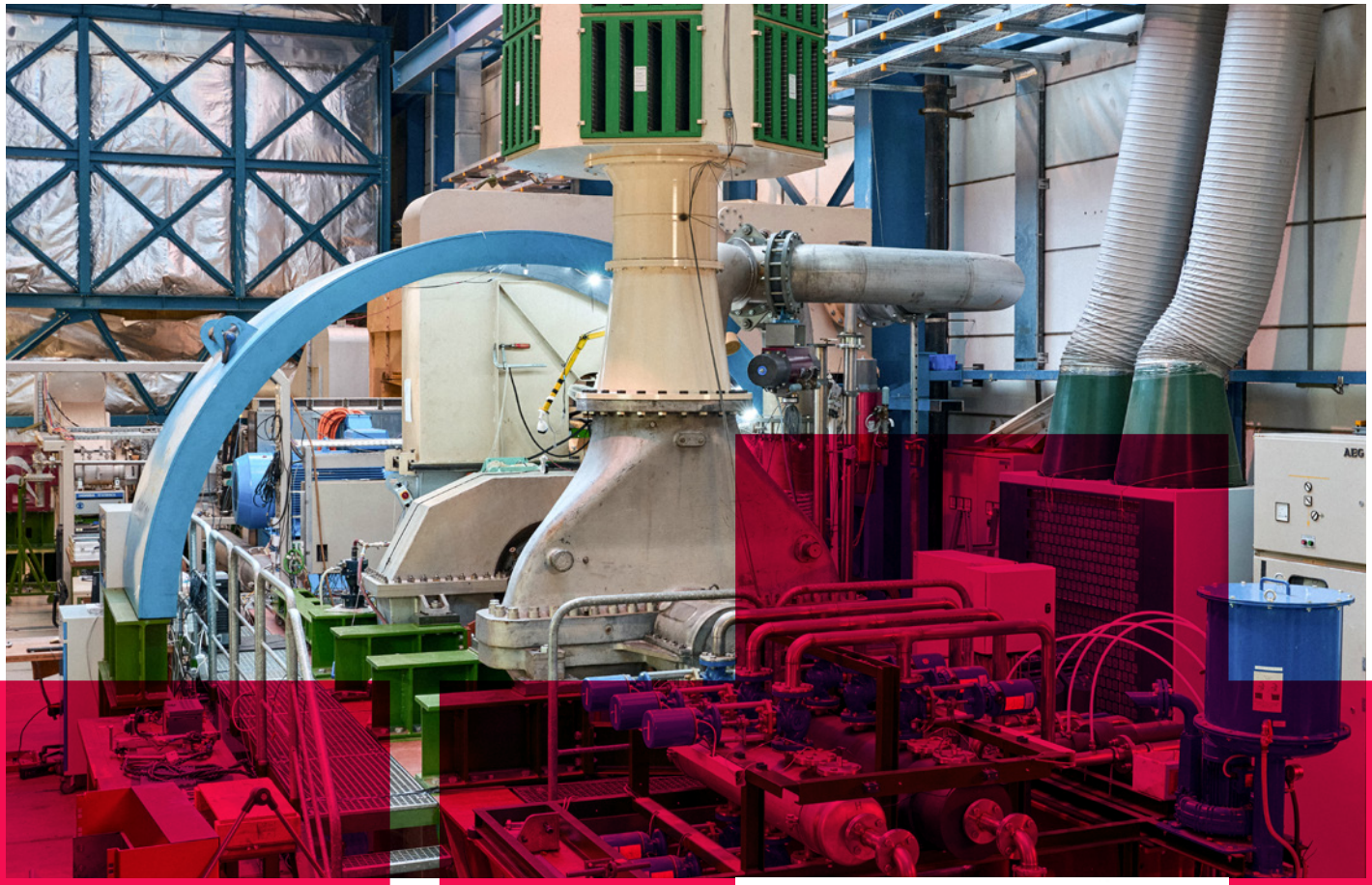
SCIENCE
PASSION
TECHNOLOGY

TU Graz

Institute of Thermal Turbomachinery and Machine Dynamics



Welcome to the Future of Engineering

Welcome to the Institute of Thermal Turbomachinery and Machine Dynamics at Graz University of Technology. Our mission is to push the boundaries of thermodynamic systems and machinery through groundbreaking research and innovative teaching.

We are committed to advancing energy and aviation propulsion systems and work hard to develop sustainable technologies.

Through our bachelor's and master's programs, you will have the opportunity to learn core concepts of mechanical engineering and the chance to apply this knowledge by getting involved in pioneering projects led by world-renowned experts.

Our courses equip you with the knowledge and skills to address global engineering challenges and create a lasting impact. Join our dynamic community of forward-thinkers shaping the future of engineering.

Looking forward to welcoming you,
Prof. Dr. Krewinkel

Study Programs

TU Graz and ITTM offer multiple pathways to start or advance your career as a mechanical engineer. Whether you begin with a bachelor's degree or continue through master's and PhD programs, you will gain valuable expertise and enter the job market as a competitive candidate. Studying or working at ITTM connects you with the turbomachinery community and opens doors to a wide range of industries, particularly within the European aviation sector. Some of our long-standing partners include GE Aerospace and MTU Aero Engines.

Bachelor's in Mechanical Engineering

Prepares students for a broad range of career opportunities in mechanical engineering, providing a solid foundation in design and construction, thermodynamics, fluid mechanics, and machine dynamics. Emphasis is placed on developing practical skills and problem-solving abilities for various mechanical systems.

Doctoral School of Mechanical Engineering - PhD

Provides advanced research opportunities in turbomachinery, fostering innovation in energy and propulsion technologies. It allows you to specialize in your chosen field and share your work at international conferences, impacting broader engineering community.

Master's in Mechanical Engineering

This degree provides in-depth knowledge across diverse areas of mechanical engineering. Its modular structure allows students to focus on topics that interest them most. ITTM offers courses that prepare you for careers in the energy, automotive, and aerospace industries. Several modern turbomachinery test benches (e.g., aero engines) offer the opportunity to gain hands-on experience and complete your master's thesis in collaboration with the institute's industry partners. Special emphasis is placed on the use of modern computational tools.

Master's in Mechanical Engineering and Business Economics

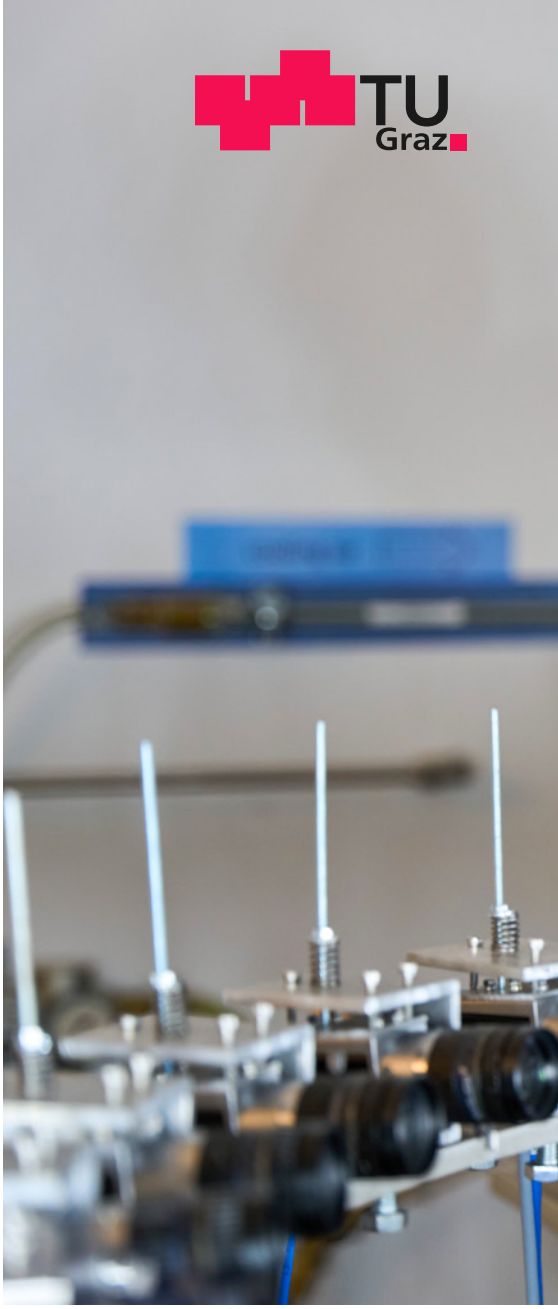
This degree combines mechanical engineering with modern management approaches and economics.


AURIGA

Heat Transfer and Combustion

At ITTM, heat transfer and combustion are key to understanding and optimizing thermal systems. Heat transfer plays a crucial role in the performance, efficiency, and longevity of components like turbines, compressors, and engines in general. Students will have the opportunity to learn and gain experience in how heat transfer investigations can help optimize mechanical components. For example, understanding heat transfer allows us to design more effective cooling systems, preventing overheating and improving the performance of critical components.

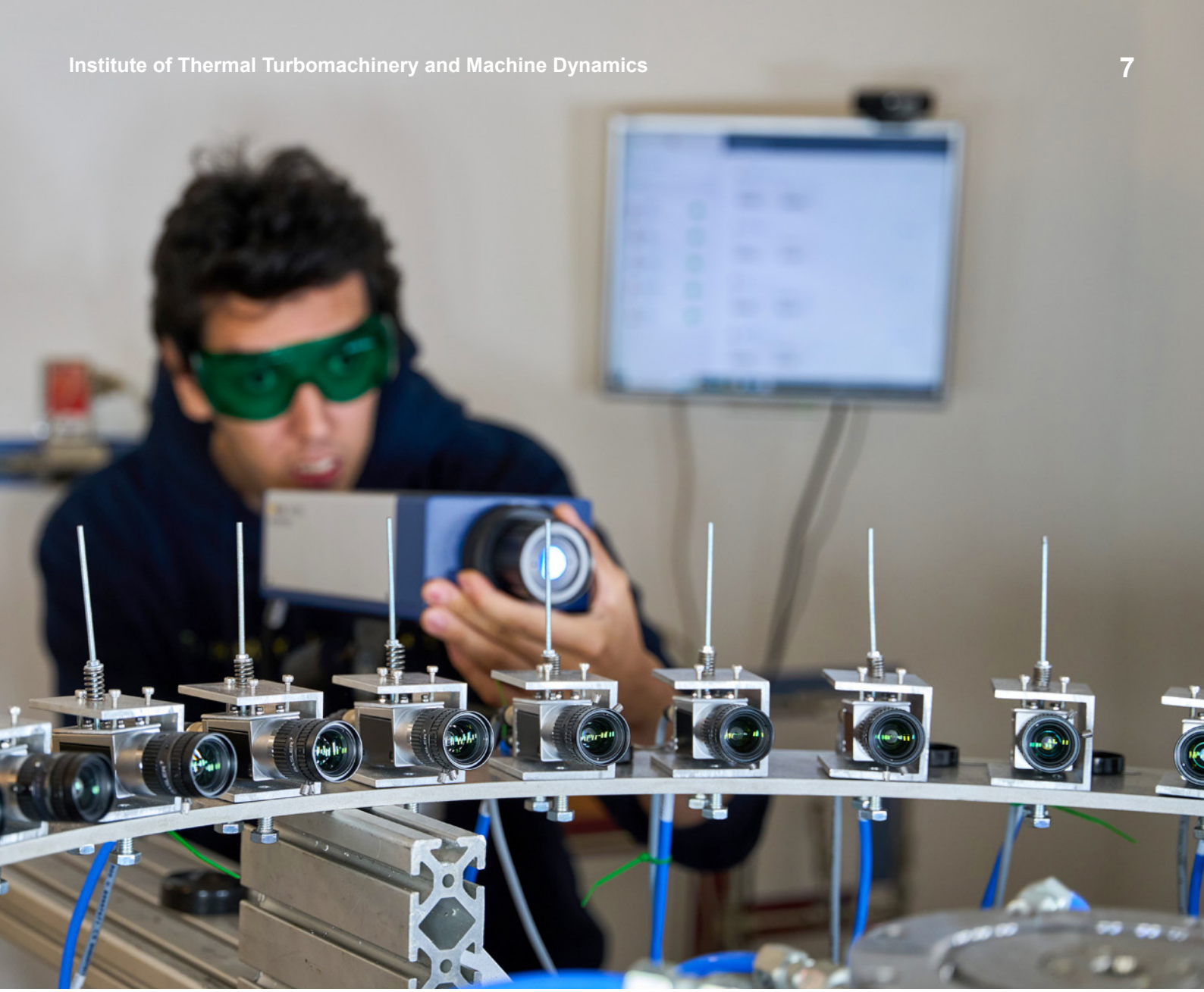
Combustion research focuses on fuel-burning processes essential for power generation and propulsion. We study chemical reactions and thermodynamic cycles with the goal of enhancing engine efficiency, reducing emissions, and developing sustainable energy solutions.

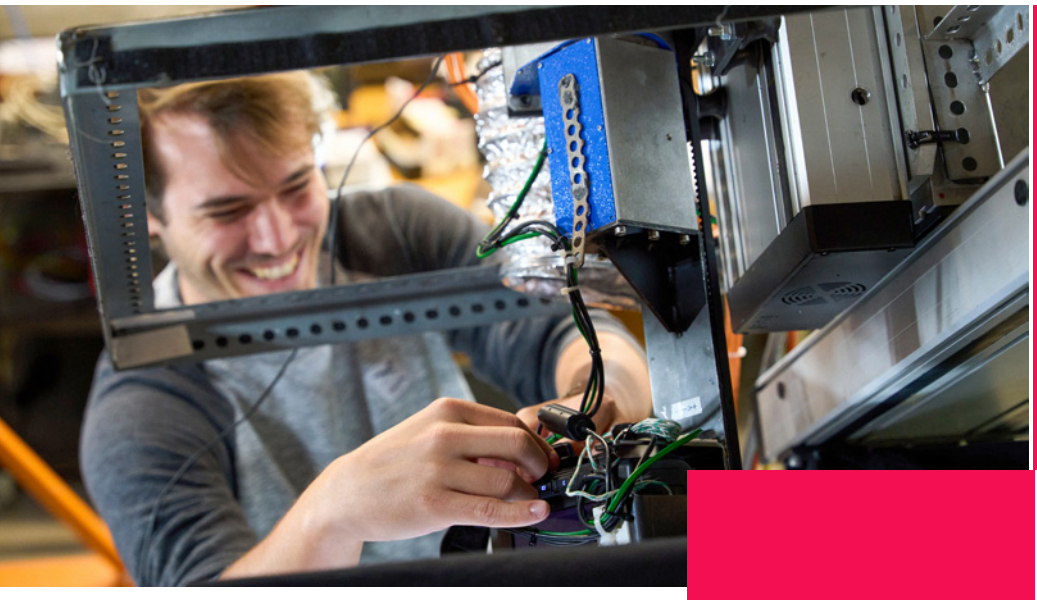


Machine Dynamics and Acoustics

ITTM’s research in machine dynamics and acoustics aims to optimize mechanical system behavior and acoustic performance. This work is vital for improving the reliability of turbomachinery like turbines and compressors.

Machine dynamics examines forces and vibrations within machines, including rotating shaft modes. Using specialized computational tools, we design more robust systems. Acoustic research explores noise generation and mitigation, enhancing system performance and user experience. Through simulations and experiments, students gain hands-on experience in addressing such challenges.

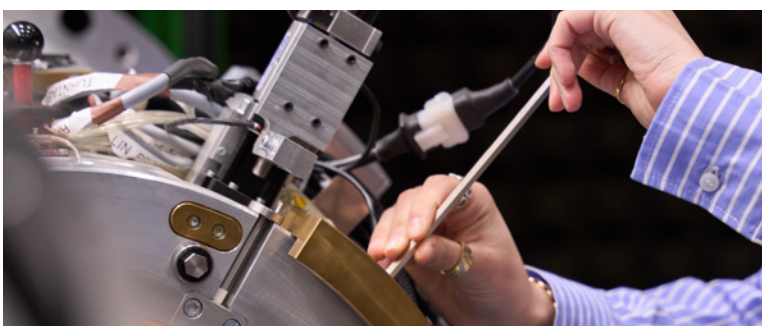




Metrology in Turbomachinery

We use an extensive range of measurement techniques to acquire accurate results and improve our understanding of thermal turbomachinery. These techniques range from common methods such as pressure and temperature probes to advanced optical measurements like laser light sheet visualization and infrared thermography. By using such non-intrusive optical methods, we ensure precise data collection without disrupting operations.

We also provide measurement services to industry partners, enhancing research collaboration.



Advanced Optical Metrology

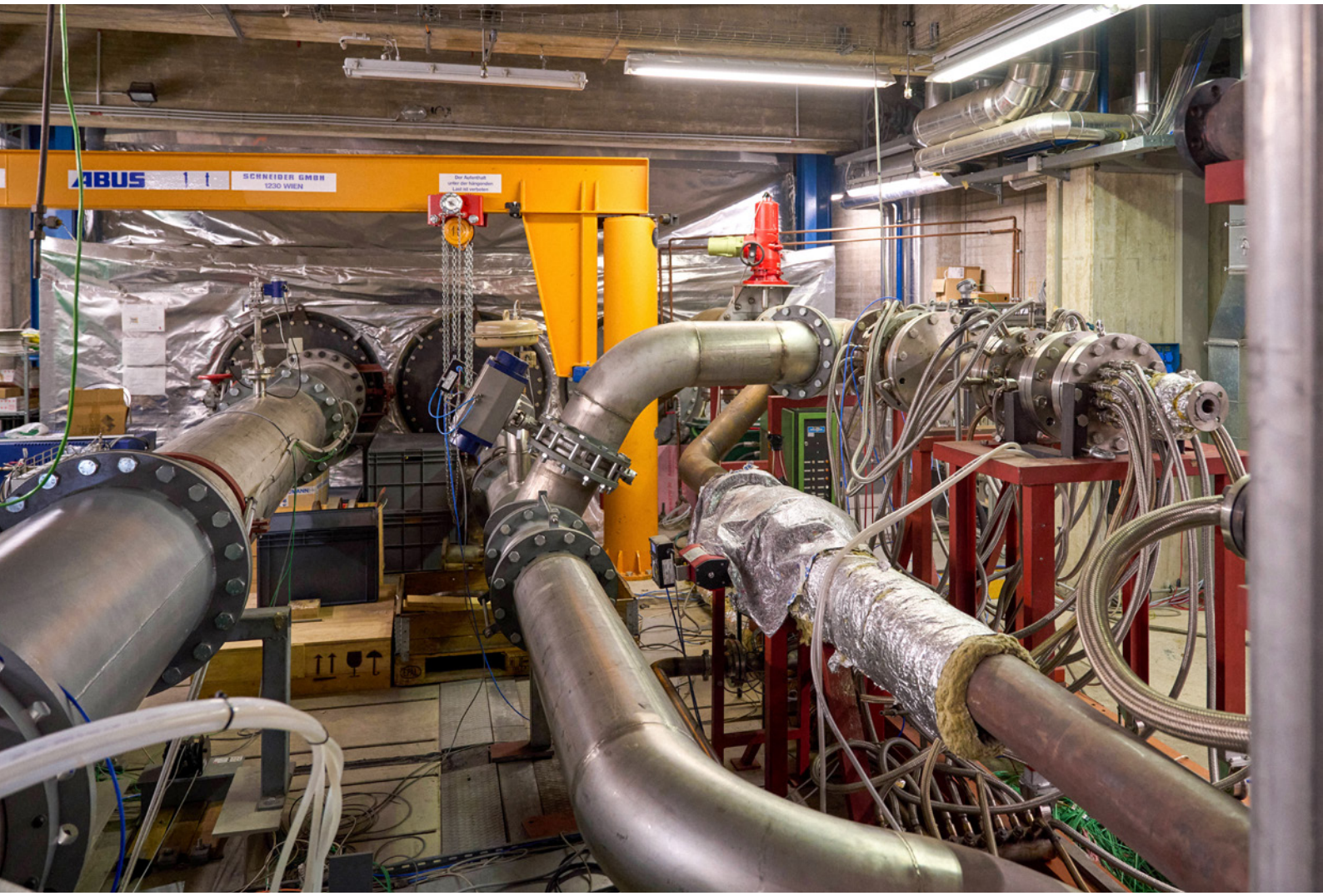
Laser optical metrology applies techniques like laser light sheet visualization, LDV, PIV, and laser vibrometry to precisely measure physical properties in turbomachinery and capture complex phenomena.

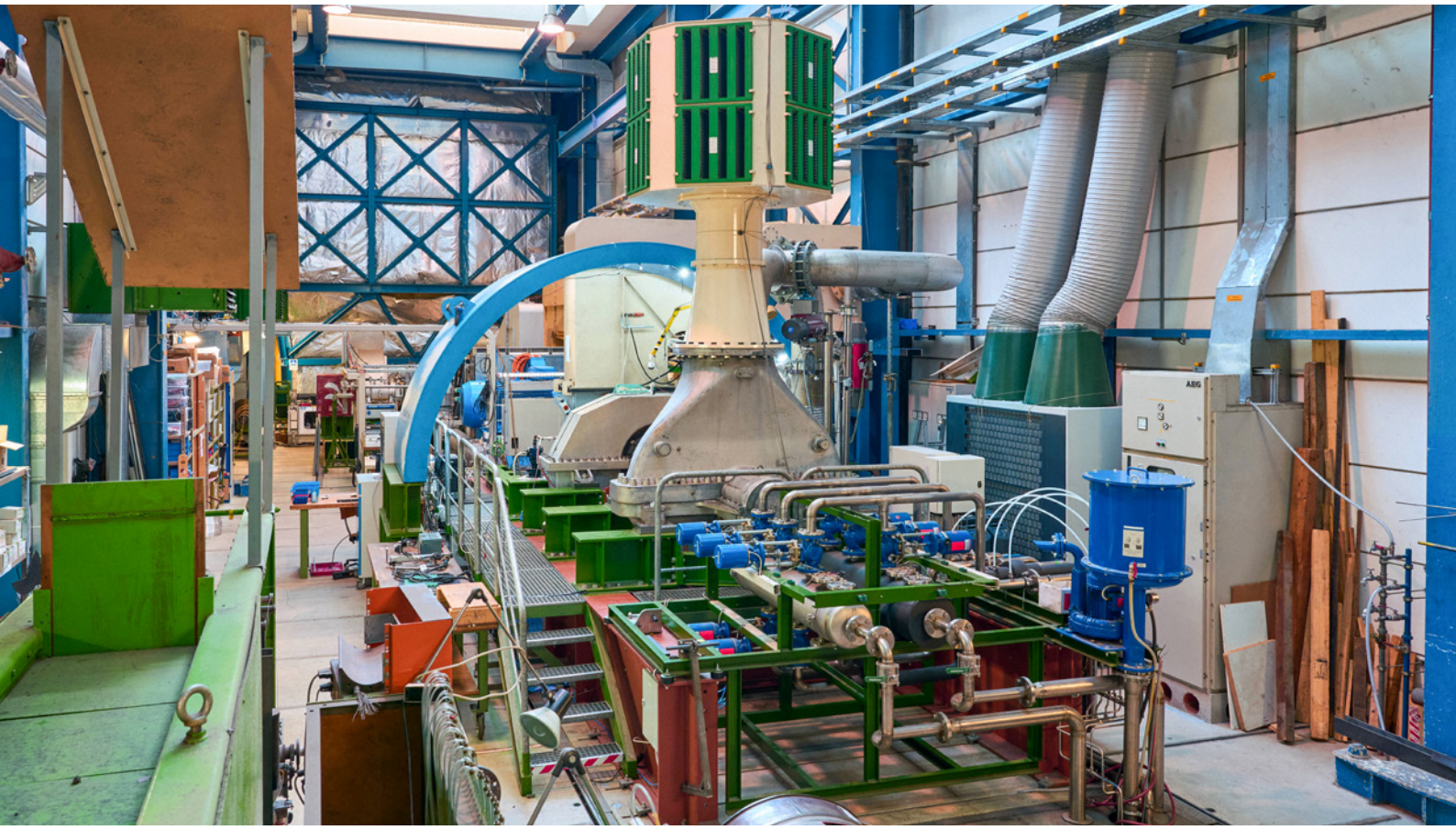
Pressure- and temperature-sensitive paints (PSP, TSP) are modern optical methods for investigating surface pressure and temperature distributions with excellent spatial resolution.

IR thermography provides surface temperature data and, combined with imposed heat flux, is used to determine heat transfer coefficients and film-cooling effectiveness with high accuracy and resolution.

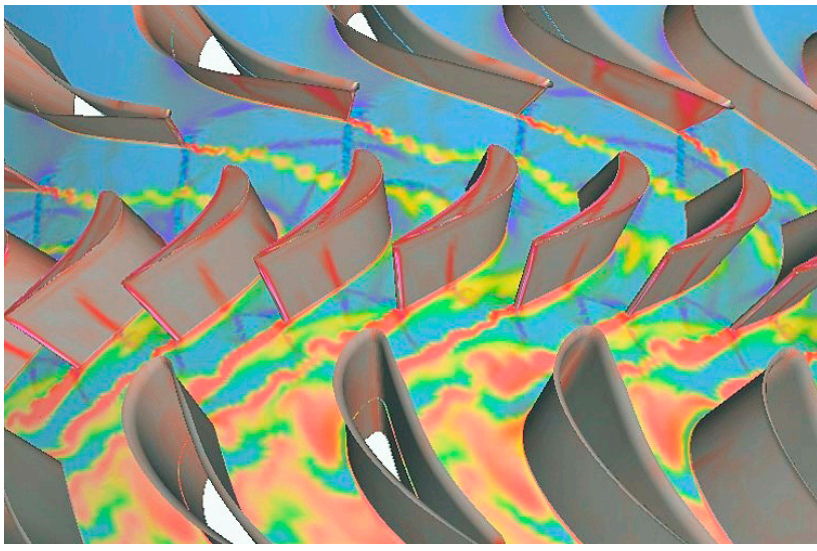
Test Facilities

There are six highly instrumented test facilities at ITTM, each designed to serve different research purposes and varying levels of complexity. Our Transonic Test Turbine Facility (TTTF) is one of the largest test rigs at TU Graz and in Europe. It features a dual-shaft configuration powered by a 3 MW compressor station, enabling full-scale testing of state-of-the-art transonic gas turbine stages and components.





Turbomachinery Optimization and CFD Methods for CO_2-Free Processes



ITTM uses CFD simulations alongside experimental testing to optimize turbomachinery components for aerospace and energy applications. An in-house code, LINARS, is used in addition to commercially available solvers like ANSYS. By simulating fluid flow, heat transfer, and combustion, CFD supports the design of systems that reduce carbon emissions and improve energy efficiency.

Our work on supercritical CO_2 (sCO_2) cycles aims to achieve higher efficiency with a lower environmental impact. We optimize compressors and turbines for sCO_2, addressing challenges such as high-density variations.

Additionally, CFD is applied to advance CO_2 capture technologies, supporting sustainable energy solutions and a cleaner energy transition

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