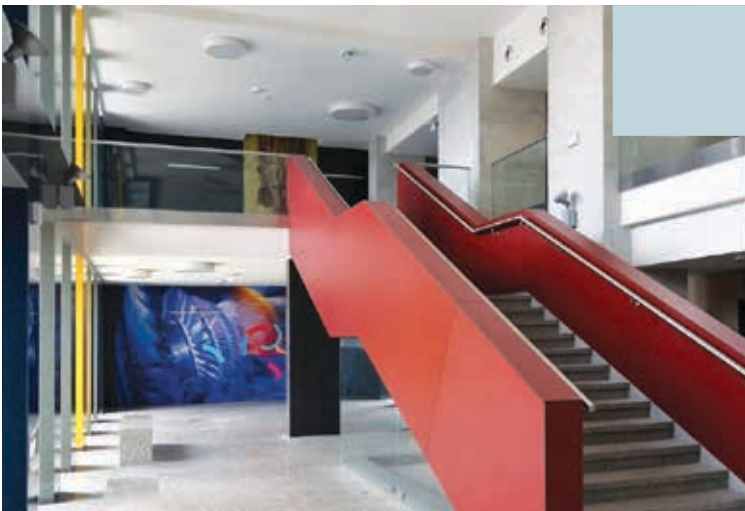




FACULTY OF MECHANICAL ENGINEERING (FME)

The Faculty of Mechanical Engineering is the second largest faculty of the Brno University of Technology located on the campus Pod Palackého vrchem near the Czech Technology Park. The FME is a modern and practice-oriented educational and research institution that provides its students with a high quality education and every prospect of finding a job on the labour market.



fme.vutbr.cz
fme.vutbr.cz/bachelors
facebook.com/fmebut
twitter.com/fmebut
youtube.com/fmebut

F M E I N F A C T S A N D F I G U R E S :

- founded in 1900
- the largest mechanical engineering faculty in the Czech Republic
- ranking among the best technical faculties and best-performance research institutions in the CR
- over 4 300 students and 500 employees in 15 specialized institutes
- 55 branches in Bachelor`s, follow-up Master`s and doctoral study branches accredited in Czech and English
- education in traditional mechanical engineering areas as well as interdisciplinary branches
- joint and double degree programmes in cooperation with some European universities
- outstanding students` results in Czech and international competitions
- over 1 000 graduates each year with excellent career prospects
- close cooperation with institutes of the Academy of Sciences of the Czech Republic, and other Czech and foreign research institutions
- an important partner for Czech and international industrial companies (Škoda Auto, ČEZ, IBM, Bosch, Honeywell, Volkswagen, POSCO, etc.)
- two research centres – NETME (New Technologies for Mechanical Engineering) and CEITEC (Central European Institute of Technology) with modern and well-equipped laboratories available for teaching, research and development activities
- professional courses for companies (quality management, welding, materials, etc.)
- organization of international conferences...

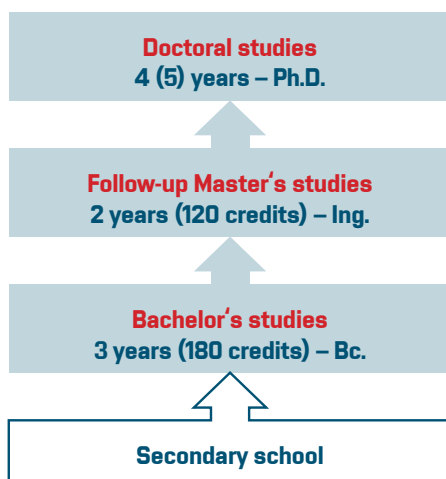


STUDIES AT THE FME

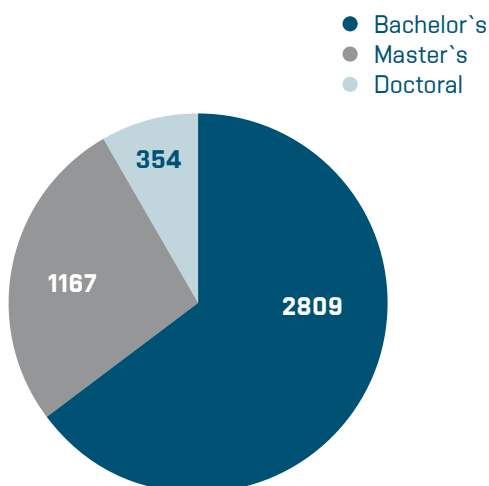
Studies are free of charge when studying in Czech for all students. Students studying degree programmes in English are required to pay tuition fee 2 999 EUR - under the same conditions as Czech nationals.

The Bachelor's degree programme includes 13 basic branches, the Master's degree programme is offered in 38 basic branches. Students in each branch can specialise by selecting optional courses and the Master's thesis topic.

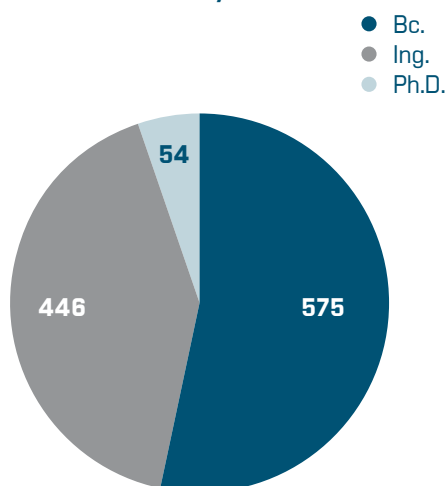
Structured studies



Students` structure



Graduates` structure (academic year)



DEGREE PROGRAMMES AND BRANCHES

| • BACHELOR`S | • Follow-up MASTER`S |
|--|---|
| Fundamentals of Mechanical Engineering | Applied Computer Science and Control |
| Production Techniques | Automotive and Material Handling Engineering |
| | Power Engineering |
| | Fluid Engineering |
| | Engineering Mechanics and Biomechanics |
| | Mechanical Engineering Design |
| | Quality, Reliability and Safety |
| | Aeronautical Traffic |
| | Materials Engineering |
| | Mechatronics |
| | Process Engineering |
| | Precise Mechanics and Optics |
| | Design of Product Machines and Equipment |
| | Foundry Technology |
| | Industrial Engineering |
| | Production Systems |
| | Production of Automotive and Technical Lights |
| | Manufacturing Technology |
| | Manufacturing Technology and Management in Industry |
| | Aircraft Design |
| | Environmental Engineering |
| Materials Engineering | Materials Engineering |
| Industrial Design | Industrial Design |
| Physical Engineering and Nanotechnology | Physical Engineering and Nanotechnology |
| Mathematical Engineering | Mathematical Engineering |
| Mechatronics | Mechatronics |
| Quality, Reliability and Safety | Quality, Reliability and Safety |
| Applied Computer Science and Control | Applied Computer Science and Control |
| Power Engineering, Processes and Environment | Power Engineering |
| | Fluid Engineering |
| | Process Engineering |
| | Environmental Engineering |
| Professional Pilot | Aeronautical Traffic |
| Machine and Equipment Construction | Automotive and Material Handling Engineering |
| | Design of Production Machines and Equipment |
| Manufacturing Technology | Foundry Technology |
| | Manufacturing Technology |
| | Manufacturing Technology and Management in Industry |



DOUBLE DEGREE PROGRAMMES

The Faculty offers several double degrees allowing students to obtain simultaneously two official degrees – from the FME and a foreign partner university. The design of these studies has a specific interdisciplinary approach.

B A C H E L O R ' S D O U B L E D E G R E E **- Production Techniques (in German)**

- guaranteed by the Institute of Production Machines, Systems and Robotics of FME and the Institute of Production Machines and Production Systems (IWP) at TU Chemnitz (Germany)
- design, quality, reliability, safety, metrology, logistics, ecology, control, operation, Industrial management, etc.
- two semesters of compulsory foreign stay at TU-Chemnitz
- Bachelor`s project defence at joint Czech/German committee
- passing German language test at B2 level in the 1st year of study and a German language test DHS at TU Chemnitz
- possible participation in research and development projects at TU-Chemnitz

MASTER ' S DOUBLE DEGREES :

1. Industrial Engineering (French – English)

ensam.fme.vutbr.cz

- guaranteed by the Institute of Manufacturing Technology of FME and AMPT Paris, Centre Cluny (part of the study placed in France)
- concerned with advanced manufacturing processes for hi-tech applications in aircraft production or defence industry
- knowledge of machining, designing of production systems and manufacturing routines, industrial robotics, automatization of industrial production and selected subjects of aeronautical engineering
- internship in Czech or French production companies

2. Production Systems (German)

- guaranteed by the Institute of Production Machines, Systems and Robotics of FME and the Institute of Production Machines and Production Systems (IWP) at TU Chemnitz (Germany)
- design, development, construction, control, operation, retrofitting and diagnostics of machine tools and forming machines, industrial robots and manipulators and production systems made up of these machines.
- IWP provides courses on properties of production machines, development of structures of machinery, forming technology and virtual reality
- FME offers construction of production machines, production systems and robotics



3. Mathematical Engineering (English)

- organized by the Institute of Mathematics of FME and the University of L'Aquila since 2007
- every year, a number (up to 10) of first-year Master's students of Mathematical Engineering of FME go to L'Aquila for a one-year study of the international programme Mathematical Modelling in Engineering
- the students return to Brno for the second year of their Master's study
- after passing a state final exam, they receive degrees from both universities



STUDENT PROJECTS

FORMULA STUDENT

youtube.com/TUBrno racing

Formula Student is a prestigious international competition of technical universities held since 1981. The aim of the competition is to show the ability to build from scratch a single seat race car (well controlled, powerful, durable and safe with appealing design, eco-friendly, with low-cost manufacturing and running of the vehicle).

TU Brno Racing Team was established in 2010 with the support of faculty academics and a great number of companies as sponsors. Seven models called Dragon 1 – Dragon 7 have been built so far. In several competitions the team was awarded 2nd place. The team consists of students of four BUT faculties, mainly from the FME (in total over 40 team members from different fields).

Sponsors

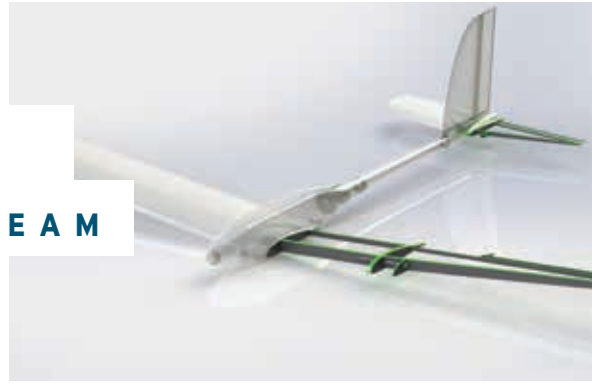
- general partner – Bosch
- platinum partners – Honeywell, Škoda Auto, Continental...
- gold partners – 3Tooling, Transtech Tooling, MCAE, Ray Service, Mann+Hummel

STUDENT AIRCRAFT TEAM

chickenwings.cz

facebook.com/BUTChickenWings

linkedin.com/company/chicken-wings-but



Students from the Institute of Aerospace Engineering (IAE) formed a team named BUT Chicken wings (over 25 students interested in aircraft engineering).

The team participated in several international competitions:

- Air Cargo Challenge. Students designed, manufactured and flew an airplane made from carbon fibre composites flying fastest with a medium payload. It was designed to reach maximum flight performance with speed and manoeuvrability in turning. The team was awarded 14th place from 28 teams as the best scoring newcomers.
- Design, Build and Fly, held in Wichita (in Kansas, USA). The objective of the competition (organized by AIAA and supported by companies Cessna and Raytheon missiles) was to design two aircrafts, one production aircraft and a second cargo aircraft capable of transporting production aircraft. Team BUT Chicken wings was invited to fly off in Wichita and ranked among the best of 32 countries around a world.

PNEUMOBIL

pneumobilvut.wordpress.com

facebook.com/pneumobilraicingteambrno



Pneumobil Project is a prestigious competition organized by the Aventics Company. Pneumobil is a short term describing a vehicle driven by compressed air. Students from the Institute of Machine and Industrial Design have successfully participated in the last four years of pneumobil races (2nd place in the Creativity of Design, 4th place in the Long Distance Race, 5th place in the Arcade Race) in a competition of 40 teams coming from 8 countries.

The gearing system of the FME vehicle is constructed with chains, free wheels and mechanical gearboxes. The pneumatic system is controlled via a series of PLC controlled valves. The FME team has introduced telemetry to measure the driving parameters online.



DOCTORAL STUDIES

- focused on the theoretical background in the given field and specific knowledge in a selected specialization
- full-time (4 year) and combined (5 year) modes of study
- ability to achieve original scientific results
- studying in English with tuition fees of 3 000 EUR (per academic year)
- all study branches accredited in Czech and English

Application procedure

- entry requirements – completed Master's study in the field of engineering science + successful entrance examination
- application period starts in April
- choice of a supervisor and a topic from an approved list www.fme.vutbr.cz/doctoral
- sending an e-application, documents on university graduation and CV

Studying

- individual student's plan including 4–6 exams (2–3 on theoretical bases, 2–3 on specialized subjects)
- giving lectures 4 hours / week
- passing state doctoral examination – 5th semester
- doctoral thesis defence
- compulsory publication in IF (Impact Factor) scientific papers

Study branches

| | |
|------------------------------------|-------------------------------------|
| Manufacturing Technology | |
| Applied Mathematics | |
| Design and Process Engineering | Power Engineering |
| | Fluid Engineering |
| | Process Engineering |
| | Environmental Engineering |
| | Automotive and Handling Engineering |
| | Machines and Equipment |
| | Mechanical Engineering Design |
| | Aircraft Design and Air Transport |
| | Control of Machines and Processes |
| Applied Mechanics | |
| Physical and Materials Engineering | Physical Engineering |
| | Materials Engineering |



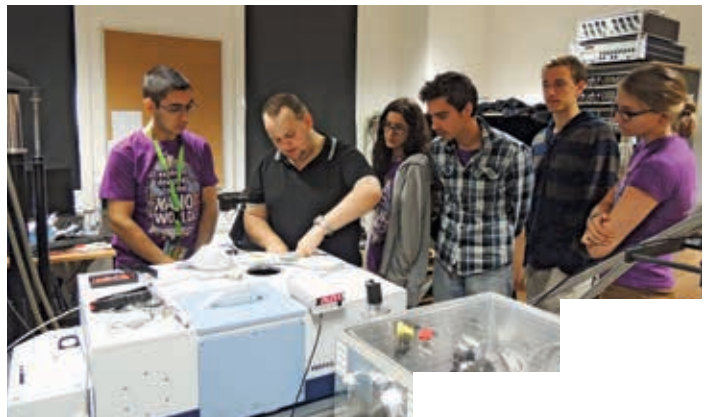
Post-doctoral research positions

- NETME (New Technologies for Mechanical Engineering) – applied research, testing and experiments – www.netme.cz
- CEITEC (Central Europe Institute of Technology) – a scientific centre in the fields of advanced materials and technologies – www.ceitec.vutbr.cz
- Czech Technology Park – www.technologypark.cz



INSTITUTES OF THE FACULTY

- Institute of Mathematics
- Institute of Physical Engineering
- Institute of Solid Mechanics, Mechatronics and Biomechanics
- Institute of Materials Science and Engineering
- Institute of Machine and Industrial Design
- Energy Institute
- Institute of Manufacturing Technology
- Institute of Production Machines, Systems and Robotics
- Institute of Process Engineering
- Institute of Automotive Engineering
- Institute of Aerospace Engineering
- Institute of Automation and Computer Science
- Institute of Foreign Languages
- Heat Transfer and Fluid Flow Laboratory
- NETME Centre





INSTITUTE OF MATHEMATICS

DEPARTMENTS

- Algebra and Discrete Mathematics
- Computer Graphics and Geometry
- Mathematical Analysis
- Statistics and Optimization

H I G H L I G H T

Mathematical methods of solar corona visualization – prof. Miloslav Druckmüller

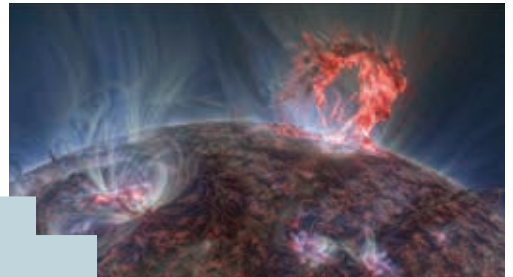
The team of prof. Druckmüller has developed new mathematical methods to make the processing of corona images obtained during the total solar eclipses more effective, especially the highly precise image registration, and the coronal structures visualization by means of adaptive filters which are inspired by human vision. The unique images of solar corona in white light (K-corona) and images in emission lines of Fe and Ni ions (E-corona) obtained in cooperation with University of Hawaii led to several discoveries. The most important ones are the discovery of the new class of coronal features caused by plasma instabilities, the first temperature map of solar corona derived from abundance of Fe IX, Fe X, Fe XI, Fe XIII, Fe XIV and Ni XV ions and the first estimation of the boundary between collision and collisionless plasma in the solar corona.

Web: mat.fme.vutbr.cz

Email: um@fme.vutbr.cz

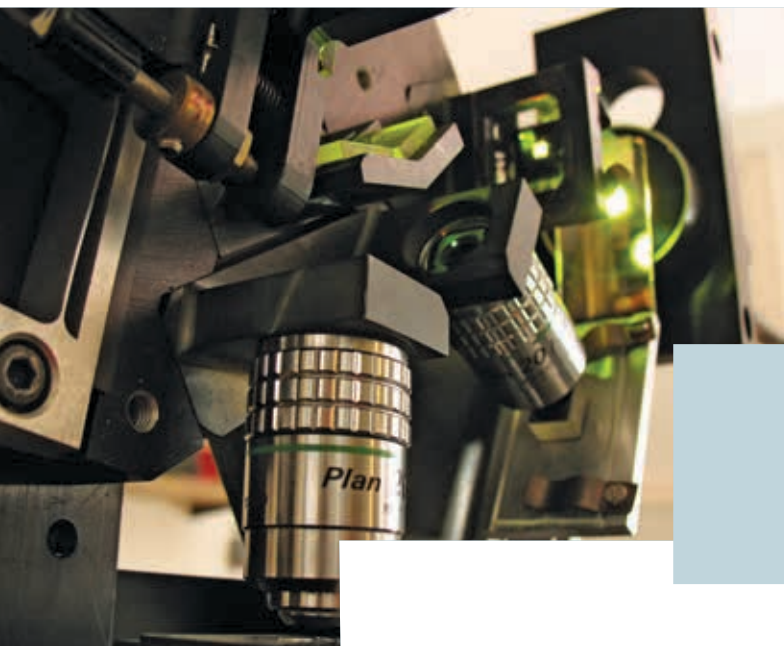
TEACHING PROFILE

- theoretical engineering background in mathematics, programming, and state-of-the-art mathematical software
- basic courses in mathematics: linear algebra, analytic geometry, calculus, numerical methods, constructive geometry and computer graphics, differential equations, infinite series, probability and mathematical statistics
- mathematical courses within Bachelor's and Master's study programmes Mathematical Engineering and doctoral programme Applied Mathematics
- courses for doctoral degree programme – applied mathematical analysis, statistics, fuzzy mathematics, optimisation methods, computer graphics, applied topology, mathematical principles of cryptographic algorithms, etc.



RESEARCH

- applied mathematical analysis (finite element method, numerical solutions of differential equations)
- applied algebra and discrete mathematics
- differential geometry and its applications (especially in mechanics)
- optimisation of engineering processes
- mathematical modelling of forming processes
- digital image processing



INSTITUTE OF PHYSICAL ENGINEERING

DEPARTMENTS

- Optics and Precise Mechanics
- Solid State Physics and Surfaces
- Micromechanics of Materials and Engineering Acoustics

H I G H L I G H T

Multimodal Holographic Microscope (MHM)

A team of scientists designed a unique multimodal holographic microscope (in cooperation with TESCAN ORSAY Holding) enabling to observe living cells without using a contrast agent. They have already taken out Czech, European, Japanese, Asian, and US patents.

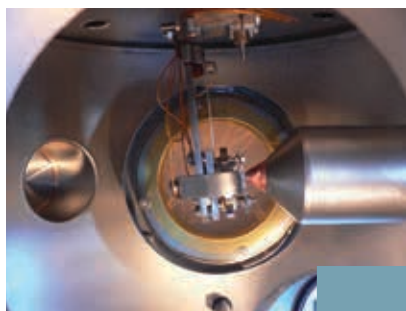
MHM is a unique instrument for quantitative phase imaging (QPI) based on patented technology of Coherence-controlled holographic microscopy. This technology uses incoherent light sources (halogen lamp, LED) providing QPI with the highest quality - enabling imaging of samples in scattering media. The Q-PHASE is purposely designed to observe living cells in vitro. It is based on a robust inverted transmission microscope platform. The whole system is situated in a microscope incubator. The full motorization fulfils even the highest demands regarding experiment automation.

Web: physics.fme.vutbr.cz

Email: ufi@fme.vutbr.cz

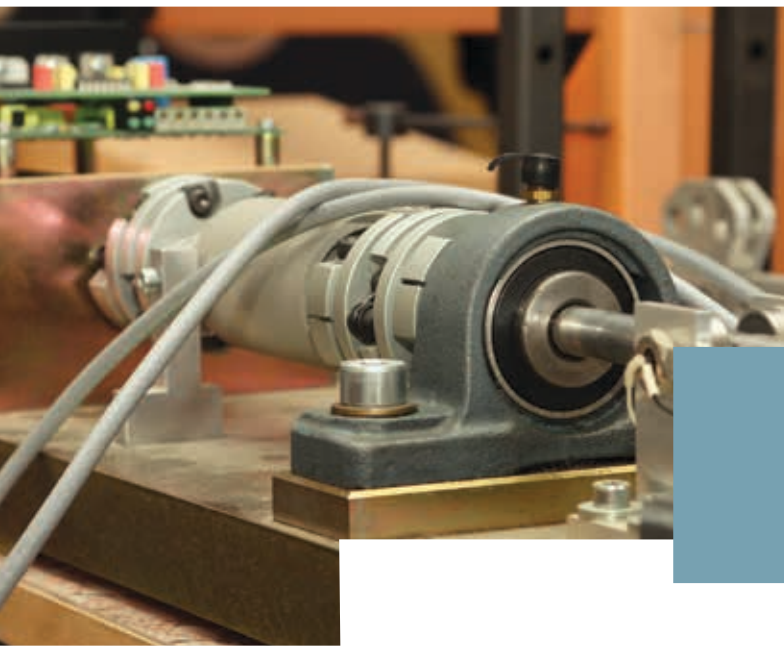
TEACHING PROFILE

- fundamental physics courses for all students (formation of the theoretical foundation of future engineers)
- basic courses on physics in Bachelor`s programmes
- advanced courses in Physical Engineering and Nanotechnology, Precise Mechanics and Optics, Materials Engineering, Metrology, etc. (Bachelor`s and Master`s programmes)
- lectures in Ph.D. study programmes of Physical and Materials Engineering
- specialized courses based on the scientific activity of the staff members



RESEARCH

- optical microscopy and tomography, particularly holographic optical microscopy
- laser spectroscopy (LIBS and LIBS+LIFS methods)
- scalar diffraction theory and kinematical diffraction theory
- holographic interferometry
- interferometric measurements of optical elements and systems
- rigorous numerical method for analysis and design of photonic elements
- development of micro positioning mechanisms
- study of the formation of early phases of thin films
- thin layers of metals and their oxides
- magnetic (ultra)thin films/multilayers and 1D-0D nanostructures
- superstructures and ultra-thin films of Ga and wide-band gap semiconductors
- fabrication of nanostructures by nanolithography and their application in a study of transport properties and plasmonics
- analytical techniques and methods for characterization of surfaces, thin films and nanostructures (UHV STM/AFM, TOF-LEIS, XPS, SIMS, spectral ellipsometry and reflectometry, LEED/AES)
- atomistic, mesoscopic and microscopic models of deformation and fracture
- experimental investigation of uniaxial and multiaxial mechanical fatigue
- measuring of elastic and inelastic properties of materials, noise in working and living environment



INSTITUTE OF SOLID MECHANICS, MECHATRONICS AND BIOMECHANICS

DEPARTMENTS

- Engineering Mechanics
- Fracture Mechanics and Mesomechanics of Materials
- Mechatronics
- Tissue Biomechanics and Numerical Modelling in Medicine

HIGHLIGHTS

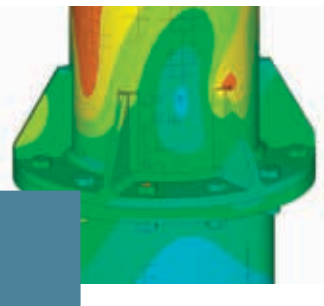
- original design of testing machine for multiaxial testing of elastomers and biological tissues
- energy harvesting devices based on alternative electro-mechanical conversions
- design and simulation of control algorithms of mechatronic systems, application of hardware-in-the-loop strategy
- complex analysis, design and optimization of structural systems from a mechanical point of view



Web: umt.fme.vutbr.cz
facebook.com/UMTMB
Email: umtmb@fme.vutbr.cz

TEACHING PROFILE

- general courses on mechanics of solids – Statics, Kinematics, Dynamics, Strength of material I, II, Technical Mechanics
- specialized study programmes in: Mechatronics (Bachelor`s and Master`s level), Engineering Mechanics and Biomechanics (Master`s level)
- doctoral study in Engineering Mechanics – mechanics of solids, mechatronics, biomechanics



RESEARCH

- constitutive models, damage and failure of special types of materials (particle and fibre composites, elastomers, laminates)
- numerical simulation of selected technological operations
- material damage and ductile fracture criteria of metals under large plastic deformation
- two parameter fracture mechanics
- measurement of residual stress, experimental stress analysis, noise and vibrations
- modelling of dynamic properties of interactive mechanical systems
- biomechanics of human musculoskeletal, cardiovascular and auditory systems
- computational and experimental analysis of mechanical structures (fatigue and failure, stability, noise and vibration, design optimization)
- design and development of mechatronic systems

SPECIALIZED LABORATORIES AND EQUIPMENT

- **Dynamics Laboratory** - Bruel&Kjaer PULSE analyser with a wide range of options in vibro-diagnostics, noise measurement and modal properties of machine systems
- **Laboratory of Experimental Mechanics / Strength of Materials** - UPM 100 central measuring station, two Spider measuring amplifiers, MGC plus system with 16 channels for dynamic measurements, digital image correlation system for measuring strains
- **Applied Mechanics Laboratory** - identification of constitutive relations of rubber
- **Mechatronics Laboratory (MechLab)** – Matlab/Simulink software, multipurpose I/O card MF624; dSPACE DS1103 with AutoBox; National Instruments cRIO and USB 6216; microcontrollers PIC32/PIC33f with complete support for code generation from Simulink



INSTITUTE OF MATERIALS SCIENCE AND ENGINEERING

DEPARTMENTS

- Metal Materials
- Ceramics and Polymers
- Structural and Phase Analysis
- Mechanics and Design of Materials

HIGHLIGHTS

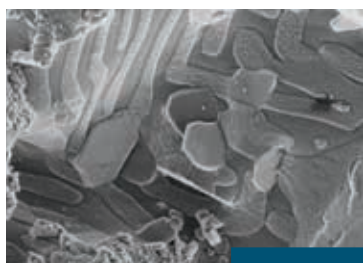
- top-class equipment of the laboratories and other workplaces of the Institute, enabling the realization of complex material-technological analyses
- electron beam technology, cold-spray technology
- high scientific and technical standard of experiments, analyses and measurements
- the possibility of profound interpretation of the original results obtained

Web: imse.fme.vutbr.cz

Email: dlouhy@fme.vutbr.cz

TEACHING PROFILE

- specialized courses in the area of materials sciences in courses in Bachelor's and follow-up Master's study programme in Materials Engineering
- doctoral programme in Physical and Materials Engineering
- life-long learning courses in technology, structure analyses, mechanical properties, etc.
- specialized courses for metallographic laboratories specialists

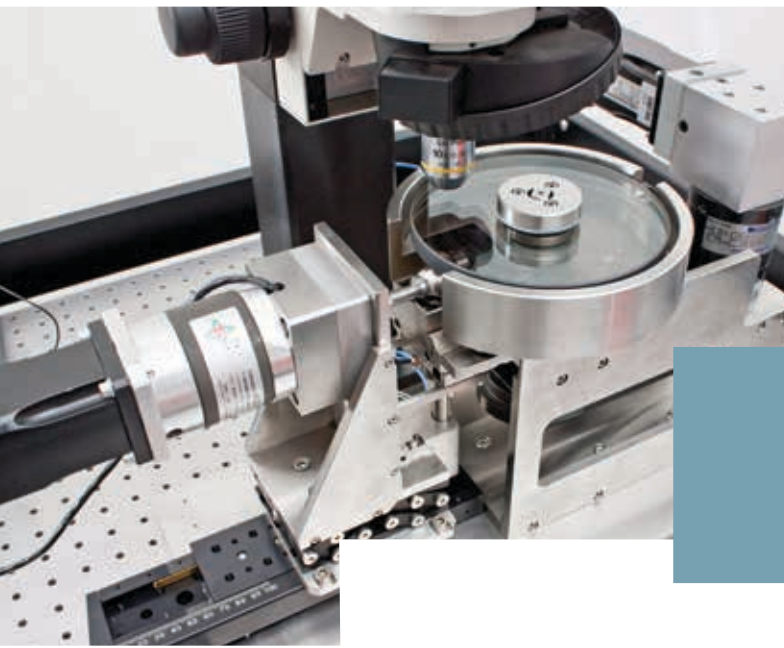


RESEARCH

- fundamental and applied research in the field of metallic materials, ceramic materials and polymers; composites and nanocomposites
- technologies applied in engineering, foundry, metallurgy, transport, and power generation industries
- material-technological problems of the crystallization of aluminium alloys under pressure
- selected aspects of the preparation and properties of type TiAl intermetallic alloys
- the properties of type Mg-Li alloys and alloys of the same type dispersion-reinforced with carbon fibres
- the optimization of chemical composition and properties of selected nickel alloys for the aircraft industry
- problems of optimum choice of dynamically loaded structural materials and their weld joints
- selected problems of material-technological properties and application of ductile iron
- prospective problems in the area of nanomaterials and nanotechnologies
- selected problems of the properties and application of ceramic and composite materials

COOPERATION WITH INDUSTRY

- development of new materials and their processing
- crash and failure analysis
- suggestions for corrective/preventive measures
- testing of materials and entire components



INSTITUTE OF MACHINE AND INDUSTRIAL DESIGN

DEPARTMENTS

- Industrial Design
- Tribology
- Condition Monitoring
- Reverse Engineering and Additive Technologies

HIGHLIGHTS

Red Dot Design Award - Design Concept for the concept ShellTec (Computed Tomography Scanner).

Maurice Godet Award - best paper by a young scientist for his paper Experimental study of real roughness attenuation in concentrated contacts.

Additive manufacturing of new conceptual lattice-structured bracket for future use at ESA orbital satellites.

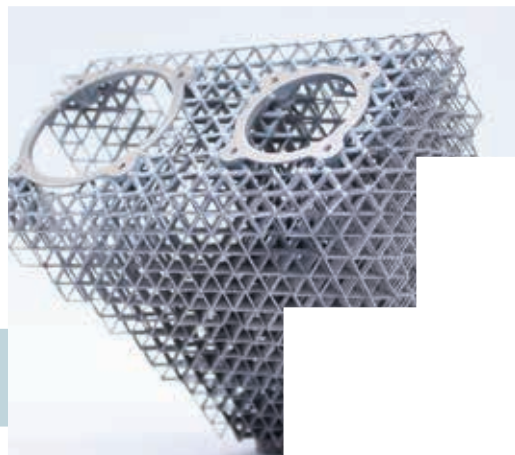
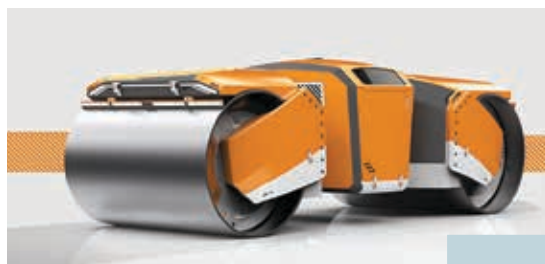
Web: uk.fme.vutbr.cz
facebook.com/UstavKonstruovani
youtube.com/ustavkonstruovani
 Email: uk@fme.vutbr.cz

TEACHING PROFILE

- Bachelor's and Master's study programmes in Industrial Engineering and Fundamentals of Mechanical Engineering
- Master's study programme in Mechanical Engineering Design
- doctoral degree in Design and Process Engineering

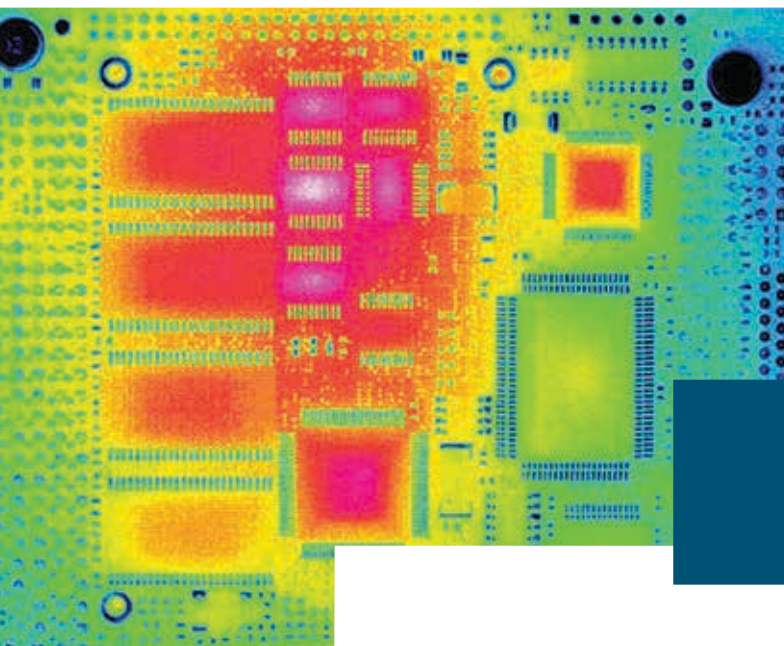
STRATEGIC THEMES & KEY COMPETENCES

- Tribology in machine design
- Biotribology
- Industrial design
- Condition monitoring and vibroacoustics
- 3D optical digitization and reverse engineering
- Metal 3D printing



RESEARCH

- **Tribology** – thin lubrication films, roughness and topography, lubricant and rubbing surfaces properties, friction, wear, rolling contact fatigue, friction and lubrication of artificial hip joints, rail tribology
- **Technical diagnostics** – optimization of methods for car testing, analysis of acoustic noise and noise source localization, self-excited vibration of bearings, identification of parameters for simulation and modelling, magnetorheological damping and fluids, identification of microstructural changes
- **Reverse engineering and additive manufacturing** – optical digitization, quality control, design with use of reverse engineering, prototyping, additive manufacturing of metal components, development of novel metal alloys for selective laser melting
- **Fatigue properties** – high cycle fatigue properties, life of bearings, acoustic emission, contact fatigue monitoring, damage diagnostic of machine parts
- **Product research** – ergonomics, 3D digital modelling, character and typographical design, visual communication design, product design, experimental and transport design



ENERGY INSTITUTE

DEPARTMENTS

- Power Engineering
- Thermodynamics and Environmental Engineering
- Victor Kaplan's Department of Fluid Engineering

HIGHLIGHTS

Swirl turbine

A new type of turbine with simple design and low manufacturing costs was invented for locations with relatively low heads (less than 3,5 meters). This turbine can be operated both in bulb and siphon layouts.

Hydraulic laboratory

The only laboratory of university hydraulic machines within the CR (dynamometers, feeding pumps, vacuum pump, flowmeters, pressure transducers, accelerometers, high speed camera, oxygen probe, stroboscope. All types of turbines and centrifugal pumps can be tested up to power output of 300 kW to obtain characteristic curves (efficiency, power, specific energy, cavitation).

Web: eu.fme.vutbr.cz
Email: eu@fme.vutbr.cz

TEACHING PROFILE

- courses in thermodynamics and hydrodynamics for all students
- Bachelor's study programme Power Engineering and Environment
- Master's study programme Power Engineering, Environmental Engineering, Fluid Engineering
- doctoral study programme Design and Process Engineering



RESEARCH

- measuring of moisture content, combustion heat, calorific/heating value, flash point, autoignition temperature of deposited and/or suspended dust, ash content, characteristic temperatures of ash
- testing of properties of fuel namely biofuel and waste
- detailed analysis of gaseous products of combustion
- size and concentration measurement of fine particles ranging from 8 nm to 2000 μm micro- and nano-particles generation
- flow, mixing, atomisation, dispersion, and agglomeration of two and more-phase fluid systems
- aerosol transport and deposition
- thermodynamic cycles of heat pumps, refrigeration and air conditioning units and other devices
- HVAC components and system design
- measurement and the assessment of thermal comfort
- pneumatic systems (piping, components and ECS); hydraulic systems (car braking systems, distribution systems of liquids); mechanical systems (camshaft and other mechanisms)
- multi-phase fluid flow modelling (liquid-gas, solid particles-gas)
- thermodynamic design of heat engines with external heat source
- hydraulic design of pumps and turbines (Francis, Kaplan, Pelton, crossflow)
- atypical designs of hydraulic machines (splitter blades, non-uniform blade cascades, hydrophobic surfaces...)
- turbomachinery flow simulations (CFD), multiphase flow simulations (cavitation, suspension flows), flow simulations for technology processes (mixing, nozzles)
- analysis of pulsations and vibrations in turbomachinery and fluid systems



INSTITUTE OF MANUFACTURING TECHNOLOGY

DEPARTMENTS

- Machining Technology
- Welding Technology and Surface Treatment
- Metal Forming and Plastics
- Foundry Engineering

HIGHLIGHTS

Double degree Master's studies Industrial Engineering – in cooperation with AmParisTech, Centre Cluny – is a Czech/French programme.

It combines knowledge of manufacturing science, management, diagnostics of production machinery and technological units while using modern methods of analysis and optimization of advanced production.

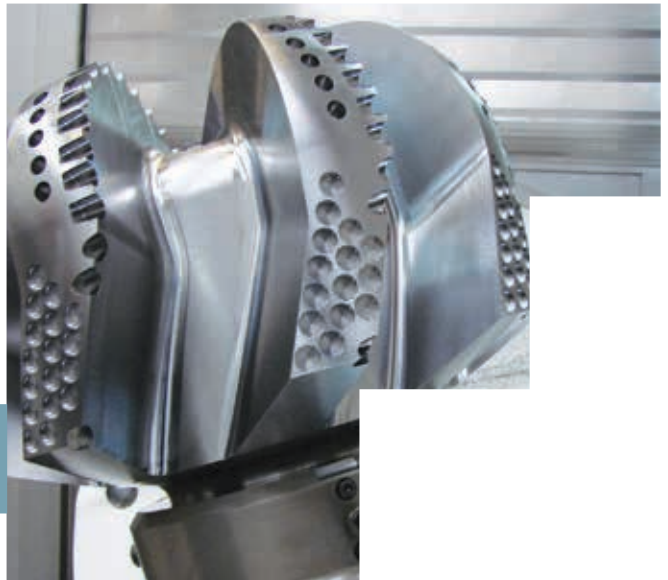
A student is trilingually trained for designing, programming and managing hi-tech applications and production systems. The unique concept of study gives to the alumni wide competencies in international production, trade and research.

Web: ust.fme.vutbr.cz

Email: ust@fme.vutbr.cz

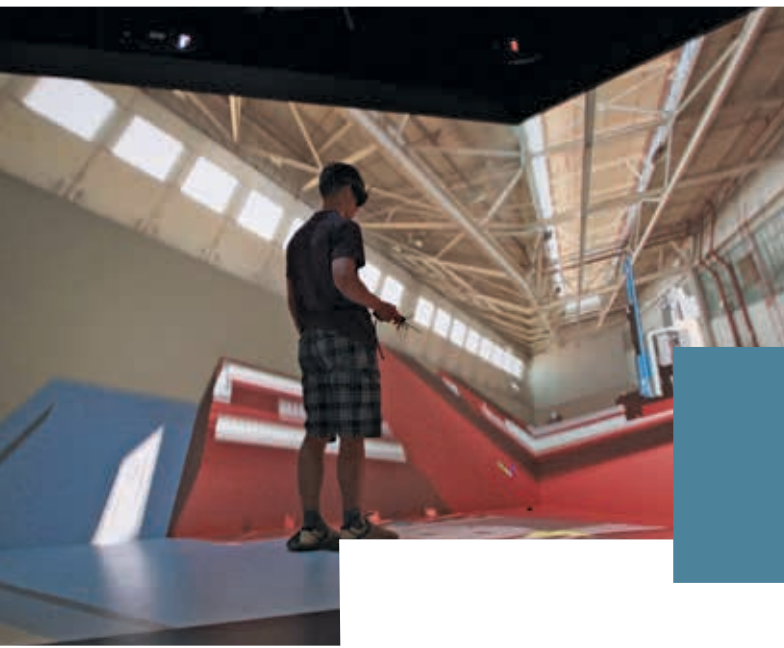
TEACHING PROFILE

- Master`s and doctoral degree in Manufacturing Technology
- Master`s degree in Foundry Technology and Manufacturing Technology and Management in Industry (in cooperation with Faculty of Business and Management)
- Industrial Engineering



RESEARCH

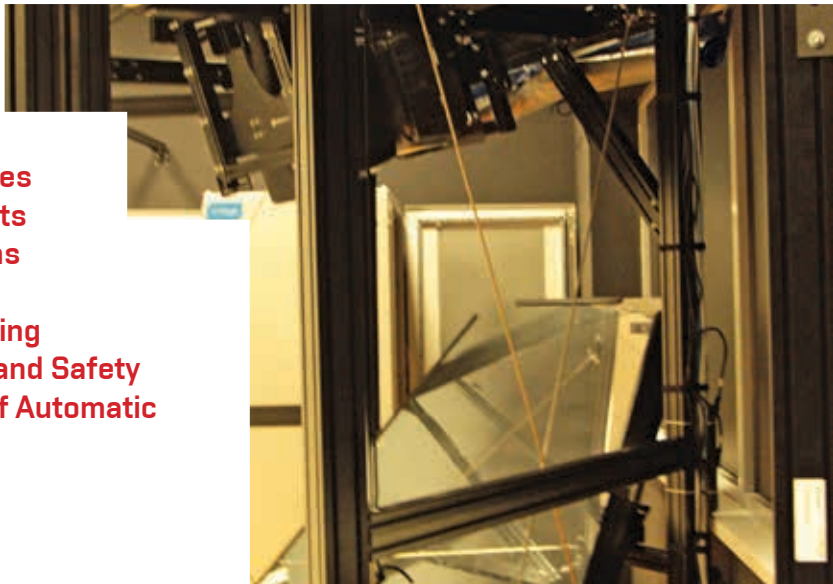
- progressive production technologies on CAD/CAM/CIM/CAE and principles and material interactions in production technologies
- analyses of workability, formability, weldability and castability of advanced materials
- tool performance and its improvement on the base of PVD/CVD/MTCVD technologies
- surface integrity of machined surfaces for high loading conditions and extreme demands
- 3D-modelling for manufacturing of CNC machine components and for visualization and testing using Rapid Tooling technology
- evaluation of cutting properties of new tool materials and working properties of new technical materials including calculations of wear
- vacuum furnace technology and its application potential in manufacturing of high-alloy steel
- measurements of mechanical properties and chemical composition of welded and soldered joints
- evaluation of macro- and microstructure of welded joints
- metallurgy and casting production of nickel based alloys and intermetallic TiAl alloys
- structural and mechanical properties of aluminium based alloys castings
- study and control of conditions of solidification of heavy steel castings and ingots



INSTITUTE OF PRODUCTION MACHINES, SYSTEMS AND ROBOTICS

DEPARTMENTS

- Production Machines
- Robotics and Robots
- Production Systems and Virtual Reality
- Electrical Engineering
- Quality, Reliability and Safety
- Research Centre of Automatic Manipulation



Web: uvssr.fme.vutbr.cz

Email: uvssr@fme.vutbr.cz

TEACHING PROFILE

- courses on design, construction, development, control, management, operation and diagnostics of production machines, machine tools, industrial robots, manipulators, production systems, quality, reliability, durability, maintenance and diagnostics
- electrotechnical courses for all Bachelor's, Master's and doctoral students
- Bachelor's degree in Quality, Reliability and Safety and Production Technology
- Master's degree in Design of Production Machines and Equipment, Production Systems and Quality, Reliability and Safety
- doctoral degree in Machines and Equipment



RESEARCH

- assessment of risks and safety of machines and electric devices according to EU legislation
- diagnostics of machines, devices and processes with special focus on thermodiagnosics, vibrodiagnosics, noise diagnostics and electrodiagnosics
- expert opinions related to engineering (production machines and industrial robotics)
- simulation of production and non-production systems, production planning, production logistics
- modelling, simulation and control of mechatronic systems
- analyses of high-speed processes, planning and reliability analyses of technical systems
- assessment of human influence on reliability
- maintenance of products, machines and equipment
- surface quality assessment
- quality assessment of product and processes
- company metrology
- virtual reality prototyping and validation

APPLICATIONS

- special measurements with unique technology (detection of fast processes with a high-speed camera, assessment of surface structure of components, measurements of geometrics characteristic, shape and position deviations, torque, momentum characteristics on rotating devices)
- development, design of machines and machines nodes (systems of tool exchange, spindle heads etc.) and virtual prototypes with the use of 3-D stereoscopic projection
- design and construction of non-conventional robots, manipulation systems, automats and robotized workplaces, end effectors of robotic systems
- software for technological control systems of PLC and PAC, for the human-machine interface (HMI), for data acquisition (DAQ)
- metrology of technical parameters
- ergonomics studies used by virtual reality environment



INSTITUTE OF PROCESS ENGINEERING

HIGHLIGHTS

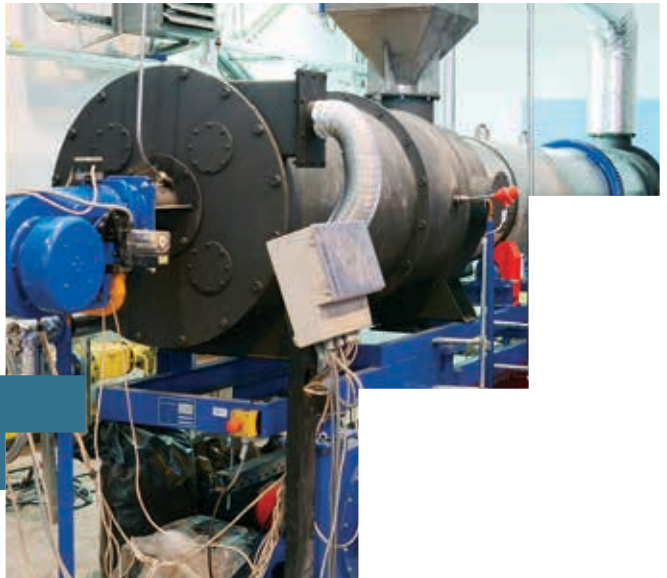
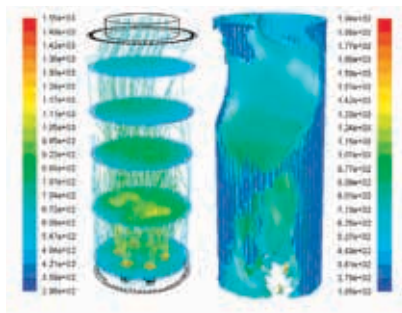
- unique system **NERUDA** – optimizing waste flow from producers (municipalities) to processors
- **JUSTINE** – processing data coming from different regions bound together through equations, constraints and regression models
- **burner testing facility** up to 1.8 MW for gas and liquid fuels with measuring instrumentation, semi-automatic control and data acquisition system
- **multifunctional pilot unit** used for pollutants removal from the waste gas
- **unit for thermal and catalytic treatment of off-gases**, for combined cleaning of off-gases and flue gases by filtration, absorption and selective catalytic reduction (mobile devices)
- **rotary drying and sintering testing furnaces** – determining technological parameters and quality of processed material
- laboratory of energy intensive processes
- **gas micro-turbine** – generator of dry air (up to 90 kW) and electrical energy (up to 28 kW) – testing of combined heat and power generation

Web: upei.fme.vutbr.cz

Email: upei@fme.vutbr.cz

TEACHING PROFILE

- Master's study programme of Process Engineering
- doctoral study in Process Engineering



RESEARCH

- minimisation of energy consumption and production of emissions in the process industry
- forecasting in waste management
- plant efficiency evaluation, waste-to-energy plant integration
- processes optimization for energy consumption reduction
- advanced computational tools for simulation and optimization, application of CFD, optimisation algorithms etc.
- computational modelling of multiphase flows, combustion of gas, liquid and solid fuels, grate combustion
- conventional and special types of heat transfer equipment (heat exchangers, fired heaters, etc.)
- heat transfer enhancement and equipment retrofit/revamp options
- low-NOx burners development and testing
- up-to-date approach for cleaning of polluted gases
- desalination of seawater and thickening of wastewater
- strength calculation of apparatuses, storage tanks, pipelines, etc.
- static evaluation of process apparatuses
- troubleshooting of process devices and estimation of corrective measures
- creating of engineering software in Python language



INSTITUTE OF AUTOMOTIVE ENGINEERING

DEPARTMENTS

- Internal Combustion Engines
- Motor Vehicles and Tractors
- Handling and Building Machines

HIGHLIGHT

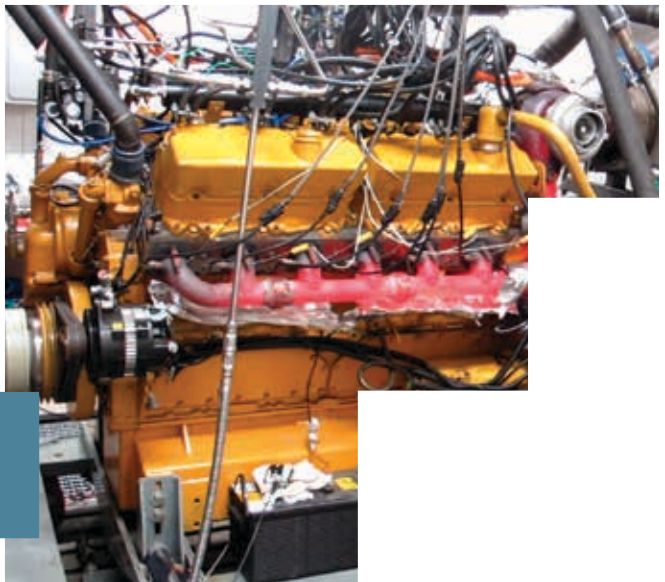
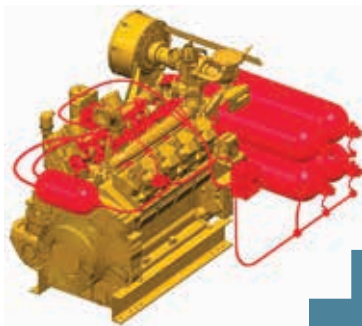
Formula Student – since 2010 students of several branches and BUT faculties have been engaged in the Formula Student worldwide project with their own TU Brno Racing team (led by the Institute). The team's activities cover all the necessary aspects from car concept ideas to races at international events, i.e. car design, computational simulations, parts and assembly production in cooperation with industrial partners (over 50), financial and business plan and team organization. Formula Student cars use an aerodynamic package and are powered by a one-cylinder engine with a purposely developed supercharger. A new car is constructed by the team every year taking part in international events. The team has taking place among the top 10 in the worldwide Formula Student University Ranking.

Web: iae.fme.vutbr.cz

Email: uadi@fme.vutbr.cz

TEACHING PROFILE

- courses in Bachelor's degree programme Engineering in Machine and Equipment Construction branch
- specialized courses in Master's degree programme Mechanical Engineering in Automotive and Handling Engineering specialization
- specialized courses in doctoral study programme Machine and Equipment in Design and Processing branch, specialization Automotive and Handling Engineering
- courses cover the construction of cars, vans and lorries, buses and trailers, vehicle handling, IC engines construction, engine thermodynamic cycles, driveline dynamics, engine accessories, emissions and ecology, measurement and simulation of vehicle dynamics, machines and devices for in-plant handling, equipment for mining and building materials transport and passenger conveyance in buildings, handling logistics



RESEARCH

- passenger car engines (dynamics and fatigue, torsional vibration dynamic dampers, engine components shape optimization, thermodynamics of combustion process, engine's vibrations and noise reduction, mechanical losses reduction, parts fatigue)
- engine testing (power and durability, ECU programming, accessories testing)
- gas engines (fuel system, regulation, gas ignition; engine control systems)
- driveline vibrations, noise and fatigue
- vehicle dynamics and aerodynamics (simulations, laboratory and on road measurement, data analysis, software development, HIL applications, suspension optimization)
- in-plant handling logistic and optimization
- computational modelling of mixing and compacting of particular matters



INSTITUTE OF AEROSPACE ENGINEERING

DEPARTMENTS

- Aircraft Design
- Aeronautical Transport
- Flight School

H I G H L I G H T

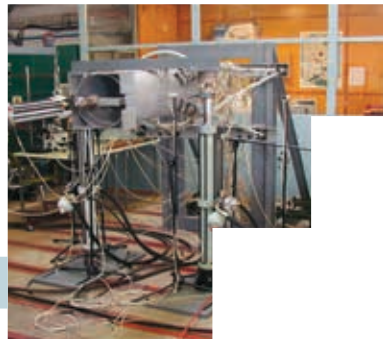
**SPARTAN (SPAc exploration Research
for Throttleable Advanced eNgine)**

The Institute of Aerospace Engineering participated in the development of new engines for space use on future planetary missions (i.e. for Mars lander). IAE researchers prepared ground and flight tests of the SPARTAN demonstrator. Activities included: modelling of aerodynamics and flight mechanics for the demonstrator, integration of developed advanced hybrid engine and installations into the demonstrator, drop tests of the demonstrator to prove function and performance of all systems.

Web: lu.fme.vutbr.cz
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TEACHING PROFILE

- Bachelor's study program Professional Pilot
- Master's study programmes Aircraft Design and Aeronautical Traffic
- doctoral study programme Design and Process Engineering in Aircraft Design and Aeronautical Transport specialization



RESEARCH

- aviation technology development, structures and equipment testing in approved laboratory and consulting services
- test facility with the Czech CAA certificate for static and fatigue testing of aircraft structures
- application of modern computational methods in aerospace (i.e. numerical methods for structures – FEM, and aerodynamic analyses – CFD)
- systematic research of modern composite materials
- research in SHM (Structural Health Monitoring)
- research of aerodynamic optimization methods and active flow control
- ballistic recovery systems
- in-flight measurements and new procedures for ground testing (static/dynamic/fatigue) of aerospace structures
- safety and reliability assessment for complex aerospace systems

Examples of projects with IAE participation:

- development of ballistic recovery system for Unmanned Aerial Vehicles (UAVs) – patented solution for **GALAXY Co.**
- modernization of 19-seat small transport aircraft **L-410NG**
- development and certification of 10-seater turboprop light transport aircraft **Evektor EV-55**
- certification structural tests for leading European manufacturers such as **Stemme AG**, **XtremeAir**
- research/qualification testing for space devices for **Mars lander project (ESA)**
- **Advanced Aerostructures Research Centre** (design procedures for composite structures and damage tolerance)
- safety and reliability analyses for complex aircraft systems
- **VUT 061 Turbo experimental aircraft** (flying laboratory for testing the PBS TP100 turboprop engine), VUT 051 RAY experimental aircraft with electric propulsion



INSTITUTE OF AUTOMATION AND COMPUTER SCIENCE

DEPARTMENTS

- Automation
- Applied Computer Science
- Computer Networks

HIGHLIGHTS

- **modern laboratories for students and developing** (adaptive control, pneumatic and hydraulics lab, laboratory for measuring, PLC lab, AI and bio-inspired robotics lab, microprocessors lab, computer networks lab)
- **International conference on Soft Computing MENDEL**
- **International Conference on Mechatronics** (a conference with a long tradition co-organized by the institution and indexed in Scopus and ISI WoS)
- **modern software packages** as all MS products by MSDN license (e.g. MS Visual Studio), JetBrains products, PLC development platforms (Siemens, Phoenix Contact, Mitsubishi, B&R Automation)
- **Electro-qualification license §5 and higher of certificate n.50/1978 Sb. LabVIEW Academy Program**

Web: uai.fme.vutbr.cz

Email: uai@fme.vutbr.cz

TEACHING PROFILE

- Bachelor's degree in Applied Computer Science and Control
- Master's degree in Engineering Computer Science and Control
- courses in artificial intelligence, microprocessor technology, computer hardware, computer graphics, encoding theory, mobile robotics, autonomous systems, database systems, computer networks...
- Control of Machines and Processes in the doctoral degree Design and Process Engineering and cooperation in Applied Mathematics, Applied Mechanics



RESEARCH

- **mobile robot construction and control** (autonomous robots, omni directional wheels, electrical sensors, control and navigation systems, trajectory generation, computer vision, machine perception)
- **soft computing** and **artificial intelligence** (neural networks, swarm intelligence, nature inspired metaheuristics for optimization, knowledge based reasoning, fuzzy logic and control, deep learning)
- **mechatronics** and **control system design** (simulation of dynamic system parameters, linear and non-linear automatic control, binary and optimal control, robust control, discrete PSD controllers, large-scale systems)
- **mathematical models and methods for logistics and transport systems** (processes of identification, multi-criteria selection, scheduling and lot sizing in flow shops and job shops)
- **software development** and information systems design, (Matlab/Simulink, NI LabVIEW, C/C++, Python or C# languages)
- multi-body modelling and simulation of the dynamic systems, hardware-in-the-loop simulation, design, etc.



INSTITUTE OF FOREIGN LANGUAGES

DEPARTMENT

- Applied Linguistics

HIGHLIGHTS

The Institute makes use of the learning management and skills testing system Moodle to monitor students' individual work and provide them with the possibility to practise the language through interactive on-line quizzes of various types (multiple choice, cloze test etc.).

The Institute created its own video courses presenting dialogues related to the everyday lives of students, or, at C1 level, soft skills addressed mostly to Ph.D. students and academic staff. Each course is supplemented with comments and language tips, interactive exercises testing comprehension, grammar and vocabulary. It has the potential to improve students' pronunciation, listening comprehension skills, develop vocabulary and soft skills typical for specific areas of communication (business meeting, delivering a presentation, replying to questions, etc.). Additional materials include further language practice, presentations (e.g. a guide to professional writing), audiomaterials (e.g. reading mathematical formulae, pronunciation guide), etc.

Web: uj.fme.vutbr.cz

Email: uj@fme.vutbr.cz

TEACHING PROFILE

- compulsory and optional courses of English, German, Russian, French and Italian
- courses in Bachelor's and Master's study programmes focused on general language, grammar, basic technical terminology and communicative skills, professional English and communicative skills
- language courses for Ph.D. students focused on languages for specific purposes and terminology according to the given specialisation with special attention to oral delivery and written form of reports, presentations, and letters (3-semester course)
- blended learning as a part of all compulsory courses
- optional conversational and general language courses
- a wide range of courses within the lifelong learning.





HEAT TRANSFER AND FLUID FLOW LABORATORY

The Heat Transfer and Fluid Flow Laboratory (Heatlab) has over 20 years of experience in theoretical investigations and technical services in the area of heat transfer in mechanical engineering and metallurgy companies. The theoretical investigation is concerned with the issue of inverse heat conduction and cooling using mainly water and air-mist nozzles. Industry oriented projects are based on experimental testing leading to mathematical models for processes like cooling during continuous casting, cooling during hot rolling, descaling (to determine boundary conditions for heat conduction equation).

Web: heatlab.cz

Email: heatlab@fme.vutbr.cz

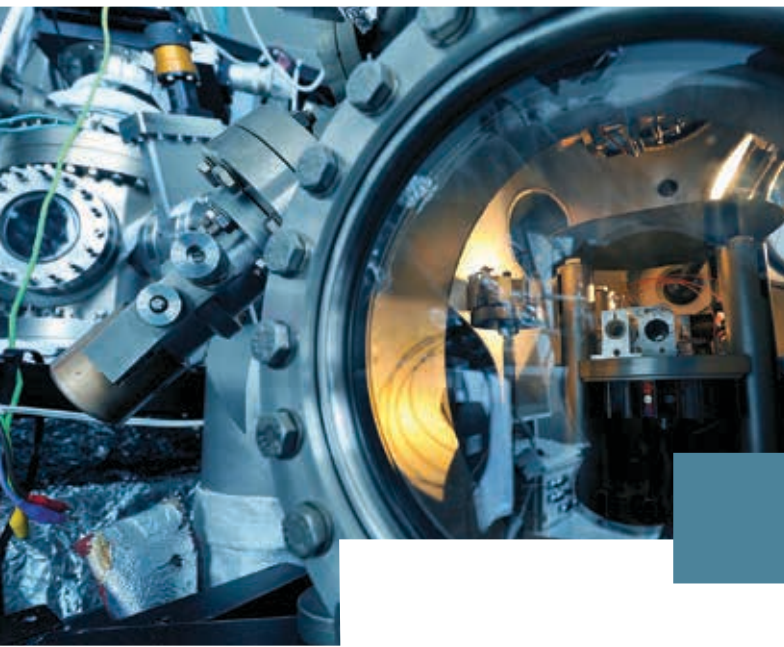
EQUIPMENT

- experimental stands to measure the boundary conditions for heat conduction equation at high temperatures – linear and vertical high speed test benches
- testing equipment to determine the boundary conditions on rotating cylindrical surfaces (design of cooling systems of rolling-mill working rolls as a main application)
- test chamber for performance measuring of heating and cooling elements (complex system of devices and special computer program)
- equipment for impact pressure measurement, for thermocouples calibration and for chemical and mechanical analysis
- original software to solve a wide range of heat transfer tasks



RESEARCH

- optimization of cooling and spraying systems to obtain maximal efficiency and minimal energy consumption, optimize descaling process in steel plants
- thermal and structural analysis for continuous casting, roll cooling and understand cooling and cooling of strips and sheets
- determination of boundary conditions for heat conduction, equation based on original verified methodology
- design of heat treatment of metals with regard to implementation into existing equipment in factory
- studying deformation-material properties of steel in semi-solid state
- polymeric heat exchangers with micro-hollow fibres
- development of specialized software



NETME CENTRE

Web: netme.cz
facebook.com/NETMEcentre
Email: info@netme.cz

- more than 500 engineering specialists (researches, managers, Ph.D. students)
- extensive knowledge based on the long tradition of the Faculty
- complex solutions from the first idea to a functional prototype
- commercial contractual research (40% of which from companies in Germany, Japan, South Korea, UK...) up to 20% of total long-term research
- 9.3 million EUR spent on contractual research over the past 5 years
- an annual turnover of 9,1 million EUR

RESEARCH AREAS

Electron beam group (Universal Chamber EB Machine type K26)

- high-power electron beam used for welding, engraving, shape corrections, surface treatment and chemical-heat treatment
- extremely precise localisation and application of high-energy density to a specified surface area
- minimum energy surplus and minimisation of the heat-affected zone and distortions

Engineering technologies

- a wide range of technologies including metal melting, surface treatment, manufacturing processes, assembly technologies, machine tools and virtual machine design
- additive manufacturing providing support in optical digitization, reverse engineering and rapid prototyping in both metallic and polymer materials

Elastohydrodynamic lubrication

- research in lubricating films, measuring its thickness and temperature, friction and wear measurements, simulations of operating conditions of the lubricated contact
- biotribology design and produce joint replacements at the highest levels in safety, durability, longevity and overall functionality
- interaction between wheel and rail in the field of rail transport

Biomechanics

- knowledge of engineering mechanics to solve biological and medical problems based on mechanical characteristics
- cardio – vascular (aortic aneurysm) and skeletal-muscles problems (mobility issues joint replacements, osteoporosis, dental implants, fixators spinal fractures, etc.)

Aerospace

- aerodynamics, design, durability and the reliability of complex aeronautical systems
- conceptual designs of airplanes and their components, numerical flow simulations, flight mechanics, measurements in wind tunnels and flight measurements
- advanced methods for manipulating air flow
- analysis of aircraft or their components, including aircraft certification as prescribed under EASA CS-22, CS-23
- development of small airplanes made of metal and composite materials – from concept to a prototype
- safety and reliability of aircraft systems as required by aviation regulations EASA CS and FAA FAR, etc.

Aerosol and spray technology

- experimental fluid mechanics focused on the research, development and testing of different types of spray nozzles
- design and diagnostics of atomisation nozzles for the automotive industry, turbine engine combustion chambers, the combustion of waste fuels, for pharmaceutical industry (nebulizers, inhalers), air flow issue

Automotive engineering

- efficiency, sustainability and safety covering a wide range of industry needs
- alternative powertrains, cabin thermal comfort (HVAC), air quality, materials, tribology, virtual industrial design and simulations
- multidisciplinary research approach covering all major engineering fields of expertise

Energy and resources

- a proven track record of analysing, designing and optimising energy grids on a system level
- combining skills in thermodynamics, heat transfer, fluid flow analysis, mechanical design, prototyping and validation

Heat and processes

- research and development activities in heat transfer, inverse problems and cooling
- heat transfer boundary conditions for cooling hot surfaces with applications for continuous casting, hot rolling and heat treatment
- research and development of polymeric heat exchangers with hollow fibers



TESTIMONIALS

GIANMARCO TAVERI, ITALY

I come from Italy and I am a Ph.D. candidate at the Institute of Materials Science and Engineering. I work on mechanical characterization of innovative ambient friendly cements coming from industrial wastes. I chose Brno as a destination for my Ph.D. studies based on the recommendation of my thesis supervisor at Politecnico of Turin. Both institutes have cooperated for many years. I have been here for seven months and I like it here very much. Most of all I would like to emphasize the high level of scientific expertise of my colleagues. I learn a lot every day! I very much enjoy the good atmosphere at work and friendliness of Czechs in general.

PROF. MOTOHIRO KANETA, JAPAN

I joined Brno University of Technology, FME in 2011 since the laboratory had invited me, although I had not known anything about the University. I have been surprised very much that the laboratory has magnificent experimental facilities developed by the staff and measuring instruments with high accuracy. Consequently, I am spending a happy research life solving tribology problems of machine elements, while being helped by very kind staff, students and citizens of Brno. I am absolutely confident that Faculty of Mechanical Engineering is a good place for researchers and students from other countries. It is my second home.



**KENNETH E. BLAZEK,
ARCELORMITTAL GLOBAL RESEARCH
AND DEVELOPMENT LABORATORY USA**

Researchers at the HeatLab at FME have been providing invaluable input to our secondary cooling control models for continuous casters.

Their expertise and knowledge of heat transfer and experimental techniques for determining interfacial heat transfer coefficients between the cast slab surface and the impinging water sprays has allowed us to predict surface temperatures on cast slabs precisely without further tuning of our models. They have provided experimentally measured heat transfer coefficients and have educated us in numerical techniques for handling the experimental data in our computer programs.

Because of the quality of their work we have installed control models on over 14 continuous caster strands in our company with the prospects of many more.

This has led to savings of millions of dollars for each plant by improving cast slab quality and prevention of damage to caster equipment.

Even though we depend on them entirely for the services they provide, they have been very timely in meeting our needs.



Partner universities

Austria

- Graz University of Technology
- Vienna University of Technology
- Johannes Kepler Universität Linz
- Salzburg University of Applied Sciences
- Montanuniversität Leoben
- University of Salzburg
- Salzburg Universität od Applied Sciences
- Carinthia University of Applied Science

Belgium

- Katholieke Hogeschool Brugge–Oostende

Bulgaria

- Technical University of Varna
- Technical University of Sofia

Croatia

- University of Rijeka
- University of Split

Denmark

- Aalborg University
- University of Southern Denmark
- Danmarks Tekniske Universitet

Estonia

- Tallinn University of Technology
- Estonian Aviation Academy

Finland

- Tampere University of Technology
- Tampere University of Applied Sciences
- University of Jyväskylä
- University of Vaasa

France

- INSA de Rennes
- INSA Centre Val de Loire
- ESIEE Paris

- Université Joseph Fourier
- Université Pierre et Marie Curie
- Ecole Supérieure d'Art et de Design
- Ecole Nationale Supérieure d'Art et Métiers
- EPF Ecole d'Ingenieurs
- Ecole Centrale Marseille
- Université de technologie de Compiègne
- ICAM
- Université Paris-Est Marne-la-Vallée

Germany

- Hochschule Augsburg
- Technische Universität Braunschweig
- Technische Universität Darmstadt
- Technische Universität Chemnitz
- Technische Universität Dresden
- Universität Potsdam
- Hochschule Merseburg
- Friedrich-Schiller-Universität Jena
- Universität Stuttgart
- Duisburg Essen University
- Helmut-Schmidt-Universität
- Hochschule RheinMain
- OTH Regensburg
- RWTH Aachen University

Great Britain

- Queen Mary, University of London
- University of Huddersfield
- University of Hertfordshire

Greece

- Technical University of Crete
- University of Patras
- Technical Educational Institute of Crete
- Technical Educational Institute of Thessaly

Hungary

- Széchenyi István University

Ireland

- University of Limerick

Italy

- Università Degli Studi di L'Aquila
- Università Degli Studi di Bari
- Università Degli Studi di Parma
- Università Degli Studi di Roma „La Sapienza“
- Politecnica di Milano
- Università Degli Studi Roma Tre
- Università Degli Studi di Trieste

Japan

- Toyota Technological Institute, Nagoya

Korea

- Keimyung University

Lithuania

- Vilniaus GediminoTechnikos Universitetas

Malta

- The University of Malta

Norway

- Molde University College
- Narvik University College
- Norwegian University of Science and Technology Trondheim

Poland

- University of Technology and Life Sciences in Bydgoszcz
- Opole University of Technology
- University of Wrocław
- Lublin University of Technology
- Lodz University of Technology

Portugal

- Universidade do Minho
- Instituto Politécnico de Lisboa
- Universidade de Coimbra
- Universidade de TrásosMontes e Alto Douro

Romania

- Universitatea Politehnica din Timisoara

Russia

- Izhevsk State Technical University

Slovakia

- Technical University in Košice
- Technical University in Zvolen
- Alexander Dubček University of Trenčín
- University of Žilina

Slovenia

- Univerza v Mariboru
- Univerza v Ljubljani

Spain

- Universitat Politecnica de Catalunya
- Mondragon Unibertsitatea
- Universidad de León
- Universidad de Córdoba
- Universidad del País Vasco / Euskal Herriko Unibertsitatea
- Universidad de Málaga
- Universidade da Coruna

Sweden

- Mälardalen University
- Chalmers University of Technology
- Linköping University

Netherlands

- Technische Universiteit Eindhoven
- Hogeschool Rotterdam
- Hogeschool Utrecht
- Radboud Universiteit

Turkey

- Afyon Kocatepe University
- Istanbul Teknik Üniversitesi
- Middle East Technical University
- Yıldız Technical University
- Cukurova University

Major partner companies (education, research projects, contracts)



Škoda Auto a.s.



ČEZ, a.s.



Bosch Diesel s.r.o.



Honeywell, spol. s r.o.



Koyo Bearings CR s.r.o.



POSCO



ON Semiconductor



Volkswagen AG



TESCAN, a.s.