Faculty of Mechanical Engineering and Economic Sciences

Subjects in mechanical engineering have been offered since Graz University of Technology was founded. The institutes of economic science take into account the fact that economic aspects are inseparably linked with technology. The Faculty is comprised of 18 institutes that offer more than 644 courses.

Recently, students have been offered the opportunity to receive an accredited bachelor's degree in Anglo-American countries. Teaching and research benefit from excellently equipped laboratories. Besides well-balanced contract research and co-operation with industry, a number of sponsored research projects and competence centers should be mentioned in particular, especially those in the areas of automobile engineering (virtual vehicle development, acoustics, large engines), in which the competences of the different institutes of Graz University of Technology are linked to those of industry of international standing in the surrounding area.

Mission:

We develop innovative and holistic solutions for the complete life-cycle of products in the fields of vehicles, power engineering and production plants.

Vision:

We have succeeded in modelling the service life cycle for energy, vehicle and production system products on an integrated and interdisciplinary basis as a result of training and research excellence in both the fundamentals and in the mechanical engineering and economic sciences areas. As a center with an international profile, we develop experimentally verified innovative concepts and tools with a specific focus on how these affect people and the environment.

Faculty of Mechanical Engineering and Economic Sciences

Periode (01.01.2024 – 31.12.2027)

Dean:
Univ.-Prof. Dipl.-Ing. Dr.techn. Franz Haas

Vice-Dean:
Univ.-Prof. Dipl.-Ing. Dr.techn. Siegfried Vössner

Dean of Studies:
Univ.-Prof. Dipl.-Math.techn. Dr.-Ing. Thomas Hochrainer

Vice-Dean of Studies:
Assoc. Prof. Priv.-Doz. DDipl.-Ing. Dr.techn. Bernd M. Zunk

Dean of Studies of Production Science and Management:
Univ.-Prof. Dipl.-Ing. Dr.techn. Hannes Hick

Dean‘s Office:
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Institute of Production Engineering “IFT”

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.techn. Franz Haas

Focus of the Institute

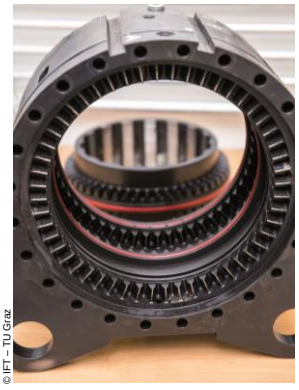
The Institute of Production Engineering addresses production in all of its facets in the context of teaching and research. It already has a long term tradition in precision machining, a realignment started with the assumption of the institute´s leadership by professor Franz Haas in 2014.

The “IFT” operates the following facilities:

- Production laboratory (ProLab) with the focus on machining (for example grinding technology)
- Training workshop for TU Graz students
- Precision laboratory with metrology equipment
- Fluid laboratory for development of hydraulic systems in production and mobility
- Additive manufacturing centre with the core areas metal 3D printing and topology optimization of complex machine construction parts
- TU Graz pilot factory „smartfactory@tugraz“

Research

The triad of material, tool and machine in production systems determines the process parameters in the field of machining. The three subsystems are either individually or as a whole optimized and their basics are also investigated. The fluid technology group recently achieved scientific success in the fields of hydrostatics, CFD-simulation and valve technology. It notably contributes to an innovative high torque hydraulic rotary actuator. The “IFT” operates a selective laser melting (SLM) machine for research in additive design and post-processing of already printed parts.



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Components of a swivel motor (fluid technology)

Selective laser melting system (AddLab@tugraz)

© TU Graz, Lunghammer

CNC Research grinding machine – world-wide unique precision technology for 3D noncircular geometries (ProLab)

The consortium of the smartfactory@tugraz is dedicating its research to the data-secure and agile production of a mechatronic product (robotic wave gear) in batch size one.

Vision

The “IFT” has set itself the strategic goal of designing the production of the future with well-founded knowledge and new systems and processes. This design is based on the fundamental understanding of the physical relationship of the considered processes.

Mission

The current topics in the area of production are of course being prioritized at the “IFT”. These are digitalization, additive manufacturing and the creation of cyber physical systems (CPS), whereby the “Precision Level” in product design and production is seen as an essential factor of success. This leads to the following leading record that claims deep consequences in all aspects of our working life.

“Precision guarantees our future.“

Teaching

The offered courses include numerous lectures, laboratories and the trainee workshop for all faculty studies. Examples are listed below.

- Mechanical Engineering (Bachelor)
- Industrial Manufacturing (Master)
- Fluid power in vehicles (Master)
- Industrial robots and robotics laboratory (Master)
- Advanced Processing Technologies (PSM)

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Institute of Materials Science, Joining and Forming

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.techn. Christof Sommitsch

Main focus of the institute

The institute is dedicated to the principles of materials science as well as production science in joining and forming technologies.

Areas of strength
Wire-based 3d-printing of metallic components using electron beam and CMT processes
Powder metallurgy and additive manufacturing by means of selective laser melting and direct metal deposition
Development of creep-resistant alloys for thermal power plants
Surface modification of metallic implant materials
Forming and heat treatment of titanium, aluminum, magnesium and nickel-based alloys
Generative manufacturing and joining of metal-polymer composites in aviation
Joining of similar and dissimilar materials by means of arc, friction and electron beam welding
Tool development, production and coating. Deep-drawing of aluminum and steel blanks, bending Microstructure modeling of thermo-mechanical processes (creep, cold and hot forming) in metals Process simulation (rolling, forging, welding and joining, deep-drawing) and process optimization

Scientific Research

We see our core competence in the Fields of Expertise *Advanced Materials Science* and *Mobility & Production*, as well as in parts of *Human & Biotechnology; and* conduct fundamental and applied research projects with scientifc and commercial partners in our working groups:

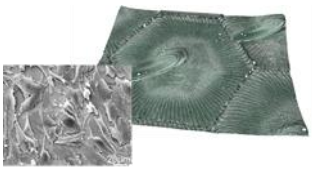
- Materials
- Joining Technology
- Tools & Forming
- Modelling and Simulation

The laboratories assist in teaching and research in the fields

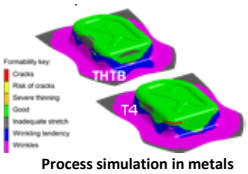
- Structural analysis and metallography
- Materials testing
- Arc, friction, beam and ultrasonic welding
- Tool technology and sheet metal forming
- Heat treatment and creep rupture testing
- Failure analysis and corrosion testing

We actively support our student initiatives High Performance Sailing TU Graz, TERA TU Graz and TU Graz Racing Team.

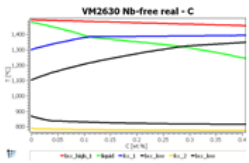
Thermomechanical characterization in metals


Surface modification by means of electron beam for implant materials


Wire-based 3D printing using CMT-process



Process simulation in metals



Microstructure Modelling

Vision

We are an international centre for developing, joining and forming socially relevant, future-oriented, high-performance structural materials. We transfer our expertise into teaching and services.

Mission

As a result of our high teaching standards coupled with the external funds we acquired, we have gradually created an exciting and stable working environment. This ensures a maximum of freedom for each staff and student member, supporting them to acquire and deepen their subject area knowledge with international standards.

Teaching

Bachelor and Master Programmes:

Mechanical Engineering, Mechanical Engineering and Business Economics, Advanced Materials Science, Production Science and Management, Technical Chemistry and Chemical Engineering

Doctoral School Mechanical Engineering

IWE – International Welding Engineer

- Welding processes and equipment
- Materials and their behavior during welding
- Construction, design and calculation
- Manufacturing and application technology

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Institute of Strength of Materials

Head of the Institute: Univ.-Prof. Dipl.-Math.techn. Dr.-Ing. Thomas Hochrainer

Core Areas of the Institute

Miniaturization, innovative materials and the need to optimize materials usage in applications brought the physical basis of strength of materials back into the focus of research. Accordingly, the focus of the Institute of Strength of Materials lies in the development of physically based, i.e. microstructure based constitutive models for computational continuum mechanics.

We teach the fundamentals of classical strength of materials and the finite element method for undergraduates and students at the early graduate level. For advanced students we offer courses in non-linear solid mechanics and materials modeling in order to prepare students for challenging research at the cross roads of engineering sciences, applied mathematics and materials science.

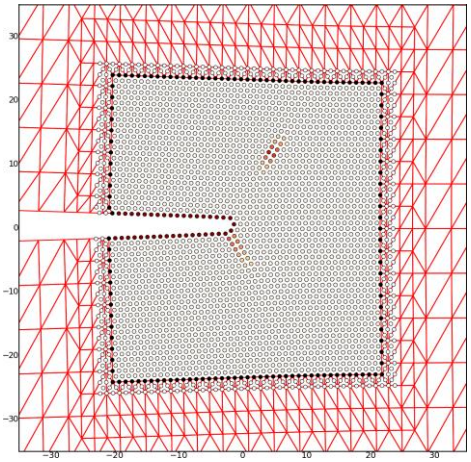
At a Glance
Mesoscopic and Scale - Bridging Methods
Dynamic Microstructure - Property Relations
Measurable Internal Variables
Numerical Homogenisation
Non-linear FE-Simulations
Plasticity, Damage and Failure
Material-Subroutines

Research

Our goal is to develop and apply microstructure-based constitutive models for continuum mechanics.

We focus on multi-scale coupling and the modeling of mesoscopic phenomena which lie out of the scope of classical homogenization methods based on averages and mean-field methods. Methodologically we focus on the finite element method and its coupling to atomistic and mesoscopic models.

Important applications for us are microplasticity, damage, and failure of metals, failure of porous brittle materials and the micromechanics of paper.



Simulation of CT-specimen using a coupling of atomistic and continuum mechanics models.

Mission

Freedom for Research – Passion for Teaching

Vision

Through innovative approaches at the cross roads of engineering sciences, applied mathematics and materials science we seek to become an internationally recognized center for mesoscopic materials modeling and a sought-after research partner for local industry.

As academic teachers we strive to not only impart knowledge but to also enthuse students for mechanics and the profession of mechanical engineering.

Teaching

Besides teaching the classical strength of materials for undergraduates, our focus lies on teaching materials modeling and numerical methods in graduate courses:

- Strength of Materials
- Advanced Strength of Materials and Finite Element Methods
- Nonlinear Solid Mechanics
- Plasticity Theory
- Mechanics of Materials and Modeling

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Institute of Mechanics

Head of the Institute: Univ.-Prof. Dr.-Ing. habil. Katrin Ellermann

Core activities of the institute

The institute of mechanics addresses several topics in the broad field of mechanics, especially focused on dynamical topics. This includes vibration analysis, rotor dynamics, mechatronic systems and flight simulation.

Research

The coupling of different physical effects, such as fluid-structure-interaction or electro-magnetical forces on mechanical structures, requires special attention in the modelling process.

The development of models demands a good balance between precision and efficiency: All important effects have to be included in the model description but at the same time the model should allow for an efficient computation.

Our research also includes the development and improvement of techniques for the analytical or numerical evaluation of the model equations.

In order to find an optimum, experimental verification of a model is an essential step, especially when very different physical effects interact in a real system.

The combination of theoretical derivation, numerical investigation and experimental validation leads to a better understanding of real world systems.

The current research topics include:

- Nonlinear dynamical effects in electrical machines,
- Techniques for model order reduction,
- Stochastic influences in rotor dynamics,
- Trefftz-methods in structural dynamics,
- Flight dynamics,
- Coupled multibody systems in offshore engineering.

In addition, members of the institute participate in the work of Graz Center of Computational Engineering (GCCE).

Education

In addition to research, teaching is a core activity in the institute. Courses in engineering mechanics are offered in different bachelor programs. At master level, the institute contributes to the fields of compuational engineering and mechatronics. The courses correspond to the topics of our research activities.

Vision

We develope simple but precise answers for all mechanical problems.

Mission

Our scientific work contributes to the development and the analysis of mechanical systems. Our teaching provides a broad basis in fundamental techniques based on research experience in order to best prepare our students for future challenges.

Lectures in bachelor programs
Engineering mechanics I (Statics)
Engineering mechanics II (Dynamics)
Mechatronic systems (in cooperation with the Institute of Logistics)
Bachelor projects

Lectures in masters programs
Multibody dynamics
Nonlinear vibrations
Flight simulation
Human factors
Course projects and laboratories
Master projects

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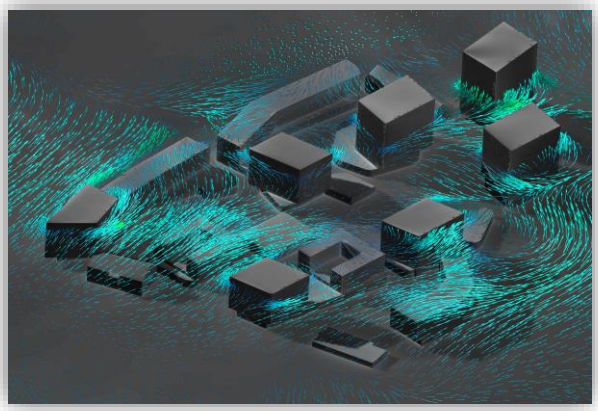
Institute of Thermal Engineering

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.techn. Christoph Hochenauer

The main focus of the institute

- Development of ***innovative approaches*** in energy technology
- ***Optimized utilization*** of conventional and alternative energy sources.
- ***Modelling and simulation*** of high-temperature processes



Simulation of the air flow in an urban area

Research

At the Institute of Thermal Engineering research is done in a huge laboratory as well as by numerical investigations. The main fields of research are:

- Investigation of high temperature ***combustion processes*** on a lab- and industrial scale.
- ***Biomass combustion*** and ***gasification***: Increasing efficiency of biomass plants and minimizing pollutant emissions.
- ***High-temperature fuel cells*** and ***electrolysis cells***: Process optimization, online-monitoring, prevention of degradation and development of regeneration strategies
- ***Heating, refrigerating and air conditioning technology***: The research topics in this area are oriented towards the development of compression-, absorption refrigerator systems and heat pumps as well as environmentally friendly vehicle air conditioning systems.
- ***Energy efficient buildings and urban energy concepts***: Optimization of buildings and district heating systems by using solar energy, industrial waste heat and innovative heating systems.

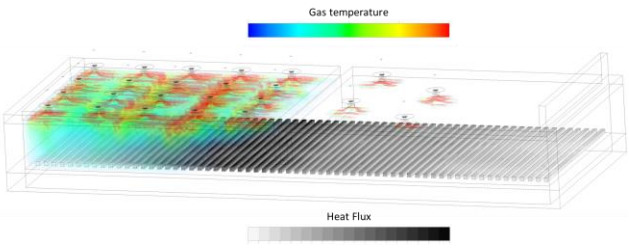
Vision / Mission

- First choice partner for national and international R&D projects
- Peer-reviewed publications in high-impact journals
- Target oriented research:
  - approx. 50% fundamental research
  - approx. 50% applied research

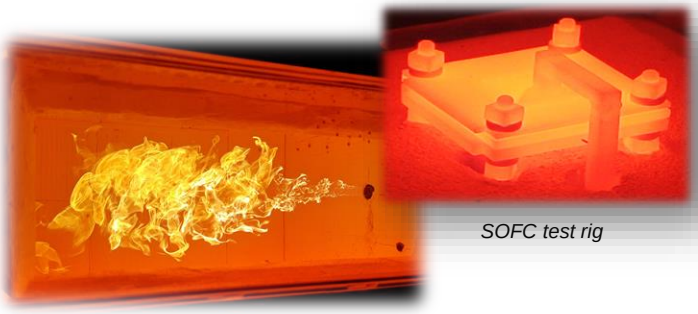
Based on the fundamental research achievements, the Institute of Thermal Engineering supports national and international R&D partners to develop highly efficient solutions in the field of energy technologies. This ensures competitiveness and makes a relevant contribution to the scientific community!

Teaching

- Thermal Engineering
- Heating, Ventilation and Air-Conditioning
- Energy and Environment related Measuring and Testing
- Informatics for Energy and Environment
- Solar Energy Use
- Heat Pumping Technologies
- Energetic Use of Biomass
- Gas and Fuel Cell Technology



CFD-Simulation of a steel reheating furnace



SOFC test rig

Flame in a 1.5 MW burner chamber with optical measurement system

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Institute of Thermal Engineering

Institute of Logistics Engineering – ITL

Head of the Institute: Univ.-Prof. Dr.-Ing. Domenik Kaever, M.Sc

Main focus

There are three main research areas at the institute: Intralogistics, Logistics Technology and Urban Logistics. From these industrial and funded projects arise in close collaboration with partners from industry and science. Organized in a matrix-structure all researchers are mostly engaged in more than one project to enable a broad view and to benefit from specific key-experience.

All industrial and funded research projects can be assigned to one of the three core activities: logistics planning, mechanical design and automation engineering. Valuable insights from research are transferred to courses for a state-of-the-art and science-oriented teaching approach.

Collage „logistics technology“ for annual ITL-conference „Logistikwerkstatt“

Research

Within the area **intralogistics** the technical systems for material flow are focused like e.g. conveying, storing, picking. They practically arise in production plants, warehouse systems and distribution centres.

Intralogistics
Resource and energy efficiency
Analysis and optimization of performance and availabilities
High performance parcel handling and sortation systems
Material flow calculation, modelling and simulation

Logistics technology analyses, optimizes and designs material flow systems and their components by the use of scientific methods. Modern CAE-tools and innovative methods like methodological engineering design effectively help to improve the performance of parts, components, assemblies and machinery.

Logistics technology
Engineering for logistics and knowledge-based design
Innovative new material handling machinery
Physical Internet (PI)

Societal trends like urbanization and e-commerce necessitate research within **urban logistics** immediately. Integrating sustainable logistic concepts in actual smart city approaches is one of the main focus of this research area.

Urban logistics
Sustainable first/last mile solutions and multimodal city-hubs
e-mobility concepts and smart city logistics

Vision

We are your top research and development partner in your scientific or industrial environment. We are internationally well recognized experts. We are enabler for future-oriented intralogistics, logistics technology and urban logistics solutions through our comprehensive approaches and experience. Well connected within our community we are researching within notable projects.

Mission

- Functionality, sustainability and efficiency by innovative logistic systems and technologies
- Industry-oriented and science-based teaching
- Bringing research and industry together for empowering both and making logistics belongings more visible in society and public thinking

Teaching

The institute‘s courses are widely integrated in bachelor and master study programs. Main courses are the following:

- Technical drawing, CAD/CAE-basics
- Material handling systems and technology
- Mechanical engineering basics (for process eng.)
- Industrial logistics systems
- Automation technologies for production systems
- Drives and control technologies

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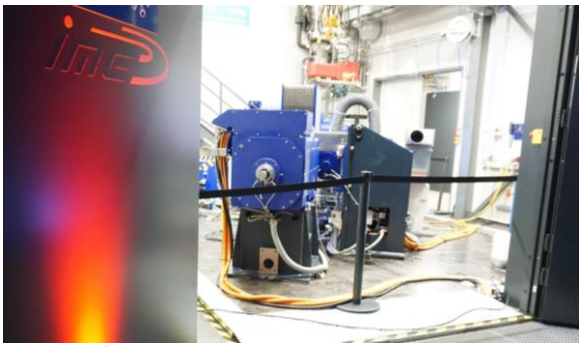
Institute
of Machine Components and Methods of Development – IME

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.techn. Hannes Hick

The Institute‘s Focus

The research areas Tribology - Powertrain Technology and Structural Durability - Railway Technology are operated in close cooperation with partners from industry and the scientific community. The institute’s overarching research area Development Methodology and Systems Engineering represents a further important core competence. Our diverse areas of activity enable us to be a partner that covers the complete development process from machine elements to entire systems.



Research

The focus of the **Tribology and Powertrain Technology** research area is on the development of automotive powertrains. The AVL/TU Graz Transmission Center boasts a broad range of competences from fundamental tribological investigations on combustion engines, via transmission technology, to research on electric drives. This puts the institute in an exceptional position.

Tribology and Powertrain Technology
Tribology / Single cylinder research engines
E-axle test rigs (up to 370kW) for functional and endurance tests
Lubrication circuit tilt test rigs
High load test rigs, special test rigs (roller bearings)
Condition monitoring and special instrumentation

The focus of the **Structural Durability and Railway Technology** research area is on the development of simulation methods for the preliminary design and structural durability of rail vehicle bogies. The team simulates the mechanical characteristics using finite element methods and validates the results on inhouse vibration test rigs.

Structural Durability and Railway Technology
Simulation of structural durability
Vibration test rigs, bogies and wheel sets
Air suspension systems
Wheel-rail contact

The focus of the **Development Methodology and Systems Engineering** research area is on the definition of model-based system architectures, function modelling and methods for the verification and validation of innovative powertrains. In parallel, a dedicated Digital-SE lab conducts research into the human factor in product development.

Development Methodology and Systems Engineering
System engineering methods, model-based SE
System modeling for powertrain systems
Design verification and validation methods
Human factor in development

Vision

The Institute for Machine Elements and Development Methodology orients its fundamental research into tribology and structural durability on the highest scientific principles and has positioned itself as the leader of the international research community into the subject of mobility - powertrains. The very specific connection between research institution and industry provides the basis for the highest quality standards towards scientific and industrial partners.

Mission

- Functionality and sustainability through research into innovative powertrain systems
- Fundamental and application-oriented teaching
- Innovative networking between university and industry to use uptodate infrastructure

Teaching

The areas of teaching focus are:

- Machine elements
- Design theory
- Development methodology
- Tribology, structural durability and simulation

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Institute of Structural Durability and Railway Technology

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.mont. Martin Leitner, MBA

Focus of the Institute

In the course of the research and teaching activities, the Institute deals with the following topics:

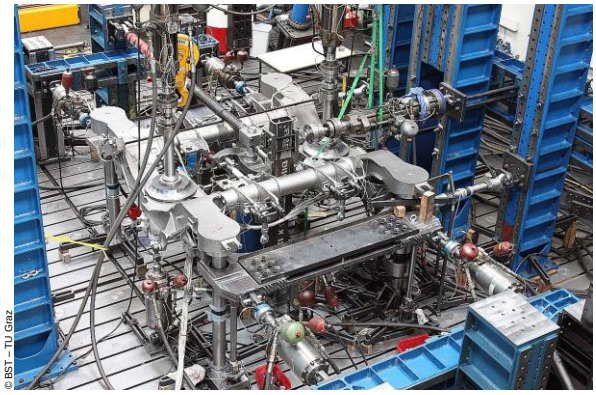
- Structural durability assessment of lightweight mechanical structures with focus on rail vehicles
- Mapping of the entire process steps for the development of elaborate design methods
- Set-up of advanced simulation concepts for the fatigue design process
- Development of experimental test methods for representative specimens and real systems

Research

A development of innovative components is essential for implementing new design concepts in mechanical and rail vehicle engineering. Research at the Institute, in close cooperation with partners from industry and science, contributes to a pre-development of modern rail vehicle structures and provides methods for the fatigue design of components and entire systems.

The modern testing infrastructure facilitates analyses on several size scales, from representative specimens to real systems, such as crack propagation tests at railway axles as well as fatigue tests of bogie frames. A significant aspect in the research activity is the development of new simulation concepts as basis for a modern engineering design process, which enables an application of the scientific results.

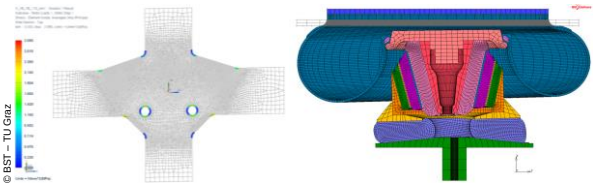
Crack propagation test at a railway axle



Fatigue test of a bogie frame

Vision

Fatigue strength, a cross-sectional science, is subject to a wide range of effects. Aim is to comprehensively evaluate the behaviour of components and rail vehicle structures during operation, considering the essential aspects and their interactions, such as the design and loading as well as material and manufacturing.



Numerical simulation: Local stress state at a welded cruciform joint (left) and model of air suspension (right)

Mission

Digitization and automation are also integrated in the design process, whereby an application of advanced simulation techniques sustainably optimizes a modern fatigue design and accurate dimensioning of light-weight components.

Teaching

The teaching at the Institute focuses on the two topics of Structural Durability and Railway Technology in theory as well as practice. The following courses are exemplarily given:

- Structural Durability
- Structural Durability Assessment
- Railway Technology
- FE Analysis for Structural Durability Assessment

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Institute of Internal Combustion Engines and Thermodynamics

Head of the Institute:
Univ.-Prof. Dipl.-Ing. Dr.techn. Helmut Eichlseder

Core areas of the institute
Teaching and research in the interconnected systems

- Propulsion
- Energy carrier
- Traffic and environment

to solve ecologically relevant questions.

Research

The key aspects are the analysis of the thermodynamic working process of internal combustion engines, the layout and design of propulsion units, and their application ranging from hand-held working equipment, two-wheelers, passenger cars, commercial vehicles to working machines / engines. This includes electrified power trains as well as concepts for Otto, Diesel and gas engines. Alternative fuels and energy carrier play a supporting and essential role.
The interdepency between traffic and environment, especially measurement and simulation of trafficrelated emissions, questions concerning air quality, dispersal of pollutants up to the layout and dimensioning of tunnel ventilation systems form a further core area.
Therefore, an essential factor is the broad infrastructure as well as the development of own procedures and tools for experimental investigations and simulation of propulsion units, traffic-related emissions, air quality as well as tunnel safety and ventilation.

Broad infrastructure

- 14 engine test benches (covering chain saws to large engines, HIL systems with battery simulator for hybrid drives, optical engines, gas infrastructure,...)
- Assembly test benches for injection ignition, rapid compression and expansion machine, waste heat recovery system...
- RDE measurement equipment
- Thermodynamic refrigeration system test bench
- Mobile environmental measurement equipment (PM, DOAS, FTIR,..)

Close collaborations are pursued with the Forschungsgesellschaft für Verbrennungskraftmaschinen und Thermodynamik, FVT, the Large Engines Competence Center, LEC, as well as with Hydrogen Center Austria, HyCentA.

Emission measurements on the chassis dynamometer with OnBoard measurement equipment

Vision

We are dedicated to providing innovative and internationally recognized teaching and research and to contributing solutions to environmentally relevant problems. Therefore, we are, founded on thermodynamic basics, engaged in simulation and virtual development as well as experimental investigations in order to create knowledge and to implement it in applications.

We would like to remain internationally reknown and well established and intend to deepen our knowledge therewith towards new propulsion systems with a minimum of environmental influences with the longterm vision of realizing zero impact vehicles.
Therefore, we aim to co-operate with research institutions and industry in national and international research and development projects and to develop innovative technical solutions.

Mission

Our main objectives are to ensure a solid and innovative scientific advancement and to offer an education that meets today's demands in the area of teaching

Teaching

With the interesting combination of the fundamentals of thermodynamics with applied disciplines, IVT offers a large array of lectures, offering thermodynamic principles and ensueing knowledge in the above mentioned areas.

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Institute of Hydraulic Fluid Machinery

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.techn. Peter Meusburger

Main focus of the institute

The Institute of Hydraulic Fluid Machinery engages in basic research, analysis and optimisation of hydraulic systems and complete plants consisting of

- Hydraulic machinenes
- Shut-off devices
- Piping and related components

Research

In our institute's independent laboratory, we research fluid mechanical problems of industrial and power plants and provide solutions. For this purpose, a powerful test bench and numerical tools and methods are available.

In addition, the practical suitability of the scientific measurement methods can be tested and proven through plant measurements.

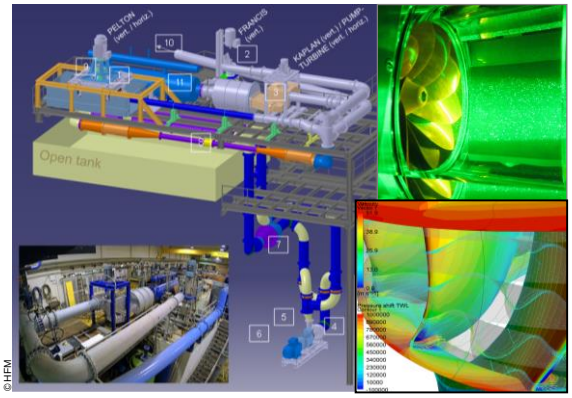
Expert opinions and damage analyses, as well as troubleshooting, round off our portfolio. This way, the knowledge developed from research can be applied in a target-oriented and practical manner.

Consultancy and expertise
Expert opinions
Damage analysis
Plant modernisation and optimisation

Numerical simulations
Analysis, design and optimisation of hydraulic machines, components and systems
Transient numerical simulation (1D) of plants with liquid and gaseous fluids
Fluid-structure interaction

Model tests
Model tests acc. to IEC 60193
Acceptance tests of centrifugal pumps acc. to ISO 9906
Valve acceptance tests acc. to IEC 60534
Long-term tests for mechanical seals and shaft seals

On-site measurements
Thermodynamic efficiency measurements
Current meter method and ultrasonic flow measurement
Dynamic pressure method
Vibration measurements



4-quadrant model test bench, hydraulic machinery

Vision

We are one of the leading academic research institutions for hydraulic fluid machinery and systems.

As a result, we make a significant contribution to the sustainable development of energy supply and power generation from renewable sources.

We have comprehensive expertise on all issues related to hydraulic machinery and plants and are recognised as problem solver.

Mission

We let the achieved practice-relevant and application-oriented results of our research flow into the education of future competent experts.

Our team is well known in industry, science and research and commissioned as an independent partner.

The Institute of Hydraulic Fluid Machinery is involved in both university and on-the-job training and education.

Education

In addition to traditional on-site teaching at the university, we also offer part-time distance learning courses on the following topics:

- Hydraulic machinery: basics and specialisation
- Pumps and compressors
- Numerical methods and CFD
- Plant hydraulics and calculation
- Hydraulic measurement technology
- Project development and operational management

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Institute of Thermal Turbomachinery and Machine Dynamics

Head of the Institute:
Univ.-Prof. Dr.-Ing. Robert Krewinkel, Robert, M.A.

Main Focus of the Institute:

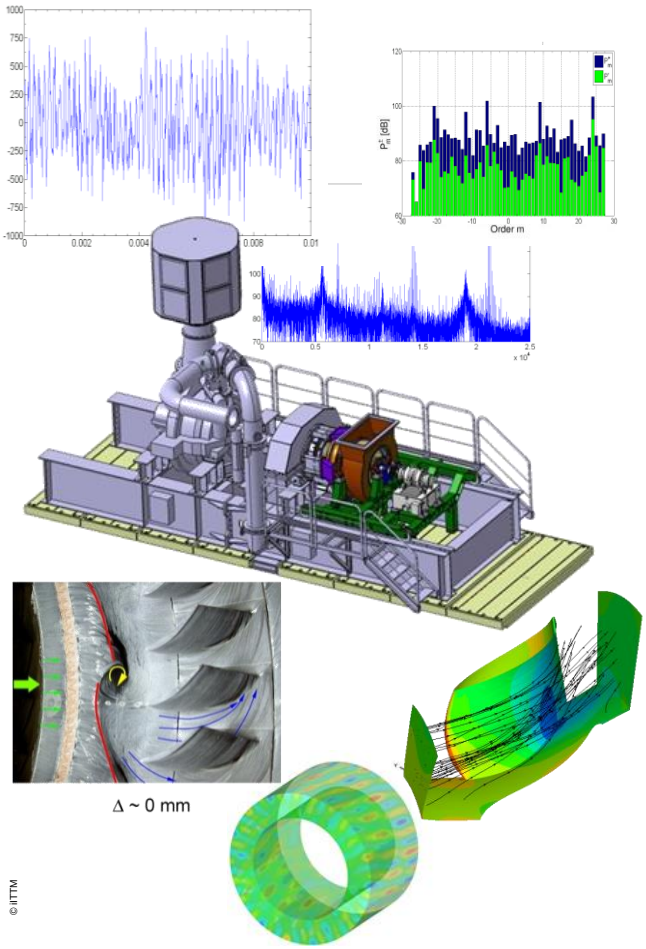
The Institute specializes in research and education in the field of compressors, gas and steam turbines and their application in modern power plants, airplanes and vehicles. The second field of activity is machine dynamics, including acoustics. Large experimental facilities are available including a 5 MW air heater, a 3,3 MW and a 1,2 MW compressor station for supplying compressed air to the test turbines or the combustion chambers. For flow and vibration diagnostics various laser systems, an infrared camera system and standard diagnostic techniques are used. In parallel a variety of CFD codes are available.

Research:

The main research focus in on aero engines. Together with renowned international industry partners the research focusses on flow physics for the overall system consisting of high pressure turbine, transition duct and low pressure turbine. An unique test facility allows for two independently running turbines. This enables the team to investigate the interdependencies of the different effects such as turbulence level, purge flows, cavity effects and so on. In addition another test facility for aero acoustics and aero elastic effects is available an in use.

Teaching:

- Thermal Turbomachinery (Steam, Gas, Aero Engines, Wind Turbines)
- Machine Dynamics
- Power Plant Operation
- Acoustics
- CFD
- Measurement Technique
- Combustion in Gas Turbines



2-spool test facility; results from flow investigation and acoustics

Vision

Renowned international partner in the field of Thermal Turbomachinery, Machine Dynamics and Acoustics.

Mission

"We know, what we are doing"

Relevant Fields of Expertise:

- Mobility and Production
- Sustainable Systems
- Information, Communication & Computing

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Institute of Fluid Mechanics and Heat Transfer

Head of the Institute: Univ.-Prof. Dr.-Ing. habil. Günter Brenn

Core activities of the institute

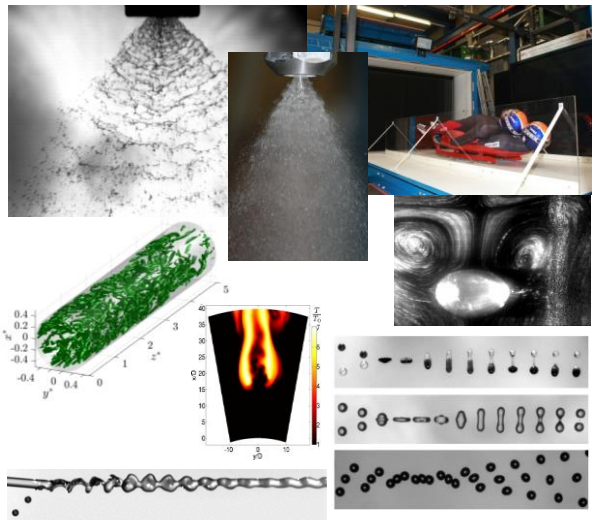
The institute works on the physics of the transport processes of mass, momentum and energy in research and teaching. Research covers wide fields of fluid mechanics, as well as heat and mass transfer, by experiment, modelling and simulation. The institute teaches for curricula of the faculties of Mechanical Engineering and Economic Sciences, as well as Chemistry and Mathematics/Physics.

Research

Scientifically, the institute's structure includes the four following working groups:

1. Transport Processes and Rheology
2. Aerodynamics
3. Modelling and Numerical Simulation
4. Interfaces and Milli-/Micro-Fluid Mechanics

Research group 1 produces and analyses multiphase flows of complex fluids and investigates the related processes of heat and mass transfer. Emphasis lies on spray research and hydrodynamic instability. The research of group 2 focusses on vehicle, sports and building aerodynamics. The latter field, in particular, covers techniques for the natural ventilation of buildings. The work of group 3 covers wide fields in process technology – from the application of thin liquid films on rotating discs to the modelling of heat transfer with flowing fluids of high Prandtl number. The newly founded group 4 works on fluid mechanics at the milli- and micrometer scale. The research focuses on capillary hydrodynamics of systems with free surfaces, including drops and jets, and on the dynamics of particles at interfaces. Industrial partners are important for many fields of research of the institute.



Vision

Theory for practice.

Mission

Transport Processes for Smart Technologies.

Teaching

The institute teaches the basic subjects in transport processes for the curricula

- Mechanical Engineering, BSc, MSc
- Mechanical Engineering and Economics, BSc, MSc
- Process Engineering, BSc, MSc
- Technical Mathematics, BSc
- Chemical and Pharmaceutical Engineering, MSc
- Bio-Refinery Engineering, MSc

The courses taught include lectures, exercises, tutorials and laboratory practice. Additionally, Bachelor and Masters projects are supervised, also for students from Universities abroad.

Industrial cooperation partners
AVL List Ltd.
Magna Steyr Fahrzeugtechnik
BMW AG
LAM Research Ltd.
BASF AG
Nestlé
MAG – Maschinen- und Apparatebau AG

Courses taught
Fluid Mechanics and Heat Transfer I Fluid Mechanics and Heat Transfer II VT
Advanced Fluid Mechanics and Heat Transfer
Gas Dynamics
Aerodynamics
Building Aerodynamics
Milli and Micro Fluid Mechanics

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Institute of Automotive Engineering

Head of the Institute: Assoc.Prof. Dipl.-Ing. Dr.techn. Cornelia Lex

Focus of the Institute

The vehicle is considered as an interconnected system. The working areas are determined by sustainable mobility, environmental aspects and customer needs in balance with economic constraints.

Head: Univ.-Prof. Dr. Peter Fischer

Automotive Mechatronic: Assoc.-Prof. Dr. Mario Hirz

Vehicle Dynamics: Assoc. Prof. Dr. Arno Eichberger

Lightweight, simulation mtehods: Univ.-Prof. Dr. Fischer

Research

Target is the development of creative solutions by using theoretical methods, numerical simulation, laboratory experiments and vehicle testing.

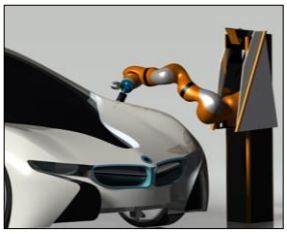
Additionally to the classical mechanical disciplines, emphasise is put on electrics, elctronics, informatics, environmental sensing and interconnection of the vehicle with its environment. Considering the increasing complexity of the vehicle, the needs of the driver and users are placed in the foreground.

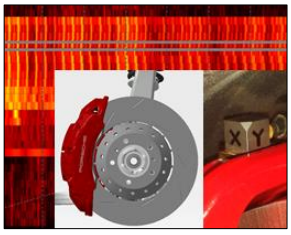
Structure of the working areas:

- Automotive Mechatronics
  - Transport Innovations and Environment
  - E-Mobility and Alternative Drivetrains
  - Virtual Product Development
- Vehicle Dynamics
  - Lateral Dynamics and Tyres
  - Automated Driving and Driver Assistance
  - Laboratory Driving Dynamics & Vehicles
- Lightweight Design
  - Structural Simulation, NVH, Brakes
  - Laboratroy E-Drive

Laboratory

ADSG: Advanced Driving Simulator Graz
E-Drive: Testbench for electrical drivetrains
Suspension and **Brake** testbench
POSE: Position- and rotation speed sensor testing for electrical drivetrains
Mobile Vehicle Dynamics Measurement Equipment
Test Vehicles: for driving dynamics, driver assistance systems, electrical and alternative drivetrains
Vehicle Workshop: for conventional and electrical vehicles





Vision

We are a worldwide acknowledged top institute for sustainable mobility, user aspects and technology of land vehicles.

Mission

The institute offers outstanding research and teaching for components of vehicles and system integration, by combining virtual development and experimental methods.

Teaching

- Vehicle technology basics:
  - Components and subsystems, suspension, drivetrain, supporting structure
- Vehicle dynamics
  - Modelling & simulation, driver assistance systems, measurement technologies, integrated safety
- Automotive mechatronics
  - Electrical and electronic systems in the vehicle, innovative & electrified drivetrains, sustainable mobility
- Lightweight, design- & simulation methods
  - Virtual product development, 3D-CAD methods, FEM- and structural simulation, CFD and aerodynamics
- Core technologies, vehicle segments:
  - Tyre technology, commercial vehicles, high-performance- and race vehicles

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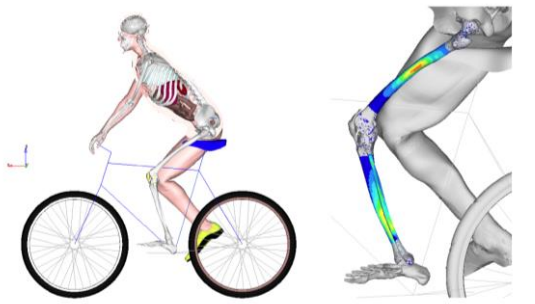
Vehicle Safety Institute

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.techn. Hermann Steffan

Focus of the institute

The Vehicle Safety Institute deals with research questions in the field of transport safety. A special focus lies on the five core research areas

- safety of energy storage systems
- crashworthiness of (bio)materials
- human modelling
- safety of vehicles with varying degrees of automation
- safety of vehicle occupants and vulnerable road users.



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Analysis of cycling accidents by using numerical human models

Research

In research projects, funded by industry or public funding agencies, research questions in the field of transport safety are investigated. To study the mostly multi-physical problems, numerical simulations and experiments are performed. Boundary conditions for the tests and simulations are derived from real-world accidents. Testing is performed with unique self-developed testbeds and simulations are performed on multiple scales from agent simulations to microscopic FE simulations. Machine learning algorithms and enhanced data analysis methods are applied to get most out of the generated data.

Basic Information

- Institute founded in 2004
- Employees: ~ 60 people
- Infrastructure simulation: HPC Linux Clusters, Finite Element Programs (LS-DYNA, PAM-CRASH,...),...
- Infrastructure testing: Full-Scale Crash-Lab, High-Speed-Film and Measurement Technology, Special Testbeds for component testing and material characterisation, Battery Safety Centre Graz,

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Full-scale crash test as part of a laboratory exercise

Vision

VSI's vision is to support the reduction of road deaths and injuries worldwide by internationally recognized cutting-edge research

Mission

VSI's mission is to investigate safety risks and countermeasures related to transportation by novel testing and simulations and to incorporate these findings into future vehicles and teaching.

Teaching

In the context of the courses, the research areas of transport safety are explained to the students by an integrated teaching concept consisting of compulsory, elective and free subjects. The core concept of the institute's teaching program consists of four compulsory subjects in the field of automotive engineering and safety:

- Trauma Biomechanics
- Impact Mechanics
- Active Safety – Accident Mitigation
- Passive Safety – Injury Mitigation

In addition, students also get some practical experience through laboratory exercises. They learn about latest research results in the elective subjects like High Dynamic FE Simulation in Vehicle Safety, Accident Simulation and Effectiveness Evaluation in Vehicle Safety, Safety of Innovative Vehicle Concepts, Integral Vehicle Safety, Traffic Safety and Selected Chapters of Vehicle Safety.

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Institute of Innovation and Industrial Management

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.techn. Christian Ramsauer

Focus of the institute

The main emphasis in the field of innovation and industrial management are reflected in initiatives, research and teaching.

- *Laboratory for Innovation:* Here students researchers, start-ups and industrial partners meet to increase the innovative power of all stakeholders. The FabLab supports with modern and digital production machines.
- *LEAD Factory:* The focus of this learning factory in research and teaching is on **L**ean, **E**nergy efficiency, **A**gility and **D**igitization.
- *Product Innovation Project:* Every year, up to 10 student teams face the challenges of the industry. The goal is to realize new product concepts, business plans and working prototypes.
- *Harvard Case Study Teaching:* This participant centred learning method is used to analyse and discuss real case studies.

IIM / Graz University of Technology

IIM Seminar Room for Harvard Case Study Teaching

Research

Selected research topics at the institute:

- *Maker Movement:* Implementation and further development of the ideas of Maker Movement.
- *Agile Production:* Fast reactions to an uncertain and volatile market environment.
- *Lean Management:* Application and adaptation of the principles of Lean Management.
- *Ramp Up Management:* Approaches and solutions to shorten time-to-market and time-to-volume to increase competitiveness.
- *Industry 4.0:* Strengthening the manufacturing industry through the use of industry 4.0 technologies.

IIM / Graz University of Technology

IIM LEAD Factory

Vision

We make a significant contribution to the successful development of the manufacturing industry in Europe.

Mission

We see ourselves as problem solvers in current and application-related issues in the field of innovation and industrial management.

Teaching

Selected courses in the field of innovation:

- Enabling Innovation
- Product Innovation Project
- Design Thinking and Rapid Prototyping
- Creativity Techniques
- Implementing Innovation through Merger and Acquisition
- Value Management

Selected courses in the field of industrial management:

- Industrial Engineering
- Industrial Management Seminar
- Production Strategies
- Learning Factory
- Logistic Management
- Energy Economics
- Manufacturing and Supply Chain Network
- Quality Management

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Institute of General Management and Organisation

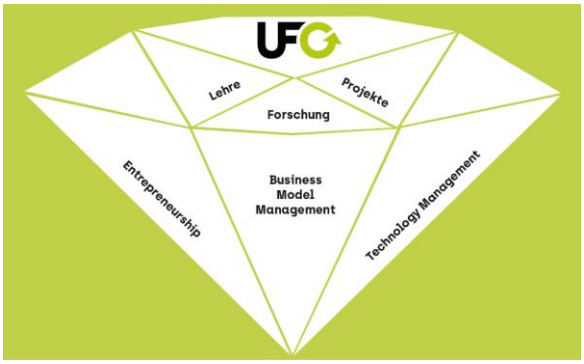
Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.techn. Stefan Vorbach

Focus Areas of the Institute

To anchor the topics of leadership and organization at the interface of technology and business, we are doing research and teaching on all aspects that enable best practice management of an organization. Our focus areas are strategy development and implementation, intrapreneurship, entrepreneurship, technology management and business model management.

Fields of Research

- Business Model Management: Business models, their adaptation to changing conditions and their sometimes disruptive changes have increasingly moved into the interest of science and practice. Our focus is particularly on technology-oriented business models and their further development. We focus on the innovation of existing business models due to internal and external developments (e.g. digitalization) in technology-oriented industries and the development of completely new business models, e.g. in start-ups.
- Technology Management: Technologies are a major source of competitive advantage for many companies. The management of technologies and technological innovations is therefore an essential aspect of business management. We deal with the practical implementation of activities as well as organizational aspects of technology management. Since technology innovation is often inextricably linked to entrepreneurial action and the innovation of business models, this aspect is an integral part of all our research areas.
- Entrepreneurship: In this research area, we focus on the characteristics of management oriented towards business start-ups. We analyze methods and approaches for the establishment of successful start-ups, such as business plans, strategic positioning, selection of suitable business models, marketing, financing and protection of intellectual property.



Courses
Unternehmungsführung und Organisation
General Management and Organization
Grundlagen der Unternehmensführung und Organisation
Projektmanagement
Project Management
Technology Management
Strategic Management
Business Model Management
Information Management
Prozessmanagement
Unternehmensgründung
Entrepreneurship
Gründungsgarage
General Management Case Studies
Selected Topics in Management

Vision

Our expertise in the areas of Business Model Management, Technology Management and Entrepreneurship is recognized in the scientific community and provides added value for business practice.

Mission

We impart managerial competence and economic know-how to the graduates of Graz University of Technology as a supplement to their excellent technical education – to enable them to take on management positions in their professional careers.

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Institute of Business Economics and Industrial Sociology

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr.techn. Stefan Vorbach
Deputy head: Assoc. Prof. Priv.-Doz. DDipl.-Ing. Dr.techn. Bernd M. Zunk

Focus of the Institute

The three techno-economic focal points in research and teaching at the Institute of Business Economics and Industrial Sociology at Graz University of Technology (TU Graz) are:

- Human Resource Management and Industrial Sociology
- Management Control, Accounting and Finance
- Industrial Marketing, Purchasing and Supply Management

Techno-Economics in Research & Teaching

The synthesis of the disciplines *technology* (applied natural sciences) and *business economics* (applied social sciences) creates the so-called "Techno-Economics". It can be understood as a discipline in research and teaching which takes into account their respective elements as well as their reciprocal influences on each other. It is embodied by a (trans- and multidisciplinary) techno-economic community consisting of researchers at universities, colleges and non-university research institutions which receive research stimuli and input from both the outside (the practical sphere of technical and economic business in action) and the inside (the formal knowledge systems, including existing academic expertise required and put to use in research and teaching). Newly gained knowledge is combined with established contents. In the techno-economic knowledge system, findings generated from current research, need to be distinguished from knowledge disseminated in teaching, the educational knowledge. Educational knowledge is particularly suitable for its immediate transfer to practical application, in order to be put to use and further developed. Thus (technical) practice can emanate into academia and – as in the case of business economics interpreted as a genuinely interdisciplinary endeavor – techno-economics, which leads to an application-oriented academic perspective.

Research

The objective is the exploration, description and explanation of techno-economic contexts relevant to management processes and its holistic conveyance into research-driven teaching activities embedded in the "Doctoral School Techno-Economics". Research knowledge generated in scientific projects is essential when it comes to sustainably ensuring effectivity and efficiency in business processes of companies in technology markets. In cooperation with industrial partners, numerous PhD theses in the research areas of the institute are supervised as well as research projects are conducted and finished that lead finally to academic and management-oriented publications.

Focus of techno-economic research and teaching at the Institute of Business Eonomics and Industrial Sociology of TU Graz

Vision

We consider ourselves an active group of researchers of TU Graz who are committed to creating an added value for society as such by engaging in application-oriented teaching and research in the techno-economic focal points of the institute.

Mission

Embedded in the "Fields of Expertise" of TU Graz, we represent techno-economic and decision-oriented business economics research and teaching that acts across the seven faculties of TU Graz. This particular interpretation of business economics deals with the description and explanation of real-world phenomena in the sphere of experience "company/business/firm" in technology markets as well as with the effective and efficient organisation of businesses.

Teaching

Established, practice-oriented techno-economic knowledge as well as high problem-solving competence, which are both imparted in numerous English and German taught courses of the institute at TU Graz, provide a well-founded basis for our graduates' future professional careers, where they prove the high level of training they received at TU Graz every day on various occasions.

Selected Courses

Business Economics / Industrial Sociology / Rhetoric
Accounting / Cost Accounting
Management Control Systems / Financial Management
Marketing Management / Marketing Intelligence
Purchasing and Supply Management
Research Design in Management Science

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Institute of Engineering and Business Informatics

Head of the Institute: Univ.-Prof. Dipl.-Ing. Dr. techn. Siegfried Vössner

Key Focus of the Institute

The Institute of Engineering and Business Informatics is mainly engaged in the engineering of systems that comprise social, technical and economical aspects. This includes the analysis, design and and implementation, as well as the operation and optimization of complex systems which are composed of humans, technology and economical elements. Therefore, existing systems are analysed using of state-of-the-art modelling and simulation technologies. In addition, the target oriented, effective and efficient application of modern Information and Communication technologies (ICT) is investigated and designed.

Research

Based on our principles the key research areas of the institute are „Human-Centred Service and Systems Engineering“ and „Operations Research“. The embedding of new technologies into a socio-technical system, such as a business environment, requires a holistic view within the framework of the system design and the system implementation. Therefore, the first research area deals with theoretical methods for systematic conception, design and introduction of new information systems, as well as with the concrete implementation of the conceptualized systems and their practical evaluation in the working environment. The second research area deals especially with topics concerning modelling, simulation and optimization of complex systems. To create sustainable solutions for a variety of organizations, qualitative and quantitative methodologies originating from the fields of Engineering, Mathematics, Computer Science and Economics are applied and advanced.

Mission

In modern times ICT influences all technological and economical aspects of life. This enables the institute to use developed methods and research results in various real-world applications. Current projects deal, among others, with modern production and logistic systems, e.g. the use of IoT technologies for maintenance and/or production planning and optimization), as well as process optimization in the health care sector and the field of public safety. The institute is a reputable partner in the scientific community, industry and governmental organizations.

Example: Modelling, Simulation and Optimization of the Production Planning and Control Processes for an European Automotive Manufacturer

Vision

It is our vision to advance interdisciplinary core and applied research at the interfaces of Engineering, Computer Science and Operations Research and to establish results in the scientific community.

Teaching

In numerous courses in German and English language we teach students the basics of computer science, applied mathematical optimization, analytics and simulation. Within the course of a close supervision of PhD, master and bachelor theses students get prepared for challenges industries are facing in the digital age.

Selected Classes
Engineering Informatics 1 & 2
Engineering and Business Informatics
Production Planning and Control
Business Modeling and Simulation (+ Selected Topics)
Business Informatics (+Selected Topics)
Modeling and Optimization in Production and Logistic Systems
Mechatronic Systems Engineering
Quantitative Methods for Business
Optimization Methods for Operations Planning
Supervision of Phd-, Master- und Bachelor Theses

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