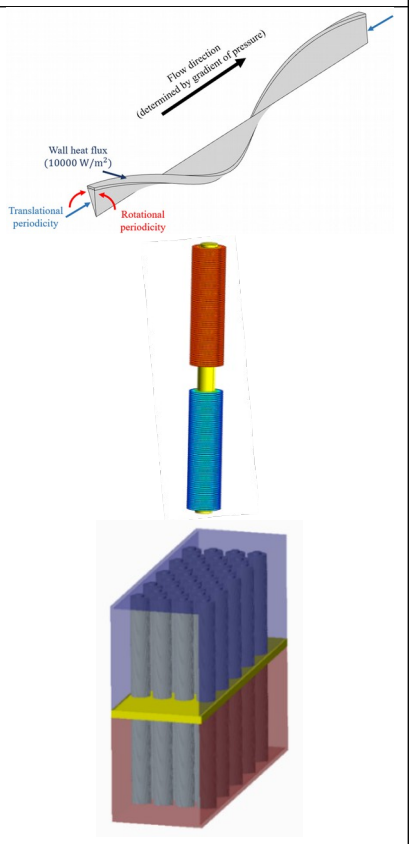
http://www.imp.p.lodz.pl

head of the unit :	potential promoters :	contact person :
Artur Gutkowski, PhD, DSc, TUL Prof.	Artur Gutkowski,PhD, DSc, TUL Prof.	Artur Gutkowski, PhD, DSc, TUL Prof. phone: 48-42-631-23-48 artur.gutkowski@p.lodz.pl

scope of activities:

The main areas of interest and research directions are the following problems falling within the general concept of Mechanical Engineering:

- experimental investigations and modeling of heat transfer processes,
- experimental and numerical investigations of heat exchangers,
- testing of working components used in heating, refrigeration, air conditioning and heat pump systems,
- heat pipe operation tests,
- experimental investigations and numerical modeling of micro-scale flame propagation.



present activities:

- We investigate experimentally and numerically micro-heat exchangers used in the automotive industry as well as in household appliances.
- We develop technologies that intensify heat transfer by using flow turbulence devices.
- We carry out tests of a household refrigerator at different thermal loads and we model a roll-bond evaporator, being a part of this device.
- We conduct research on the efficiency of a linear compressor.
- Heat pipes filled with various refrigerants and with various degrees of refrigerant filling are also tested.
- We have been working on a cooling system for PVT panels, the results will allow us to assess an influence of the panel temperature on its efficiency.
- A CFD model accounting for heat and mass transport is generated and will be used to analyze the paper drying process.
- We investigate experimentally and use numerical tools to analyze mechanisms of the laminar flame propagation in narrow channels.

future activities:

Development of technology related to the intensification of heat transfer in heat exchangers as well as investigations of individual elements of cooling, air conditioning and heat pumps systems in order to optimize their operation.

Publications/patents, awards, projects :

- Jasiński P.B., Kowalczyk M.J., Romaniak A., Warwas B., Obidowski D., Gutkowski A. (2021). Investigation of Thermal-Flow Characteristics of Pipes with Helical Micro-Fins of Variable Height. Energies, 14(8), 2048, 1-18,
- Gutkowski A. N., Łęcki M., Jasiński P., Jędrowiak B. (2019). Flame Behavior During Propagation in Small Isothermal Tubes Characterized by Different Degrees of the End Opening, Combustion Science and Technology, vol. 191, No. 4, 711-725,
- Górecki G. (2018). Investigation of Two-Phase Thermosyphon Performance Filled with Modern HFC Refrigerants. Heat and Mass Transfer, vol. 54, no. 7, p. 2131-2143.
- We have been conducted the following research project: Hybrid Systems for Solar Energy Conversion – project financed by the National Centre for Research and Development, Lodz University of Technology and FLEXIPOWER GROUP, 01.12.2019 – 30.11.2022, co-executor.
- Patent: Górecki G., Łęcki M. Banasiak A. Two-phase thermosiphon heat exchanger, PAT. 230688.

keywords:

refrigeration, refrigeration compressors, heat transfer, heat exchangers, two-phase flows, heat pipes, micro-scale gas combustion

List of internship proposal in this research team :

- Investigation of an influence of geometric parameters of the microchannel evaporator in refrigeration systems on its thermal efficiency.

name of the unit:

DIVISION OF TURBINES AND COMPRESSORS

Institute of Turbomachinery, Lodz University of Technology

symbol:

I-12

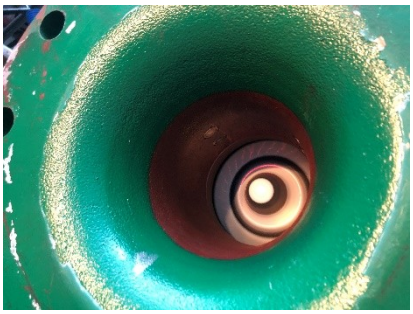
http://www.imp.p.lodz.pl

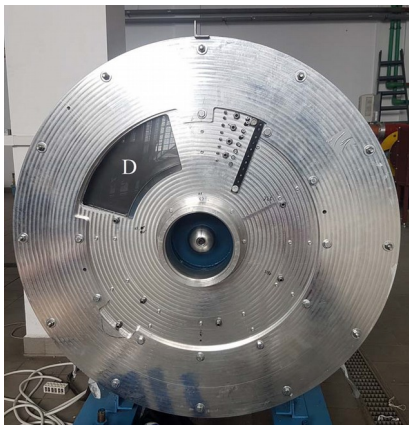
head of the unit:	potential promoters:	contact person
Prof. Władysław Kryłłowicz, PhD, DSc		Grzegorz Liśkiewicz, PhD phone: 48-42-631-23-70 grzegorz.liśkiewicz@p.lodz.pl

scope of activities:

The main fields of the team's research interests cover the following items:

- unsteady flow-phenomena in radial diffusers of centrifugal compressors;
- issues of aerodynamic instabilities in the stages of centrifugal compressors;
- fluid-structure interactions in turbo-compressors;
- revamp and retrofit of process centrifugal compressors;
- design of small steam turbines for decentralized power generation;
- problems of in-field applications of industrial turbomachinery;
- design projects of Organic Rankine Cycle (ORC) circuits and turbines.





present activities:

- Investigations of compressor surge at the dedicated test-rig.
- Investigations of rotating stall in vaneless radial diffuser (carried out at the specialized single-stage blower test-bench).
- Development of aerodynamic design methods of multi-stage centrifugal compressors.
- Investigations of forced-response of compressor impeller wheels to fluid-induced excitations at nominal and off-design conditions.
- Design and development of small steam turbines (up to 300 kW).

future activities:

Development of three currently existing centrifugal compressor test-rigs with focus on increase of their maximal rotational speeds and extension of measurement instrumentation's capabilities.

publications/patents, awards, projects:

Publications:

- Liśkiewicz G, Kabałyk K. i inni: Experimental Analysis of Surge -Detection System based on Pressure Derivatives at Part – Speed Operation, J. Eng. Gas Turbines and Power, May 2021, Vol.143., 0511018
- Kryłłowicz W., Szewczyk W. i inni: A blower for high temperaturę fumes in a paper machine, Engineering Stuctures 196 (2019) 109279
- Kabalyk K., Jaeschke A. i inni: Structural response of a single-stage centrifugal compressor to fluid-induced excitations at low-flow operating condition: experimental and numerical study, Energies, 2021, (article in press)
- Grapow F., Olasek K. i inni: Experimental Study of Vaneless Diffuser Rotating Stall Development and Cell-Merging Phenomena, J. Turbomachinery, May 2021, Vol. 143, 051008

Research projects:

- Investigations of vaneless diffuser air injection for stability improvement and performance range extension of centrifugal compressors, Nr.0200 /DIA/ 2015/44
- Industrial centrifugal compressors: safety and efficiency, Nr Lider/447/L-6/14/NCBR/2015

keywords:

steam turbine, radial compressor, compressor surge, fluid-structure interaction

list of internship proposal in this research team:

- development of software for aerodynamic design and optimization of centrifugal compressors,
- experimental and numerical investigations of aero-instabilities in centrifugal compressors,
- development of methods for fatigue assessments in compressors' impellers via fluid-structure interaction modelling (FSI).

name of the unit:

DIVISION OF MACHINE TOOLS

Institute of Machine Tools and Production Engineering

symbol:

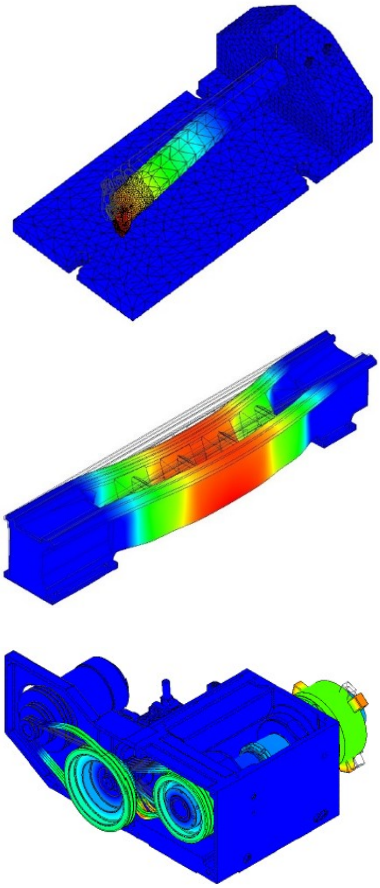
I-13

http://www.ioitbm.p.lodz.pl

head of the unit:	potential promoters:	contact person:
Witold Pawłowski, PhD, DSc, TUL Prof.	Witold Pawłowski, PhD, DSc, TUL Prof. Andrzej Kosucki, PhD, DSc	Norbert Kępczak, PhD phone: 48-42-631-39-36 norbert.kepczak@p.lodz.pl

scope of activities:

The main areas of activity of the Machine Tools Division are scientific research conducted with the use of modal analysis. Modal analysis is an analysis of dynamic properties of mechanical objects. As a result a modal model is obtained in the form of free vibration frequencies, amplitudes and damping coefficients. Modal analysis is divided into 3 basic types: theoretical modal analysis, experimental modal analysis, and operational modal analysis. The theoretical modal analysis is carried out based on a 3D structural model. It is used most often at the design stage. The experimental modal analysis is carried out by means of an identification experiment, which consists in exciting the vibrations of the object with simultaneous measurement of the exciting force and the response of the system. On the other hand, the operational analysis is performed during the actual work of the machine or device with the simultaneous measurement of the system's response to the actual inputs.



present activities:

Currently, the scientific activity of Machine Tools Division is focused on research on the influence of doping polymer concrete with rubber granules on the dynamic and mechanical properties of the composition and the possibility of using this modern engineering material in the construction of machine tools. A hybrid solution is proposed (a combination of cast iron and polymer concrete), which will allow the use of the advantages of both construction materials. Both simulation and experimental studies are carried out.

The use of a polymer concrete filling in deep hole boring bar tools is also considered. Theoretical and experimental research is also conducted for this purpose.

Another conducted research is the determination of the dynamic properties of the SOH-10 internal cylindrical grinding machine, which is the equipment of the Institute of Machine Tools and Production Engineering. It is also here that simulation and operational tests are planned.

future activities:

Research on the wide application of polymer concrete in the field of machine tool construction and tools for machining.

Development of an oscillation-assisted grinding method for the basic types of grinding.

publications/patents, awards, projects:

- Kępczak N., Pawłowski W. Dynamic Properties of Hybrid Machine Tool Body – Theoretical and Experimental Investigation Journal of Mechanics and Mechanical Engineering 2021; artykuł przyjęty do publikacji
- Deredas K., Kępczak N., Urbaniak M. Influence of doping with styrene-butadiene rubber on dynamic and mechanical properties of polymer concrete, Composite Structures 2021; 268: 113998
- Kępczak N., Bechciński G., Rosik R. Experimental verification of the deep hole boring bar model, Eksploatacja i Niezawodnosc – Maintenance and Reliability 2021; 23 (1): 55–62
- Pawłowski W., Kaczmarek Ł., Louda P. Theoretical and experimental modal analysis of the cylinder unit filled with pur foam, Eksploatacja i niezawodność – Maintenance and Reliability2016; 18 (3): 428-435
- Kępczak N., Pawłowski W., Kaczmarek Ł. Cast Iron and Mineral Cast Applied for Machine Tool Bed – Dynamic Behavior Analysis, Archives of Metallurgy and Materials, 2015, Volume 60, Issue 2A, pp. 1023-1029

keywords:

modal analysis, dynamic properties of mechanical objects, frequencies of free vibrations, amplitudes of free vibrations, damping coefficients of free vibrations

list of internship proposal in this research team:

- conduct the research of dynamic properties of internal cylindrical grinding machine (theoretical and experimental analysis);
- conduct the research of dynamic properties of hybrid machine tools body (theoretical and experimental analysis).

name of the unit:

DIVISION OF MACHINING PROCESSES AND TOOLS

Institute of Machine Tools and Production Engineering, Lodz University of Technology

symbol:

I-13

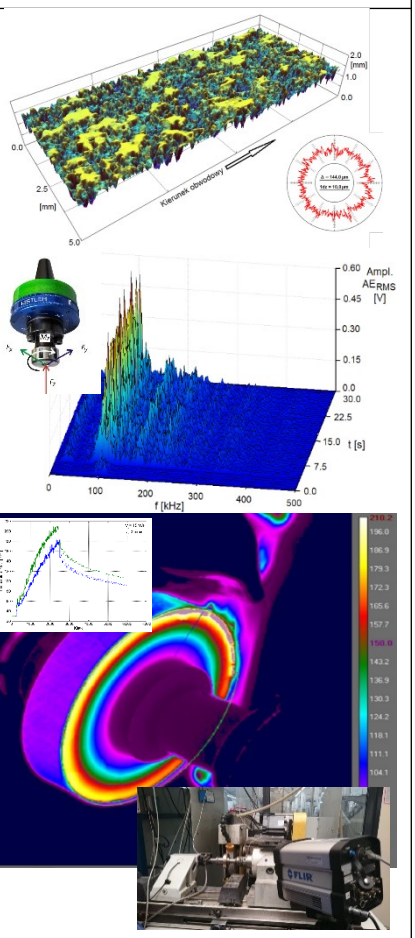
http://www.ioitbm.p.lodz.pl

head of the unit:	potential promoters:	contact person:
Wojciech Stachurski, PhD, DSc, TUL Prof.	Wojciech Stachurski, PhD, DSc, TUL Prof.	Wojciech Stachurski, PhD, DSc, TUL Prof. phone: 48-42-631-24-13 wojciech.stachurski@p.lodz.pl

scope of activities:

The main areas of interest and research directions are the following problems falling within the general concept of Mechanical Engineering:

- research of material removal processes in the field of:
  - analysis of cutting forces and temperatures, vibrations, acoustic emission,
  - use of cooling and lubricating fluids,
  - wear of cutting tools,
  - modeling of machining processes.
- tests of technological surface layer (surface roughness, residual stress, microhardness),
- diagnostics of machining processes (signal processing),
- intelligent grinding system,
- design, machining and measurement of gears.



present activities:

We conduct research work on improving the efficiency of supplying cooling and lubricating fluids into the grinding zone by modifying the shape of the grinding wheel active surface (GWAS). We develop technologies for shaping macrocontinuities on GWAS and determine the impact of the geometry of these macrocontinuities on the course and result parameters of the grinding process.

We conduct research on the use of methods that minimize the amount of cooling and lubricating fluid supplied to the cutting zone, especially the MQL (*Minimum Quantity Lubrication*) method, in the material removal processes.

We carry out research works in the field of measurement and analysis of temperatures in the cutting zone arising during the processing of difficult-to-cut materials. For this purpose, we use a laboratory IR camera.

We conduct scientific research in the field of signal processing and modeling in order to determine the condition of the tool and identify undesirable states of the cutting process. We model machining processes in terms of the analysis of self-excited vibrations and the selection of the most important measurement variables.

future activities:

Development of current research.

publications/patents, awards, projects:

- Stachurski, W., Sawicki, J., Krupanek, K., Nadolny, K. (2020). Application of numerical simulation to determine ability of air used in MQL method to clean grinding wheel active surface during sharpening of hob cutters. International Journal of Precision Engineering and Manufacturing – Green Technology, https://doi.org/10.1007/s40684-020-00239-x.
- Rusinek, R., Lajmert, P. (2020). Chatter detection in milling of carbon fiber-reinforced composites by improved hilbert-huang transform and recurrence quantification analysis. Materials, 13(18), 4105.
- Kępczak, N., Zgórniak, P., Lajmert, P., Rosik, R., Sikora, M. (2020). Influence of machining parameters on the polymer concrete milling process. International Journal of Advanced Manufacturing Technology, 106(7-8), 3017-3032.
- Stachurski, W., Sawicki, J., Wójcik, R., Nadolny, K. (2018). Influence of application of hybrid MQL-CCA method of applying coolant during hob cutter sharpening on cutting blade surface condition, Journal of Cleaner Production, 171, 892–910.
- Patent 237406: Method for supplying the cooling and lubricating agent into the toothed gears hobbing zone, Stachurski, W., Sawicki, J., Przybysz, M., Ostrowski, D., Krupanek, K. (2021).
- Patent 226148: System of supervision over the process of grinding on the centre-type cylindrical grinder, preferably objects made from hardly machinable materials, Lajmert, P., Kruszyński, B., Sikora, M., Wrąbel, D., Ostrowski, D. (2017).

keywords:

material removal processes, coolants (cutting and grinding fluids), MQL method, technological surface layer, surface integrity in machining, cutting tools, monitoring of tools and machining processes condition

list of internship proposal in this research team:

- Stable machining conditions estimation and chatter vibrations detection during milling of hard to machine materials.

name of the unit:

DIVISION OF ROBOTICS AND AUTOMATION

Institute of Machine Tools and Production Engineering, Lodz University of Technology

symbol:

I-13

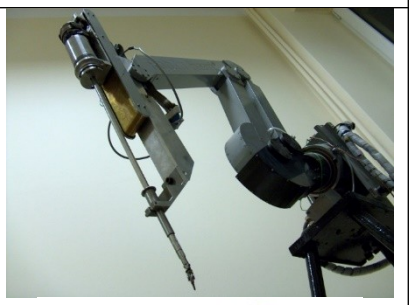
http://www.ioitbm.p.lodz.pl

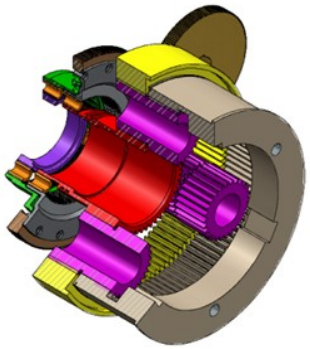
head of the unit:	potential promoters:	contact person:
prof. Leszek Podsędkowski, PhD. DSc.	prof. Leszek Podsędkowski, PhD. DSc.	Paweł Żak, PhD. phone: 42-631-2434 pawel.zak@p.lodz.pl

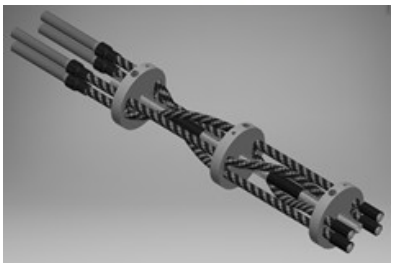
scope of activities:

The main areas of our interests and research fields are those connected to implementation of automation and robotics into various life aspects:

- The design, development and tests on the robot to perform the cardiosurgical operations – one of the versions of a Polish response to the similar constructions developed in the West,
- The design, development and tests on the snake-like robot to perform a colonoscopy procedure – there is no similar solution available all over the world,
- The development of a system and algorithms for mobile robots allowing them to build a map of their surrounding and navigate on it at the same time, SLAM,
- The development of algorithms and construction of the fumes fan with an adjustable geometry of blades to be used in a powerplant







present activities:

We are developing an advanced system for an automatic procedure of fan's shafts balancing. We are focused on objects located in a harsh environment conditions, e.g. cement plants or power plants. The developed solution is to be mounted on a shaft radially. Therefore, the shaft remains mounted. Such automatic procedure provides the possibility to balance the shaft without the necessity to stop its motion.

We are developing an innovative device – a measurement arm to be used during the medical procedure of the total hip replacement. This procedure common outcome is the change of patient's leg length which results in one's great discomfort. The device is capable of performing a simple and swift measurement during the operation process. It enables the surgeon to adjust the parameters of an implant.

We are developing a device to be used in human jaw rehabilitation process. Around 70% of patients suffering from trismus require rehabilitation to be performed. Currently, such procedure requires a therapist to be present to perform the treatment using a simple tools, like wooden spatulas or jaw dilators. The developed device will enable the patient to perform the procedure be his own.

future activities:

The works on currently running projects are to be continued in order to: develop the constructions, control systems, and to perform functionality tests. It is planned to continue the works on the development of the snake-like robot.

publications/patents, awards, projects:

- L. Podsedkowski, P. Wroblewski, L. Fracczak, A. Kobierska, E. Marciniak, G. Wrobel, A. Marciniak, K. Jozwik, A. Papierski, K. Sobczak, D. Obidowski, W. Kryllowicz, A differential planetary gear for regulation drive design and selected tests, Journal of Mechanical Engineering Science doi: 10.1177/0954406217745338,
- L. Fracczak, L. Podsedkowski, A. Kobierska, Data fusion using Fuzzy Logic techniques supported by Modified Weighting factors (FLMW), International Journal of Fuzzy Systems, 18(1), 72-80, FEB 2016; DOI: 10.1007/s40815-015-0095-3,
- L. Podsedkowski, M. Panasiuk, A. Kobierska, A. Niewola, M. Szaniewski, Device for measuring femur displacement and method of making orthopedic measurements during a surgical procedure to correct damaged hip, US2018036093, 2018

We are realising the R&D project:

- Opracowanie systemu automatycznego dwupłaszczyznowego wyważania zespołów wirujących wentylatorów, w szczególności energetycznych, w czasie ich pracy, w celu zwiększenia ich dyspozycyjności, zmniejszenia strat związanych z przymusowymi postojami bloków i zwiększenia żywotności, POIR.01.01.01-00-0219/18, 2018-2021

keywords:

medical robot, automation of rehabilitation process, automation of balancing process, SLAM, palm rehabilitation, jaw rehabilitation, colonoscopy automation, mid-surgery measurements

list of internship proposal in this research team:

- A cooperation in research tasks on defining of active pneumatic elements parameters specification

name of the unit:

DIVISION OF PRODUCTION ENGINEERING

Institute of Machine Tools and Production Engineering, Lodz University of Technology

symbol:

I-13

http://www.ioitbm.p.lodz.pl

head of the unit:	potential promoters:	contact person:
Marcin Gołąbczak, PhD, DSc, TUL Prof.	Marcin Gołąbczak, PhD, DSc, TUL Prof.	Robert Święcik, PhD phone: 42-631-2288 robert.swiecik@p.lodz.pl

scope of activities:

The main areas of interest and research directions are the following problems falling within the general concept of Mechanical Engineering:

- research on the improvement of methods and tools for abrasive, discharge and electrochemical machining as well as monitoring and optimization of these processes,
- methods of electrochemical and electrodischarge dressing of superhard grinding wheels,
- measurements and evaluation of the surface topography and properties of surface layer,
- research on diagnostics of abrasive materials and tools, including theoretical and experimental foundations of designing and testing the strength of grinding wheels,
- tests of functional properties of wear resistant and low friction coatings (PVD and CVD) on cutting tools and aerospace alloys,
- ecology in abrasive machining, post-grinding waste management and processing,
- computer-aided technology and design of technological processes (CAM, CIM),
- numerical simulations: the geometric structure of the treated surfaces, temperature in the surface layer during electrodischarge grinding, thermoelasticity of thin cylindrical shells,
- environmental protection and health and safety care in industrial enterprises.

present activities:

We develop a new method of measuring the temperature in the surface layer during the process of electrodischarge grinding of difficult-to-machine aerospace alloys. We conduct research on the improvement of the processes of electrodischarge dressing of superhard grinding wheels with a stationary, rotating and segment tool electrode. Safety of the grinding wheels: we examine the effect of the conditions of use on the dynamic strength of cut-off wheels. In numerical tests, we determine the stability of thin micro-periodic cylindrical shells and the scale effect in the stability of thin biperiodic cylindrical shells.

future activities:

Developing the current and building new, more comprehensive numerical models that will better describe the properties of the surface layer of the machined surfaces.

publications/patents/awards/projects:

- Gołąbczak M., Gołąbczak A., Tomczyk B. (2021). Electrochemical and X-ray examinations of erosion products during dressing of superhard grinding wheels using alternating current and ecological electrolytes of low concentration of chemical compounds, Materials, 14(1375), 1-23.
- Dębkowski R., Gołąbczak M., Skowron M., Urbaniak M. (2019). Lifetime increase method of cutting ability of grinding wheels in the process of magnesium alloy grinding, Materialwissenschaft und Werkstofftechnik, 50(11), 1343-1352.
- Sutowski P., Święcik R. (2018). The estimation of machining results and efficiency of the abrasive electro-discharge grinding process of Ti6Al4V titanium alloy using the high-frequency acoustic emission and force signals, The International Journal of Advanced Manufacturing Technology, 94(1–4), 1263–1282.

- Gold medal at the International Invention Show INPEX XIII, USA, for developing a method for monitoring the grinding wheel condition.
- Gold medal at the International Fair INTERTECHNOLOGY for developing the technology of rotating dressers manufacturing.

list of internship proposal in this research team:

- Co-operation during tests for electro-erosion grinding and polishing of magnesium, nickel and titanium alloys as well as metrology of the surface layer after machining processes.

name of the unit:

Department of Automation, Biomechanics and Mechatronics

symbol:

K-11

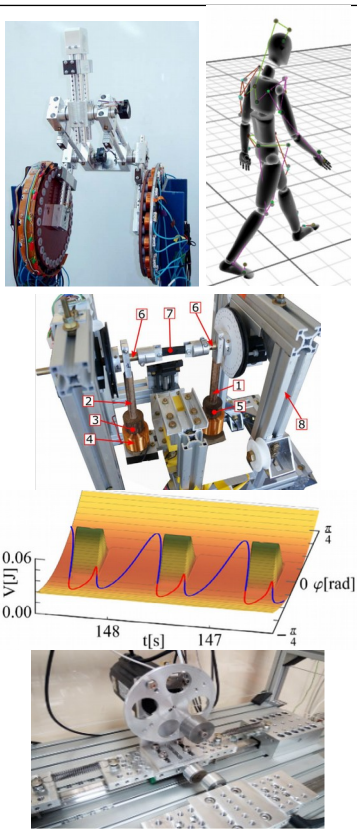
http://www.abm.p.lodz.pl

head of the unit:	potential promoters:	contact person:
Prof. Jan Awrejcewicz, PhD, Dsc	Grzegorz Kudra, PhD, DSc, TUL Prof. Paweł Olejnik, PhD, DSc, TUL Prof. Dariusz Grzelczyk, PhD, DSc	Grzegorz Kudra, PhD, DSc, TUL Prof. phone.: 42-631-2339 grzegorz.kudra@p.lodz.pl

scope of activities:

The main areas of interest and research directions are:

- nonlinear dynamics of mechanical and mechatronic systems
- mathematical modelling and identification of mechanical and mechatronic systems
- mechanical systems with dry friction and impacts
- multibody systems dynamics
- vibrations of plates and shells
- biomechanics (exosceletons, modelling and gait analysis)
- asymptotic techniques and symbolic computations
- numerical methods and algorithms
- control systems



present activities:

We conduct works concerning modelling, simulation, analytical and experimental studies of nonlinear dynamics of mechanical and mechatronic systems and system composed of nanoplates and nanoshells. We develop software that allows to predict, study and control bifurcation and chaotic phenomena occurring in such systems.

We investigate the dynamic properties of mechanical systems exhibiting complex self-excited vibrations or vibrations. In these tests, we take into account the properties of energy sources, such as various types of drives, including electric motors. We detect, study and control complex and potentially unknown physical processes and bifurcation dynamics, such as complex resonances, including parametric resonances, synchronization, regular and chaotic vibrations.

We conduct research on gait stability, geometric and kinematic analysis of limb motion. We use the Motion Capture system to study motion. We analyse the effectiveness of electromyography in identifying activity and controlling muscle groups. We develop and improve mathematical models of muscles and bones.

future activities:

Development and improvement of mathematical and numerical models and dynamics control systems of mechanical, mechatronic and biomechatronic systems.

publications/patents, awards, projects:

- Polczyński, K., Skurativskyi, S., Bednarek, M., Awrejcewicz, J. (2021). Nonlinear oscillations of coupled pendulums subjected to an external magnetic stimulus. *Mechanical Systems and Signal Processing, 154, 107560.*
- -Awrejcewicz, J., Kudra, G. (2019). Rolling resistance modelling in the Celtic stone dynamics. Multibody System Dynamics, 45(2), 155-167
- Witkowski, K., Kudra, G., Skurativskyi, S., Wasilewski, G., Awrejcewicz, J. (2021. Modelling and dynamics analysis of a forced two-degree-of-freedom mechanical oscillator with magnetic springs. *Mechanical Systems and Signal Processing*, 148, 107138**.**

We conduct the following research projects:

- " Modelling and nonlinear dynamics of magneto-electro-mechanical systems ", National Science Centre, competition OPUS 14, 2017/27/B/ST8/01330.
- "Nonlinear vibrations of combined self-excited oscillators with parametric/auto-parametric excitation and non-ideal energy

keywords:

nonlinear dynamics, bifurcations, chaos, gait stability, plates and shells, dry friction, impacts, mathematical modelling, identification, synchronization, non-ideal energy sources, energy harvesting

list of internship proposal in this research team:

- Postdoctoral fellowships and fellowships for doctoral students and second-cycle students in grants related to the following works: experimental investigations, development of mathematical and simulation models, identification and study of dynamic phenomena in mechanical, mechatronic and biomechanical systems.

name of the unit:

DEPARTMENT OF STRENGTH OF MATERIALS

Lodz University of Technology

symbol:

K-12

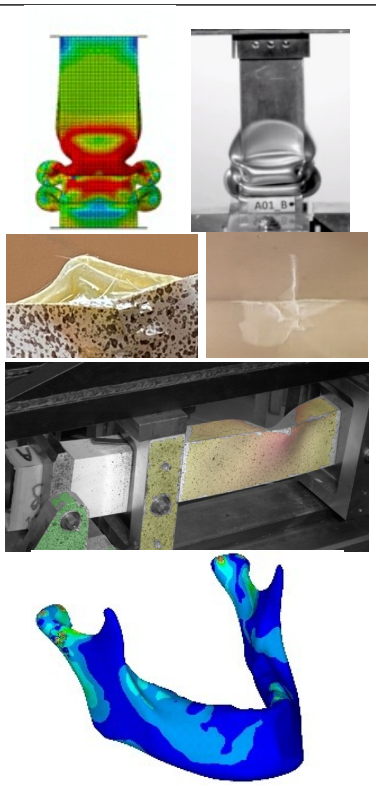
http://www.kwm.p.lodz.pl

head of the unit:	potential promoters:	contact person:
Prof. Tomasz Kubiak, PhD, DSc	Prof. Maria Kotelko, PhD, DSc Prof. Zbigniew Kołakowski PhD, DSc Prof. Radoslaw Mania, PhD, DSc Prof. Tomasz Kubiak, PhD, DSc	Leszek Czechowski, PhD. phone: 48-42-631-2215 leszek.czechowski@p.lodz.pl

scope of activities:

The main areas of research activity in the field of mechanics of thin-walled structures are:

- development of mathematical models, numerical simulations and experimental verification of thin-walled structural elements made of isotropic and composite materials (FRP, FML or FGM laminates),
- analysis of the failure mechanisms and energy absorption in thin-walled elements subjected to impact,
- experimental and numerical tests in the field of fracture mechanics for laminates,
- numerical simulations and experimental studies of biomechanical elements with the main focus on the stress state and deformations in bone systems and implants (e.g. mandible, teeth, implants and bone connecting elements).



present activities:

We develop mathematical models, conduct numerical simulations and experimental tests of thin-walled structural elements made of steel materials or laminates, including hybrid ones. We investigate thin-walled structural elements loaded statically or dynamically, mechanically and thermo-mechanically, considering their stability (including interaction of various buckling modes), post-buckling equilibrium paths, load-carrying capacity and phases of failure (including delamination and its propagation in the case laminates).

We analyse the fixation of mandibular bone fractures in terms of strength by conducting numerical simulations using the results of experimental studies on the structure of the mandibular bones of other research teams.

This activity is complemented by scientific and technical works in the field of stress and deformation analysis of structural elements of machines and devices carried out in cooperation and for the needs of industry. The team conducts research for large corporations such as: AirBus, B/S/H, ABB and provides support for local companies, e.g.: OKB, SPRAK or POLTAU.

future activities:

We plan further analysis and development of methods for the study of nonlinear static stability and dynamic buckling of thin-walled elements. Further work in the field of fracture mechanics of modern sandwich materials. Improving numerical models based on their experimental verifications. Development of biomechanical models and numerical FEM analyzes. The team intends to take up new topics related to the endurance, including fatigue, and stability of elements produced by 3D printing.

publications/patents, awards, projects:

Exemplary publications:

- Gliszczyński A., Kubiak T., Wawer K. Barely visible impact damages of GFRP laminate profiles – an experimental study. Composites Part B, 2019, 158:10-17, doi: 10.1016/j.composites.2018.09.044
- Kołakowski Z., Mania R., Semi-analytical method versus the FEM for analysis of the lokal post-buckling of thin-walled composite structures. Composite Structures, 2013, 97:99-106, doi: 101016/j.compstruct.2012.10.035
- Kozakiewicz M., Swiniarski J., "A" shape plate for open rigid internal fixation of mandible condyle neck fracture. J. Cranio Maxillofac. Surg., 2014, 42:730–737. doi: 10.1016/j.jcms.2013.11.003

keywords:

strength of materials, mechanics of thin-walled structures, load-carrying capacity, energy absorbers, failure mechanics, fracture mechanics, biomechanics

list of internship proposal in this research team:

- analysis of the destruction of energy absorbers with a drop hammer,
- adaptation (design and construction) of research and didactic test stands,
- determination of critical temperatures for thin-walled structures made of FRP laminates.

name of the unit:

DIVISION OF DYNAMICS

Faculty of Mechanical Engineering, Lodz University of Technology

symbol:

K-13

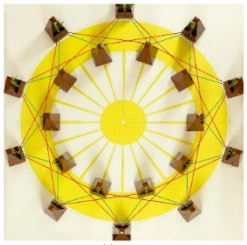
http://www.kdm.p.lodz.pl

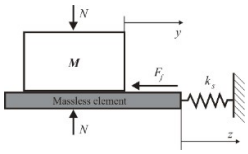
head of the unit:	potential promoters:	contact person:
Prof. Tomasz Kapitaniak, PhD, DSc	Prof. Tomasz Kapitaniak, PhD, DSc, Prof. Przemysław Perlikowski, PhD, DSc, Prof. Andrzej Stefański, PhD, DSc, Piotr Brzeski, PhD, DSc, Artur Dąbrowski, PhD, DSc.	Prof. Tomasz Kapitaniak, PhD, DSc phone: 48- 42-631-2231 k-13@adm.p.lodz.pl

scope of activities:

The main areas of research interest can be listed as follows:

- investigations on chimera and chimera-like states,
- mitigation of vibrations, probabilistic methods and dynamics of non-smooth systems,
- discontinuous dynamical systems and problems of their control.





present activities:

We study the phenomena of chimera states and related chimer-like states in networks of coupled nonlinear oscillators. The considered models are typically arranged in the form of a ring with local or non-local couplings. We analyse the possibilities of the chimera's occurrence, its properties and transitions between different types of behaviours. The models considered within the studies relate to mechanical systems, artificial flows and complex maps.

Our research is also related to the study of novel tuned mass dampers. We developed various modifications to the classical device. The most successful is one with a particular type of inerter, which incorporates a continuously variable transmission that enables step-less changes of inertance. Thus, it allows to adjust parameters of the damping device to the current forcing characteristic. We also apply probabilistic methods in the analysis of dynamics of dynamical systems.

We develop new method of Lyapunov exponents estimation and work on a novel approach to optimal control of non-smooth dynamical systems. We also model and analyze numerically unidirectionally coupled, identical dynamical systems in various configurations and develop a new friction model that takes into account the so-called mapping effect.

future activities:

The continuation of present activities, the generalization of the results and the description of new phenomena occurring in complex dynamical systems.

publications/patents, awards, projects:

Most relevant publications:

- F. Hellmann, P. Schultz, P. Jaros, R. Levchenko, T. Kapitaniak, J. Kurths, Y. Maistrenko, *Network-induced multistability through lossy coupling and exotic solitary states*, Nature Communications 11, 592 (2020).

- M. Balcerzak, A. Dabrowski, B. Blazejczyk–Okolewska, A. Stefanski, *Determining Lyapunov exponents of non-smooth systems: Perturbation vectors approach*, Mechanical Systems and Signal Processing, 141, 106734 (2020).

- P. Brzeski, A.S.E. Chong, M. Wiercigroch, P. Perlikowski, *Impact adding bifurcation in an autonomous hybrid dynamical model of church bell*, Mechanical Systems and Signal Processing 104, 716 (2018).

We conduct the following research projects:

Solitary states in coupled oscillators (OPUS Programme NCN); *Mitigation of vibrations by tuned mass damper with inerter and non-linear damper (*OPUS Programme NCN); *Multi-frequency quasiperiodic solutions in coupled oscillator systems* (OPUS Programme NCN); *Sample based approach for simultaneous estimation of different stability measures for multistable dynamical systems (*SONATA Programme NCN); *Chimera and chimera-like states in networks of coupled oscillators with moving support* (SONATA Programme NCN); *Simple numerical method of constrained control optimization for discontinuous systems based on Fourier series* (PRELUDIUM Programme NCN).

Awards and scholarships:

Award for scientific achievements contributing to the development of science for young scientists from the Polish Academy of Sciences (P. Perlikowski, P. Brzeski, D. Dudkowski); *The scholarship for young scientists from the Minister of Science and High Education* (P. Perlikowski, P. Brzeski, D. Dudkowski); *Award from the Prime Minister of Poland for scientific activity: best PhD Thesis in 2017*

keywords:

chimera states, multistability, hidden attractors, synchronization, complex systems, bifurcations, chaos, mitigation of mechanical vibrations, non-smooth systems, fry friction, multiscale modelling, Lapunov exponents, optimal control

list of internship proposal in this research team:

Analysis of dynamical behaviours in various types of complex systems with possible applications.

name of the Unit:

DEPARTMENT OF MATERIALS ENGINEERING AND PRODUCTION SYSTEMS

Faculty of Mechanical Engineering, Lodz University of Technology

symbol:

K-14

https://k14.p.lodz.pl/

head of the Unit:	potential promoters:	contact person:
Prof. Tadeusz Pacyniak, PhD, DSc	Grzegorz Gumienny, PhD, DSc, Prof. of TUL Bogusław Pisarek, PhD, DSc, Prof. of TUL Tomasz Szymczak, PhD, DSc	Grzegorz Gumienny, PhD, DSc, Prof. of TUL phone: 42-631-2204 grzegorz.gumienny@p.lodz.pl

scope of activities:

The main areas of interest and research directions are the following issues falling within the general concept of Mechanical Engineering:

- designing new materials based on Fe, Al, Cu, Mg and other metals,
- selection of materials for machine parts,
- development and improvement of technology (Lost Foam, Inmold, permanent mould casting, high pressure die casting (HPDC), lost wax process, etc.).

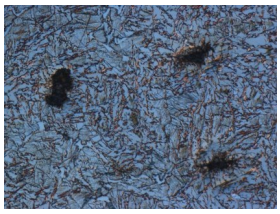
present activities:

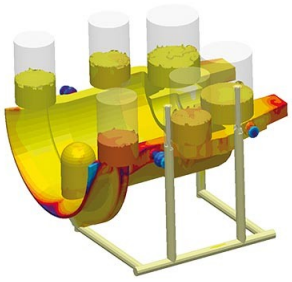
We deal with the development of modern casting alloys based on iron, aluminium, copper, magnesium and others. We use the thermal and derivative analysis (TDA) method to study the crystallization process of alloys and to assess their quality. We develop environmentally friendly technologies of materials with high strength parameters. We build and implement quality control systems for casting alloys based on the analysis of the crystallization process, enabling the assessment of the alloy's quality before pouring the mould.

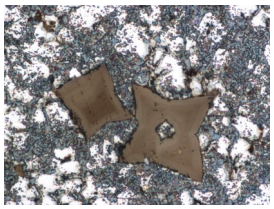
We carry out numerical tests using the MAGMASOFT software, which allows us to improve the quality of castings, optimize process conditions, and reduce production costs. Using virtual experiment design and autonomous optimization methodology, proper process parameters and optimized gating systems can be established for all casting materials and processes, including heat treatment and melting metallurgy.

We conduct reverse engineering research using a 3D scanner.

We are ISO 9001 TÜV certified for laboratory tests using the TDA method.







future activities:

Development of current and new, environmentally friendly foundry technologies as well as high-strength alloys with high resistance to abrasive and adhesive wear.

publications/patents, awards, projects:

- Gumienny, G., Kurowska, B., Klimek, L. (2020). Aluminium in Compacted Graphite Iron, China Foundry. 17(2), 137–143.
- Szymczak, T., Gumienny, G., Klimek, L., Goły, M., Szymszal, J. & Pacyniak, T. (2020). Characteristics of Al-Si Alloys with High Melting Point Elements for High Pressure Die Casting. Materials, 13(21), 4861.
- Jankowski, J., Kołakowski, D., & Pisarek, B. (2020). Selection of the Technological Ceramic Layer Thickness in an HPDC Machine Plunger in the Aspect of its Strength. Advances in Science and Technology. Research Journal, 14(4).
- T. Szymczak, G. Gumienny, C. Rapiejko, T. Pacyniak. Silumin for pressure die casting with additive of tungsten and vanadium Patent EP 3184659 A1.
- G. Gumienny, B. Kacprzyk. Compacted graphite iron with a matrix of ausferrite and carbides. Patent 232412.

We conduct the following research projects:

- "An innovative production line for the production of high pressure castings with significantly reduced porosity" - project financed by the European Regional Development Fund, Intelligent Development Operational Program, 01.2019-12.2021;
- "Development of an innovative technology for making high pressure castings made of aluminum alloys with increased quality parameters" - project financed by the Intelligent Development Operational Program, 09.2020 – 06.2023.

keywords:

casting alloys, crystallization, simulation of the solidification process, foundry technologies, reverse engineering

list of internship proposal in this research team:

- The possibility of internships in the production of machine and device parts.

name of the unit:

Department of Vehicles and Fundamentals of Machine Design

symbol:

K-15

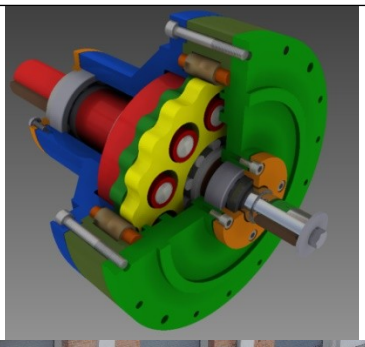
https://pojazdy.p.lodz.pl/

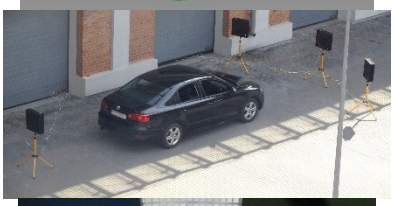
head of the unit:	potential promoters:	contact person:
Damian Batory PhD, DSc, TUL Prof.	Damian Batory, PhD, Dsc, TUL Prof. Krzysztof Siczek PhD, DSc Bogdan Warda, PhD, DSc	Grzegorz Mitukiewicz, PhD phone: 42-631-2391 grzegorz.mitukiewicz@p.lodz.pl

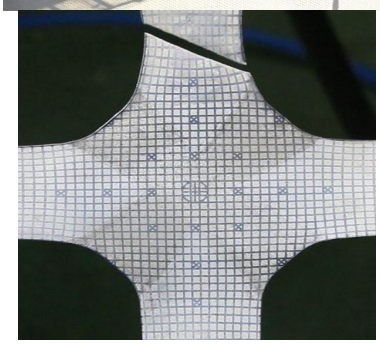
scope of activities:

The main areas of interest and research directions are the following issues falling within the general concept of Mechanical Engineering:

- designing and testing of the transmission drive systems for motor vehicles
- tests of internal and external combustion engines (SI, CI, Stirling)
- testing the reaction time of drivers
- plane stress state phenomena testing (Forming Limit Diagram, coatings)
- the analysis of mechanical properties of substrate – coating systems under
- biaxial tensile conditions
- testing of roller and journal bearings,
- pitting in gear meshing.







present activities:

We prepare prototypes of mechanical transmissions, which we then test on specially designed stands. We have test benches up to 220kW. Thanks to the cooperation with the Stellantis concern, we conduct research on cylinder deactivation or additional HHO injection on our engine dynamometers (Horiba / Schenck) in order to reduce fuel consumption. Research on an alternative source of propulsion is currently focused on the Sirling engine. Our work on this topic concerns the development of an effective combustion chamber and the reduction of mechanical losses in the engine itself. We conduct tests of drivers' reaction time at a specially designed stand. A large group of research participants (university staff, students) allows for a broad statistical analysis of the results obtained. We are also developing the system which allows to introduce plane stress state to the material sample. The state of bidirectional stress of the specimen is being achieved by stretching a cruciform specimen in two perpendicular directions. This kind of method allows to characterize the materials modified with variety of protective and technical layers work in devices where they are subjected to mechanical loads, usually with complex character. Our team developed a bench for journal bearing testing, which enable to measure its drag torque depending on the surface shape, roughness and lubrication.

future activities:

Developing the new designs of drive systems, intended mainly for electric vehicles. Development of a cooling system for car batteries during the charging process. Developing the method to characterize the materials modified with variety layers

publications/patents, awards, projects:

- J. L. Dion, Z. Pawelski, V. Chianca, Z. Zdziennicki, N. Peyret, G. Uszpolewicz, J. Ormezowski, G. Mitukiewicz: Theoretical and Experimental Study for An Improved Cycloid Drive Model, Journal of Applied Mechanics JANUARY 2020, Vol. 87
- J. Goszczak, G. Mitukiewicz, B. Radzymiński, A. Werner, T. Szydłowski, D. Batory: The study of damping control in semi-active car suspension, Journal of Vibroengineering, Vol. 22, Issue 4, 2020, p. 933-944
- T. Szydłowski, K. Surmiński, D. Batory: Drivers' Psychomotor Reaction Times Tested with a Test Station Method Appl. Sci. 2021, 11(5), 2431
- G. Mitukiewicz, C. Kuzalski, J. Goszczak, J. Leyko, Z. Dimitrova, D. Batory: Analysis of the cruciform sample shapes for bi-axial tensile tests based on the geometries currently present in the literature, Advanced in Science and Technology Research Journal 2021
- Patent FR3063531 Reducteur hypocycloidal, Wascheul Michael; Lelasseux Xavier; Mitukiewicz Grzegorz; Ormezowski Janusz; Pawelski Zbigniew

keywords:

cycloid gear, Stirling engine, driver response time, roller and journal bearings, forming limit diagram, material coatings

List of internship proposal in this research team:

- Co-operation during the analysis of mechanical properties of substrate – coating systems under biaxial tensile conditions.
- Co-operation during testing and analysis of journal bearings or gears wearing.

name of the unit:

CENTRE OF PAPERMAKING AND PRINTING

Lodz University of Technology

symbol:

CPP

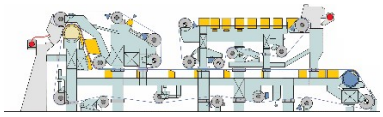
https://inpap.p.lodz.pl/

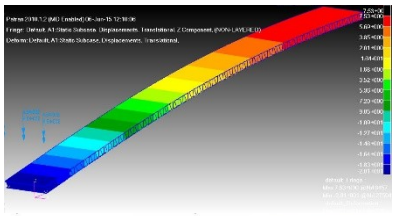
head of the unit:	potential promoters:	contact person:
Włodzimierz Szewczyk, PhD, DSc, LUT Prof.	Svitlana Khadzhynova, PhD, DSc	Mariusz Reczulski, PhD phone: +48 42 631 38 31 mariusz.reczulski@p.lodz.pl

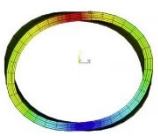
scope of activities:

The main areas of interest and research directions:

- paper machines, printing and converting,
- stock preparation and web consolidation processes: forming, dewatering, pressing and drying,
- laboratory tests of physical properties of paper, board and products made of them, and prediction of their strength properties in real operating conditions,
- research on the impact of design and operating parameters of disc chippers on the quality of chips,
- testing the quality of overprinting in classic and digital printing techniques,
- testing of packaging materials for contact with food,
- testing of printing materials,
- processes of producing printing forms, printing and securing prints,
- ink transfer studies in printing processes.







present activities:

We prepare concepts for the modernization of paper, printing and converting machines in order to improve the quality of produced papers and paper products and reduce energy consumption. We test the strength properties of paper, board and products made of them, and the impact of printing techniques on the quality of overprinting. We develop mathematical models to predict the mechanical properties of board and packaging made of them based on the mechanical properties of the raw materials used in their production.

We carry out experimental research on the press felts dewatering process using the air blowing method to increase the production of paper machines. We perform numerical simulations of the wood chipping process in disc chippers in order to improve the quality of wood chips. We develop research methods to verify the presence of potentially migrating compounds from packaging materials into food. We carry out experimental research and numerical simulations to improve the quality of overprinting in classic and digital printing techniques.

future activities:

Based on modern research methods and the latest research results, work will be carried out on extending the existing mathematical models.

publications/patents, awards, projects:

- L. Czechowski, G. Kmita-Fudalej, W. Szewczyk: "The strength of the egg trays under compression – numerical and experimental study", 2D Materials, ISSN: 2053-1583, vol.13, no. 2279, 1-15, (2020)
- G. Kmita-Fudalej, W. Szewczyk, Z. Kołakowski: "Calculation of honeycomb paperboard resistance to edge crush test". 2D Materials, ISSN:2053-1583, vol.13, no.1706, (2020)
- W. Kryłowicz, W. Szewczyk, J. Świniarski, P. Pełczyński, „A blower for high temperature fumes in paper machine". Engineering Structures 196 (2019)

We have conducted and are conducting the following research projects :

- Project no. GEKON2 / 05/268278/22/2016: "Increasing the recycling of waste paper and reducing energy consumption and improving the efficiency of the drying process in the paper machine through the use of micro-nozzle systems " – project financed by the National Centre for Research and Development and National Fund for Environmental Protection and Water Management under the Program GEKON (2016-2017)
- R&D projects on pro-environmental packaging for the RTV/AGD industry with the technology of their production (European Regional Development Fund, Smart Growth Operational Programme, Measure 1.1)

keywords:

paper machine, printing machine, converting machine, dewatering and drying of paper and board, strength properties of paper and board, printing techniques, mathematical models

list of internship proposal in this research team:

- Ink transfer tests on IGT printing simulators.

name of the unit:

LabNOISE Laboratory

Institute of Social Science and Technology Management, Faculty of Management and Production Engineering, Lodz University of Technology

symbol:

I-81

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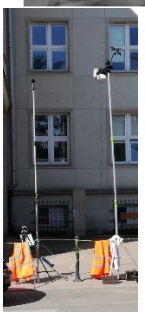
head of the unit:	potential promoters:	contact person:
Prof. Zbigniew Leszczyński, PhD, DSc	Andrzej Marcinkowski, PhD DSc, TUL prof. (LabNOISE)	Joanna Kopania, PhD phone: 48-42-631-3690 joanna.kopania@p.lodz.pl

scope of activities:

The main areas of interest and research directions are the following problems falling within the general concept of Mechanical Engineering:

- standardized measurements of environmental noise emission (traffic and industrial), the noise of machines and devices and also the noise at workplaces, in accordance with an accreditation No. PCA 1660;
- acoustic analysis, measurement and development of noise abatement structures based on the plastic and absorption materials;
- acoustic analysis of technical installations in buildings (ventilation and air conditioning systems) with noise reduction concepts;
- sound propagation modelling in the environment, acoustic-flow simulations of ventilation and air-conditioning systems, coupling LCA analysis and noise factors.

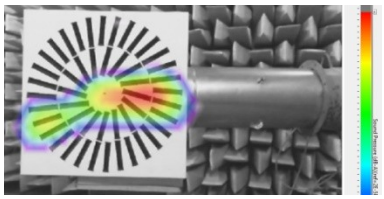


present activities:

The current activities of the LabNOISE and aides concerns:

- acoustic analysis at flow field in air-vent systems (grilles, regulators, dampers) and the reduction of flow noise;
- acoustic analysis of plastic panels as single or layer structures, also with absorption materials or absorption-resonance systems.

The another aspect of laboratory research is the environmental noise, e.g. identification of acoustic hazards in the urban space, linking Life Cycle Assessment (LCA) with noise from industrial installations, defining health indicators in the field of environmental noise impact.



future activities:

Development of current research in acoustic simulation and generation of new research in ambisonics field.

publications/patents, awards, projects:

- Marcinkowski A., Kopania J., 2021. "Environmental Performance of Noise Reduction System in Cogeneration Plants—A Life Cycle Assessment Study," Energies, MDPI, Open Access Journal, vol. 14(5), pages 1-19, March.
- Marcinkowski A., Gralewski J., The comparison of the environmental impact of steel and vinyl sheet piling: life cycle assessment study, International Journal of Environmental Science and Technology, ISSN 1735-1472, vol 17, no. 9, 2020, p. 4019-4030
- Bogusławski G., Kopania J., Gaj P., Wójciak K.: Determination of sound power level by using aspherical microphone array and conventional methods, Vibrations in Physical Systems, Volume 30, No. 1, 2019, 2019139
- Galińska B., Kopania J., Organizacyjne i techniczne metody redukcji hałasu komunikacyjnego w przestrzeni miejskiej, Autobusy 6/2017, s.163-167, ISBN 1509-5878

keywords:

acoustics, environmental noise, LCA and noise, flow noise, soundproofing materials

list of internship proposal in this research team:

- Co-operation in the acoustic analysis and noise reduction concepts