UNIVERSITÄT SIEGEN

Naturwissenschaftlich-Technische Fakultät

Master's Program - Content

Compulsory Modules

- Vibration Theory
- Signal Processing
- Reliability of Tech. Systems

Internship for international Students

- Condition Monitoring

Elective Modules, Examples

Dynamics and Data (strongly recommended)

- Condition Monitoring
- Data-Driven Modeling

Automation

- Automatic Control
- Embedded Systems
- Automation Technologies

Mechanics

- Computational Elasticity
- Numerical Dynamics
- Fracture Mechanics

Materials

- Micro- and Nano-Analytics
- Functional Materials
- Materials under Mech. Stress
- Damage Diagn. in Material Sci.

Software and Artificial Intelligence

- Advanced Progr. C++
- Ubiquitous Computing
- Introduction to ML
- Deep Learning

Interdisciplinary Modules

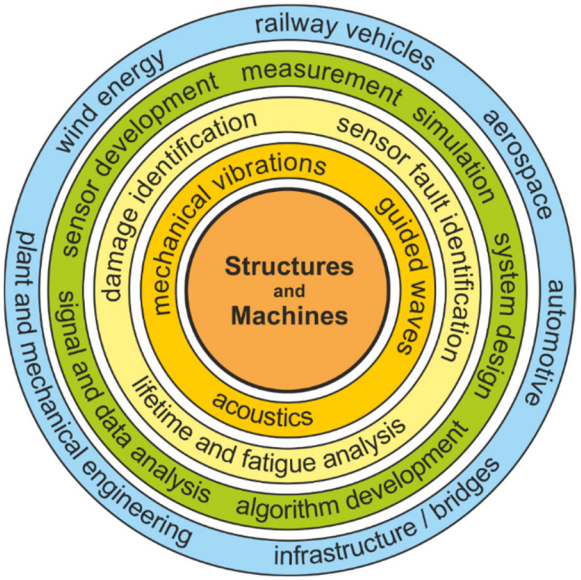
- Technical English
- Francais Technique
- El español técnico

Labs

- Experimental Mechanics
- Syst. Dynamics & Control Eng.
- Finite Element Method
- Finite Element Programming

Legend:

- Mechanical Engineering
- Computer Science
- Electrical Engineering
- Other Departments



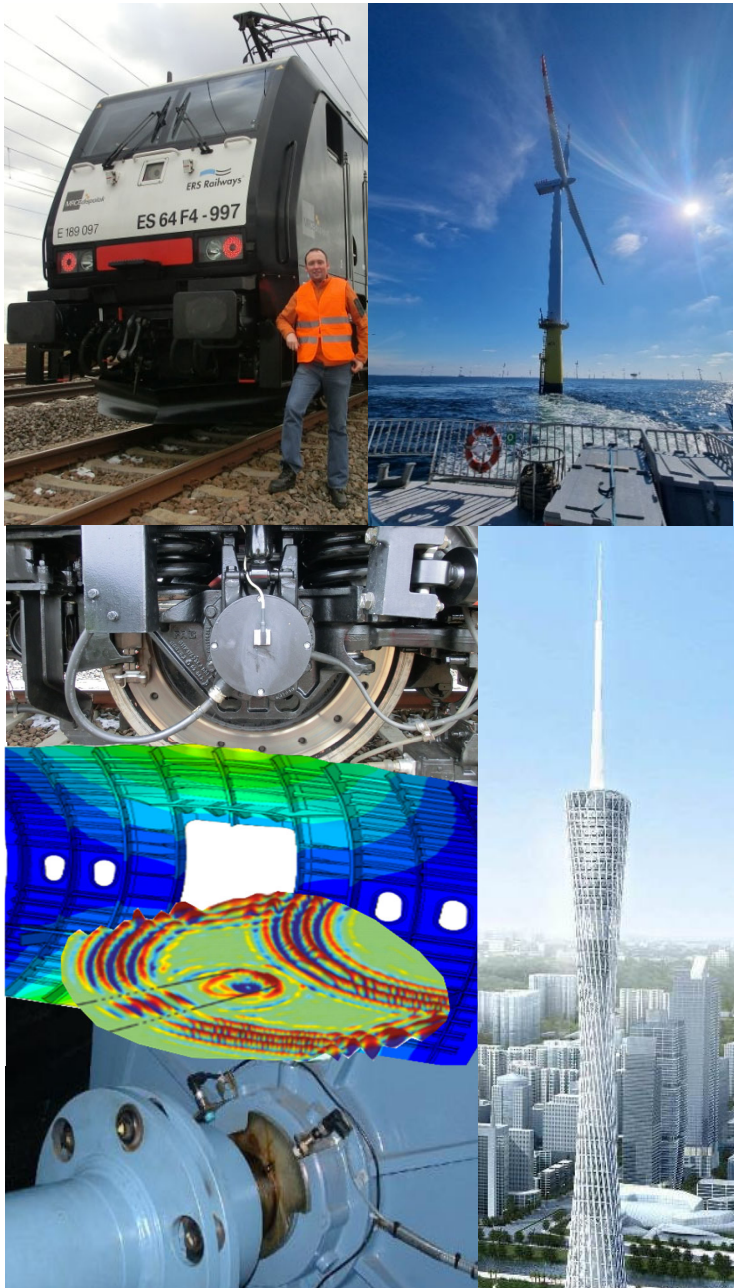
Condition Monitoring
Digital Technologies

Contact persons:

Prof. Dr.-Ing. Peter Kraemer
peter.kraemer@uni-siegen.de

Prof. Dr.-Ing. Oliver Nelles
oliver.nelles@uni-siegen.de

Mechanical Engineering
Condition Monitoring – Digital Technologies



Content

The specialization **Condition Monitoring - Digital Technologies** focuses on aspects of monitoring, damage identification and diagnosis for mechanical and mechatronic systems. Condition monitoring follows two objectives: safety and machine efficiency. In the case of rotating machines, this is called Condition Monitoring (CM) and in the case of complex structures, such as rotor blades of wind turbines, piping systems, aircraft fuselages, bridges, towers, etc., Structural Health Monitoring (SHM).

The **analysis and processing of sensor data** on the one hand and the **modeling of processes** on the other play a key role in Condition Monitoring. Modeling often based on data-driven approaches using classic statistical techniques or machine learning methods such as neural networks.

For this purpose, in addition to classic mechanical engineering topics, skills in the fields of mechatronics, information processing, software and artificial intelligence are of outstanding importance. Condition Monitoring is an **interdisciplinary** topic combining **mechanics, acoustics, systems theory, electronics, statistics and computer science**.

Orientation

The specialization is strongly method-oriented. It focuses on understanding practical methods and algorithms. In particular, the following skills and competencies are trained:

- Good understanding of dynamic processes
- Signal analysis and processing
- Data-based, learning approaches - Artificial Intelligence
- Algorithm and software development
- Machine and structure diagnostics
- Sensors and hardware for machine and structure diagnostics

Practical skills are trained in the exercises, laboratories and seminars using measurement data from machine and structures in various industrial branches (wind energy, rail vehicle technology, plant engineering, aerospace).

Career perspectives

Traditional mechanical engineering systems are steadily becoming more intelligent. The proportion of added value and productivity growth is increasingly shifting towards automation, smart and learning systems and Predictive Maintenance, and will continue to do so in the future.

The expertise taught in this specialization will also be essential in the context of production and Industry 4.0. The Condition Monitoring – Digital Technologies combines a solid mechanical engineering degree with modern methods for autonomous and intelligent systems.

The need for engineers with skills in Condition Monitoring and experience in development and application of data-driven algorithms and software is growing rapidly. This qualification profile is becoming a key factor for the survival and further development of the industry in Germany and Europe.